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Abstract:

Rapid advances in information and communication technologies present a challenge to information systems (IS) professors. Not only do these advances frequently make course materials out of date, but also IS professors may struggle to stay current with popular technology applications. In a sense, these forces lead to a paradox that students may be more techno-savvy than their professors (at least in certain areas). Furthermore, students may feel frustrated when techno-savvy professors cannot efficiently teach them in learning technologies. In this paper, we synthesize the panel titled "The Elephant in the Classroom: Do Information Systems Professors Need to be more Techno-Savvy than Students?" at the 55th ACM SIGMIS Computer and People Research Conference in Nashville, Tennessee. Thomas Ferratt, Michael Gallivan, Yaojie Li, Thomas Stafford, Mary Sumner, and Crag Van Slyke served as panelists. We use their discussion to develop techno-savviness as a construct in the IS education context and to describe distinct types of techno-savviness.

Keywords: Information Systems Education, Techno-Savviness, Learner-centered Teaching.

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1 Challenges to Information Systems Education: The Elephant in the Classroom

We can define information systems (IS) as formal, sociotechnical, organizational systems designed to collect, process, store, and distribute information (Piccoli & Pigni, 2016). Besides business knowledge and skills, IS educators and learners also need to comprehend and proficiently use technology (especially computers). In other words, they need to be techno-savvy. IS educators face some significant challenges with respect to techno-savviness.

First, exponential advancements in technology often obsolete instructional materials that IS professors have exclusive or privileged access to, such as textbooks, manuals, and software. Instead, IS professors have to constantly "patch and upgrade" their knowledge and skills repository. Second, online learning sources and platforms, such as massive open online courses (MOOCs), extend the frontiers of information technologies (IT) to everyone, not only professors. In many instances, students can acquire knowledge faster than their professors.

A dilemma surfaces when students become more techno-savvy than their teachers. One issue concerns how professors' prestige in class may fade due to outdated pedagogical paradigms rooted in closed learning systems. However, many IS professors do not willingly acknowledge this "elephant in the classroom". The following backstories briefly describe several challenges that IS professors currently face. We use these backstories as a foundation to discuss techno-savviness in IS education and learning.

1.1 Scenario 1: Techno-savviness in a Pandemic

Higher education's adaptations to the coronavirus disease of 2019 (COVID-19) pandemic have exacerbated the challenges we note above[1]. Virtually all higher education faculty who taught face-to-face courses faced an unprecedented challenge: shifting courses to online delivery with little notice. Some faculty had only a few days to make the transition. This rapid change put a new light on the importance of techno-savviness. To effectively transition to online courses, many faculty needed to quickly become competent with various technologies ranging from learning management systems and online test proctoring systems to applications that could help schedule virtual office hours. Social media communities focused on faculty contained numerous posts and responses that asked for help with and shared information about technologies. These events emphasized the value of being able to quickly find, evaluate, and deploy new technologies. Faculty with such skills could more effectively navigate the turbulence that the COVID-19 pandemic created. Further, we contend that the changes that the pandemic caused have increased the need for to understand techno-savviness's nature and may also change its relative importance between students and faculty.

1.2 Scenario 2: Textbooks are Becoming Obsolete

Microsoft magnate Bill Gates has proclaimed himself an avid reader. In his annual letter 2019 with his wife, Melinda, Gates mentioned, however, "I read more than my share of textbooks, but it's a pretty limited way to learn something…. But now, thanks to software, the standalone textbook is becoming a thing of the past" (Gates & Gates, 2019). In Gates' view, textbooks have begun to lose their halo. If textbooks do indeed end up losing their value, faculty may lose a key resource for staying up to date with advances in information technology and its applications.

1.3 Scenario 3: Students Know More about Technology than Faculty

During an interview for an IS faculty position with several committee members, a candidate attempted to convince the committee that he could handle various technical courses by acquiring knowledge and skills on his own first and then teaching students. One committee member, however, interjected, "Do you believe professors need to know more than students?". "Absolutely", he replied. However, he hesitated for a few seconds before adding, "Well, it is hard to say…". This uncertainty reflects the thinking that, in some cases, greater student techno-savviness may be an asset rather than a liability. The COVID-19 pandemic may change this dynamic due in part to the need for faculty to be able to use technologies that facilitate

[1] The panel occurred prior to the pandemic. However, we also discuss how changes that the pandemic created might affect the panel's findings.

teaching online and maintaining communication with distant students. In addition, when classes do not occur via face-to-face instruction, faculty may need to find new ways to leverage their students' techno-savviness.

1.4 Scenario 4: The Professor has Much Knowledge but no Idea How to Teach

In teaching evaluations, IS faculty may receive feedback that resembles "the professor has much knowledge but no idea how to teach". We frequently see this situation in technical courses, such as programming, database, security, networks, and data science. Helping students become techno-savvy may involve much more than simply being techno-savvy oneself. The COVID-19 pandemic affects this scenario as well. What "how to teach" means has shifted as educators have had to increasingly use distance learning due to pandemic restrictions. Faculty who can teach in face-to-face settings may face challenges when teaching through technology-mediated means.

1.5 Summary

These scenarios depict a seemingly pessimistic situation for IS professors in the information age. We can attribute the threats to environmental changes, emerging technologies, and "intelligent audiences" inside the classroom. Hence, we may need to rethink and revisit IS professors' role. Distinguished from colleagues from accounting, finance, management, and marketing disciplines, IS professors are often colloquially referred to as "technical guys". IS professors' traditional roles and responsibilities include nurturing IT agility (AACSB, 2018) among IS and other business majors students. Indeed, the halo effect of "technical experts" substantially promotes IS professors' mastery of techno-savviness in one or more areas. IS professors also seek to fulfill industry and market demand for students with technological knowledge and skills. The transitions that the COVID-19 pandemic created provided a strong lesson in the importance of IT agility not only for faculty but also for the many workers and businesses that needed to continue operations despite COVID-19 restrictions. To help students gain IT agility skills and knowledge, IS professors must acquire techno-savviness through systematic education and training (e.g., graduate and doctoral programs) and continual self-development in their careers.

Besides savviness in using and learning technologies, one can criticize a professor for inadequacy in teaching techno-savviness (e.g., Scenario 4). From reviewing the literature, we can see that researchers have well examined savviness in using and learning IT (see Table 1) such as computer savviness (e.g., Kaifi, Mujtaba, & Williams, 2009), Internet savviness (e.g., Levin & Arafeh, 2002; cyber savviness (e.g., Imgraben, Engelbrecht, & Choo, 2014; Willard, 2011), IT competencies (e.g., Ho & Frampton, 2010; Lee & Lee, 2006), IT skills (Bryd & Turner, 2001; Todd, McKeen, & Gallupe, 1995) in the workplace. However, researchers have paid little attention to savviness in teaching IT. Furthermore, we need to better understand the techno-savviness construct in the IS education area. As such, as our primary research inquiry, we explore techno-savviness's nature and dimensions based on a panel discussion among IS professors with diverse backgrounds.

As we mention above, IS professors' technical prestige in the classroom now faces overwhelming challenges from the Internet. Presumably, students may sometimes know more than their IS professors do. This phenomenon leads to critical questions that prior work has rarely examined, such as what an optimal balance between professors' and students' techno-savviness would be and whether IS professors should be more techno-savvy than students.

Therefore, in this paper, we explore techno-savviness in IS education while considering how techno-savviness impact IS faculty. This paper proceeds as follows: in Section 2, we recount the discussions that occurred during the panel. Specifically, panel members addressed two questions: "What is techno-savviness (and what is it not)?" and 2) "Which types of techno-savviness are more important to IS faculty and students?". We also elaborate on contextual factors that can affect the distribution of techno-savviness between IS faculty and students and what IS faculty can do to develop and maintain their and students' techno-savviness. In Section 3, we summarize the main findings from the panel and associated discussions. Finally, in Section 4, we discuss future research opportunities and practical considerations before concluding the paper.

2 Discussion Questions

In this section, we recount the discussions that occurred during the panel. The discussion focused on several questions as an organizational and dialog-stimulating tool. After the conference, we expanded on and clarified our thoughts, which we present in Appendix A.

2.1 Question 1: What is Techno-savviness (and What is it Not)?

According to some popular IS principles textbooks and instructional materials (e.g., Baltzan, 2018; Laudon & Laudon, 2018; Stair, Moisiadis, Genrich, & Reynolds, 2018), scholars have often articulated "people" as the most significant IS components. We further argue that people should be aware of and use information technologies proficiently (i.e., be techno-savvy) to maximize organizational value. IS education and the IS profession requires techno-savvy individuals. Indeed, in many ways, techno-savviness represents the core of IS education's mission. Hence, in the panel, we first focused on discussing what techno-savviness means and its scope. This discussion transitioned into an interesting exchange regarding the distinction between "special" and "general" techno-savviness in IS educational settings.

Ferratt started by arguing that understanding information technology should be associated with the topics that the IS curriculum and courses include. In his definition, techno-savviness includes:

> *Understanding what the technology is capable of doing, being aware of strengths and limitations of the technology, and being able to contribute knowledgeably to discussions about when and how to use the technology to address work-related problems or opportunities and meet organizational objectives/ business requirements. This answer is consistent with the undergraduate IS curriculum being an applied curriculum designed to educate students to become IS professionals who are capable of contributing to an organization's IT-reliant systems.*

In reminiscing about enterprise systems courses, Sumner noted techno-savviness in particular should comprise the abilities to learn and to maintain business-oriented IS:

1) Ability to learn systems: enterprise platforms, navigation, applications, reporting, documentation, training, and testing;
2) Ability to support the IT infrastructure: configuration, troubleshooting, technical support, documentation, and testing

The 2013 AACSB Standards (2018) address the need for students to be proficient in IT. Li agreed that, for students, techno-savviness ultimately allows them to serve organizational and business missions.

> *Evidence-based decision making integrates current and emerging business statistical techniques, data management, data analytics, and Information technology in the curriculum…. Student experiences integrate real-world business strategies, privacy and security concerns, ethical issues, data management, data analytics, technology-driven changes in the work environment, and the complexities of decision making*. (AACSB 2018)

It turned out to be an intriguing conversation as participants explored different techno-savviness genres by drawing on their diverse teaching backgrounds and perspectives. Three techno-savviness categories emerged from this discussion and later reflections: 1) savviness in using and managing IT, 2) savviness in learning IT, and 3) savviness in teaching IT (see Table 1 and Figure 1).

Table 1. Summary of Savviness Concepts

Category and concept	Definition and discussion excerpt	Relevant concept & literature
Savviness in using and managing IT. Desired mainly for students or the future workforce. Work context.	Definition: perception, comprehension, and shrewdness in using and managing IT to achieve personal, organizational, and social goals. Relevant topics discussed: 1) using IT to address work-related problems while meeting business requirements and organizational objectives (Ferratt), 2) developing T-shaped skills—deep expertise in an area and general knowledge of a broad array of relevant areas (Van Slyke).	IT competencies—generic competency applied to IT workforce (e.g., Ho & Frampton, 2010; Lee & Lee, 2006): ability to transform IT investment into business opportunities. Savviness in specific information technologies, such as computer savviness (e.g., Kaifi et al., 2009), Internet savviness (e.g., Levin & Arafeh, 2002), cyber savviness (e.g., Imgraben et al., 2014; Willard 2011). Technical capability and skill (e.g., Aasheim, Li, & Williams, 2019; Bharadwaj, 2000; Byrd & Turner, 2001; Todd et al., 1995): the technical ability of IT personnel based on their specific technical expertise. IT agility (Börjesson & Mathiassen, 2005; Chang & King, 2005; Gebauer & Schober, 2006; Fink & Neumann, 2007), which includes 1) IT-dependent system agility—accommodating change in IS in an efficient fashion, 2) IT-dependent information agility—accommodating change in the way how users use information, and 3) IT-dependent strategic agility—responding to emerging market opportunities by leveraging existing IT capabilities.
Savviness in learning IT. Desired for both faculty and students. Community-based learning context.	Definition: perception, comprehension, and shrewdness in learning and adapting to emerging information technologies, for personal, organizational, and social purposes. Relevant topics discussed 1) learning enterprise systems and supporting the IT infrastructure (for students and the future workforce) (Sumner), 2) an education program or resource person that professors can obtain assistance from while preparing a course and use to guide their students (for faculty self-development) (Ferratt), 3) online learning platforms such as Coursera (Stafford & Van Slyke), and 4) university tuition assistance programs (Gallivan & Li).	User or employee training and learning (e.g., Bostrom, Olfman, & Sein, 1990, 1993; Compeau & Higgins, 1995; Gupta & Bostrom, 2013; Gupta, Bostrom, & Huber, 2010; Puhakainen & Siponen, 2010). Faculty development (e.g., Coppola, Hiltz, & Rotter, 2002; Moore, Moore, & Fowler, 2005). Online learning platform (e.g., Kane & Fichman, 2009; Mindel & Verma, 2006; Wang & Baker, 2015).
Savviness in teaching IT. Desired mainly for faculty. Lecture-based learning context.	Definition: perception, comprehension, and shrewdness in promoting students' mastery of IT through pedagogical strategies and educational technologies. Relevant topics discussed: 1) the undergraduate IS curriculum should be designed to educate students to become IS professionals who can contribute to an organization's IT-reliant systems (Ferratt), 2) equipping students with empirical decision making integrated with statistical techniques, data management and analytics, and IT in the curriculum (Li), and 3) using various media technologies in online teaching (Stafford).	Techno-savviness in teaching (e.g., Hicks 2011; Hockly, 2012; Jacobson & Mark, 2000; Schrum, Shelly, & Miller, 2008). Technology agility (AACSB, 2018): decision-making using current and emergent technologies, understanding the role of technology in the workplace and society, demonstrating a "learn to learn" mindset while adapting to new technologies, analyzing and solving problems using appropriate technology, and so on. Agility-, flexibility-, and adaptability-embedded course design (e.g., Tan, Tan, & Teo, 2010; Topi et al., 2010).

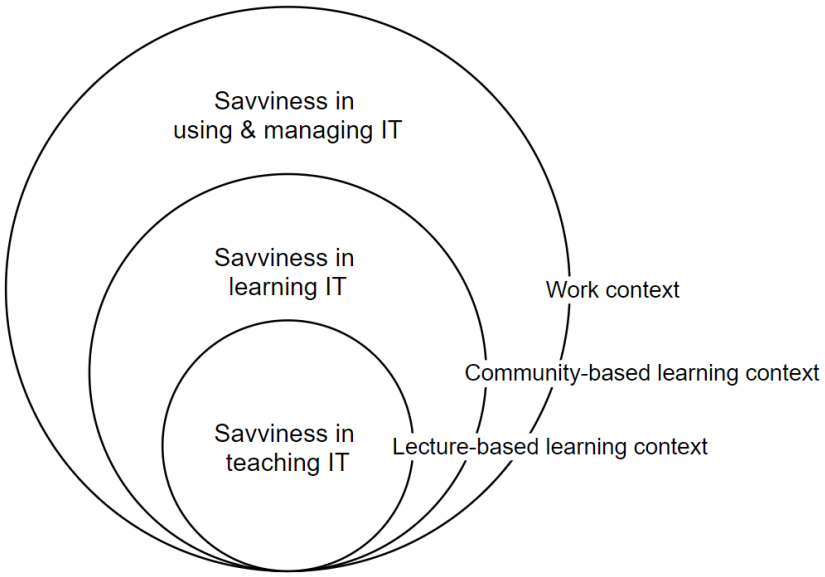

Figure 1. Techno-savviness in Varying Contexts

According to Van Slyke, one can refer to savviness in using and managing IT as "operational savviness" or "professional savviness" (distinguished from personal savviness in computer games, social media). It refers to the knowledge about and skills in specific technologies that could impact individuals, organizations, and society. Van Slyke also suggested looking at techno-savviness in the classroom by considering T-shaped professionals (Heinemann, 2009; Demirkan & Spohrer, 2018) who have deep expertise in an area but also have a general knowledge about various broader relevant areas. We can apply this thinking to IS faculty; faculty should have deep expertise in at least one area (possibly a specific technology application) but should also be conversant in various technologies and applications.

The second category (savviness in learning IT) permeates IS educators' professional life as they have to adapt to technological dynamics and advances. Sharing his wealth of academic experience spanning decades, Tom Ferratt highlighted the need for IS faculty to develop techno-savviness through continued self-development:

> *Another possibility is that the professor is not more technologically savvy than the students. In such instances, particularly when the level of the professor's understanding of the IT associated with one or more topics included in the course is below that needed to guide the students to develop the needed understanding, the professor would need to have some form of assistance. That assistance could be an educational program for the professor that would provide the preparation needed to guide students appropriately. It could be a resource person who could provide the needed guidance for the students.*
>
> *[Speaking of teaching a programming course] I tried learning it on my own but felt my progress was inadequate. I took a short summer course for faculty interested in learning Java from an experienced computer science professor and sat through a semester-long course taught, coincidentally, by a former undergraduate MIS student of mine who taught a number of courses in our MIS program as an adjunct faculty member. These educational programs helped me understand Java and the object-oriented paradigm. That preparation provided the solid understanding I needed to guide students in learning this application development technology.*

Building on these comments, other participants discussed how they developed their techno-savviness through online learning platforms (e.g., Coursera, Stafford & Van Slyke) or university tuition support/assistance programs (e.g., the University System of Georgia's Tuition Assistance Program, Gallivan & Li). IS faculty members' research projects may also help keep them current with respect to emerging technologies and applications.

Ideally, faculty will be reflective learners. They should not only have the capability to learn new technologies but should also continuously evaluate and adjust their mental models by integrating new

knowledge with existing knowledge. In addition, techno-savvy faculty must also be able to discern important from non-important technologies—they should be able to learn what to learn with respect to technology. To do so, they may need to reflect on and challenge their own assumptions regarding technologies. For example, many faculty enter the IS discipline because they love technology and, therefore, eagerly learn about emerging technologies. However, they should reflect carefully on whether students need to learn about these technologies. Just because people find new technology "cool" and interesting does not mean that faculty should teach students to use the technology. This sort of evaluation resembles the double-loop learning concept (Argyris, 1977) in that faculty members must challenge their own assumptions about the importance of learning emerging technologies.

As a final note regarding faculty and learning, faculty must be willing to be life-long learners. Clearly, information technology has and will continue to develop rapidly. Faculty must have the ability to effectively learn relevant technologies' capabilities and must be able to effectively assimilate emerging technologies into existing knowledge structures to understand them. Only then will faculty be able to help their students understand how these emerging technologies fit into the existing technology landscape.

The last category (savviness in teaching) concerns faculty's ability to help students learn, use, and manage IT. This concept surfaced from the panel discussion: if students have more techno-savviness than their professors, then what should professors do? We looked into this question by considering techno-savviness as a general concept that includes professors' techno-savviness, students' techno-savviness, and savviness to teach techno-savviness (similar to the metaphor of fish and fishing) rather than only one concept. In the panel, Tom Stafford illustrated that techno-savviness could involve applying technology to teaching and learning using online education as an example:

> *You need to skill up on and deliver a "flipped format" perspective, which means rich media enhanced lecture recordings posted online, mingled with live access either in lab sections or office encounters or even small group encounters that permit these new learners to merge the online content they access with in-person Q&A and feedback. I typically use a utility called Camtasia to record narrated versions of my live class PowerPoint slides and after producing the voice-over narration. I go back and enhance the presentation (which stores and presents as an MP4 movie) with graphic emphasis points—pop-ups, key issue balloons, highlighting of key content passages, etc. I essentially add a third channel of information to a voice-over narrated PowerPoint lecture that provides key points of emphasis and reinforcement, just as live Q&A and feedback would permit me to do in a live lecture.*

Mike Gallivan also stressed the importance of teaching students techno-savviness—designing an active learning environment where students can learn about techno-savviness:

> *Based on my philosophy of being the "guide on the side" instead of "sage on the stage" and using flipped learning approaches, I try to consistently send the message that my expertise is in understanding how to create a suitable learning environment where motivated students can be active in acquiring assigned information (outside the classroom) and working actively on tasks with other students (inside the classroom) to achieve the course objectives.*

As Scenario 3 shows, it is troubling when instructors excel in learning and using IT themselves yet fail to produce student "techno-savviness" in their classes. Ironically, isolated techno-savviness prevailing over general techno-savviness seems to contradict one fundamental premise behind information systems: systematic solutions that span the information silos' boundaries. In other words, techno-savviness is not static, individual, and isolated but adaptive, social, and transitive IS teaching and learning.

Although Figure 1 accurately portrays the discussion that occurred among the panelists, if the panel took place today, a new element would likely emerge: the ability to teach with information technology. As we note above, COVID-19 restrictions forced many IS faculty (and faculty from all disciplines) to rely on technology to continue their courses. Although this element may be a subset of "savviness in using and managing IT", it seems reasonable to call attention to it here. Whether a new element or an expansion of an existing element, being able to use IT to facilitate learning clearly took on special importance during the pandemic.

Due to the importance of techno-savviness in IS education, the panel discussed the second question below.

2.2 Question 2: Should IS Professors be more Techno-savvy than Students? What would be an Ideal Balance between Professors' and Students' Techno-savviness?

Panelists tended to acknowledge the gap in techno-savviness between professors and students. This gap comes in many variations. In one instance, the more techno-savvy professor guides students based on that greater techno-savviness. In another, students have more techno-savviness than their professors because "technical skills required of IS professionals change over time and with their work context" (Niederman, Ferratt, & Trauth, 2016). In addition to the techno-savviness that some students (e.g., adult and graduate students) acquire at work, the Internet grants students access to much information about their course content. With the assistance of the Internet, active, self-directed learners may know more than what lectures and textbooks cover and, thus, be more techno-savvy than their peers and perhaps even professors. This perception runs contrary to the orthodox, instructor-oriented perspective.

We understand the possibility that, while students may be more techno-savvy with respect to specific technologies than their professors, faculty need to maintain their advantages in general techno-savviness and techno-savviness in teaching techno-savviness. Tom Stafford illustrated this point with a good example about using social media: some students may be more interested and proficient in using social media in their daily life, study, and work than their professors. Older professors or professors indifferent to social media do not need to be as techno-savvy as their students, but they do need to understand its capabilities and impacts on business. A possible perspective on this issue comes from the T-shaped skillset that we mention above: professors have to be techno-savvy in one or two areas in depth and techno-savvy in many areas in breadth. Van Slyke pointed out that an ideal balance can depend on the course and type of techno-savviness, the teaching method, and teaching modality (online/blended learning).

Mike Gallivan used the terms "super user" and regular users to illustrate the techno-savviness balance between professors and students. He accentuated that, whenever one perceives one's role and responsibilities as a "super user" in a realm, one has to be more techno-savvy than regular users. He added:

> *I also reinforce the message that my knowledge as an IS professor is in understanding, in general, what are the challenges and opportunities for organizations (either business, educational, or government ones) to benefit from using different types of IT. I am not, myself, the expert in all things about "using IT," although I do happen to be a super user of some types of IT (specifically statistical software and spreadsheets), but that doesn't mean that I know about all the same apps and systems that students themselves may know about and use.*

With that said, to achieve an ideal balance in techno-savviness, IS professors do not necessarily need to be techno-savvy in all aspects and settings (a consensus that all panelists reached). Thus, multiple contextual moderators can apply to determine who should be more techno-savvy than another. We identified several such moderators in our discussions, which we classify into three groups: 1) institutional, 2) faculty relevant, and 3) course relevant. We provide the discussion that follows to illustrate how contextual factors might change the ideal balance of techno-savviness.

The distribution of techno-savviness can differ between schools that accentuate practical education (e.g., co-op programs and university alliance programs) and cultivate a collaborative learning environment and those that do not. As for professors, their career stage, teaching philosophy, and pedagogical practices can also impact the distribution of techno-savviness in the class. For example, junior faculty and those near retirement may struggle more with new technologies, while more seasoned professors at the height of their career may be savvier in tackling technologies (although not always). Also, IS faculty's personality and pedagogical philosophy and practice can influence their mastery of techno-savviness. For example, some professors can proficiently learn and use technologies but lack good communication skills to promote their students' techno-savviness. Course modality (online vs. face-to-face), course level (undergraduate vs. graduate), and course content (survey vs. technical) may also affect the desired balance of techno-savviness. For example, a survey course would require lower techno-savviness for both faculty and students. In contrast, a technically oriented graduate course may require its professor to have high techno-savviness. Initially, professors and students acquire savviness in learning and using IT; later, they may need to "teach" savviness to peer learners too.

When teaching online, faculty need to be more knowledgeable regarding how technology mediation can change communication, interaction, and engagement. Also, IS faculty should also be able to use technology flexibility and creatively to overcome technology mediation challenges. To do so, IS faculty quickly need to become conversant with unfamiliar technologies (savvy in learning about technology) that may help them adapt quickly to COVID-19 restrictions. IS faculty should also be able to effectively show students how to use these technologies to adapt to a dynamic environment. For example, a faculty member in an IS capstone course might need to quickly learn and introduce students to collaboration tools such as Slack or Microsoft Teams to help them coordinate their capstone team project.

Techno-savviness will also allow IS faculty to leverage the turmoil that the COVID-19 pandemic created as a "teachable moment". To perhaps a greater extent than any event in recent memory, the pandemic has illustrated information systems' and technologies' enabling role. It is difficult to imagine how universities and other organizations could have continued operating without information systems. Even daily life serves to exemplify how information systems can overcome the challenges associated with distance—Facetime, Zoom, Google Hangouts became ways for people to maintain contact with family members and friends. Some IS faculty saw teaching opportunities in the COVID-19 chaos. For example, Van Slyke integrated COVID-19 related questions into his junior-level introduction to IS course. One assignment asked students to reflect on and discuss the important information systems that enabled them to continue their courses during the lockdown. Other faculty used current events to illustrate the importance of business continuity and disaster recovery planning. Taking advantage of these opportunities required savvy faculty.

Although the discussions revealed the three types of techno-savviness (see Table 1), to further refine the concept, we needed to reflect more on it, which we discuss in Section 2.3.

2.3 Defining Techno-savviness

In this section, we discuss and refine our techno-savviness definition that emerged from our discussion and subsequent reflection. Suddaby's (2010) prescriptions on construct clarity guided our efforts to develop and refine our definition. According to his prescriptions, clear constructs have good definitions, delineate scope conditions, illustrate semantic relationships to related constructs, and logically concur with overarching theoretical arguments. As an initial step in more fully developing techno-savviness as a construct and in keeping with the panel's purpose, we focus on the first prescription and on developing a sound definition. Suddaby (2010) notes that a "good" definition has three characteristics: 1) it captures the construct's important properties, 2) it avoids tautologies, and 3) it is parsimonious. We used these characteristics as the goals for our definition.

In general usage, savviness is an informal term that refers to "shrewdness and practical knowledge; the ability to make good judgments" ("Savviness", n.d.). This common definition aligns well with the conceptual definition of techno- savviness that emerged from our discussion and subsequent reflection. However, simply affixing "technology" to this definition does not sufficiently define the concept.

Conceptually, techno-savviness sits at the intersection between three types of understanding as Figure 2 reflects. The first type, which we refer to as skills, refers to the ability to manipulate technology to produce certain outcomes. Interestingly, it resembles the Greek philosophers' concept *techne* from which the word "technology" originates. To the Greeks, techne represented making or doing something, which parallels idea of craftsmanship. The second type, which we label knowledge, concerns understanding facts and concepts related to technology. This knowledge does not simply constitute the ability to recite facts and definitions but also to understand how the facts and concepts connect in coherent frameworks and models. It resembles the Greek concept *episteme*, which scholars sometimes define as knowledge. The final type, judgment, involves understanding how to evaluate and make decisions regarding technology, including how it should be used and managed. It resembles what the Greek philosophers called *phronesis* or knowing how to act in particular situations. Drawing on the above view, we define techno-savviness as an individual's skills in manipulating information technology to achieve desired outcomes, knowledge of and the ability to connect facts and concepts related to information systems, and the ability to make judgments about applying information technology in pursuing personal, organizational, or social goals.

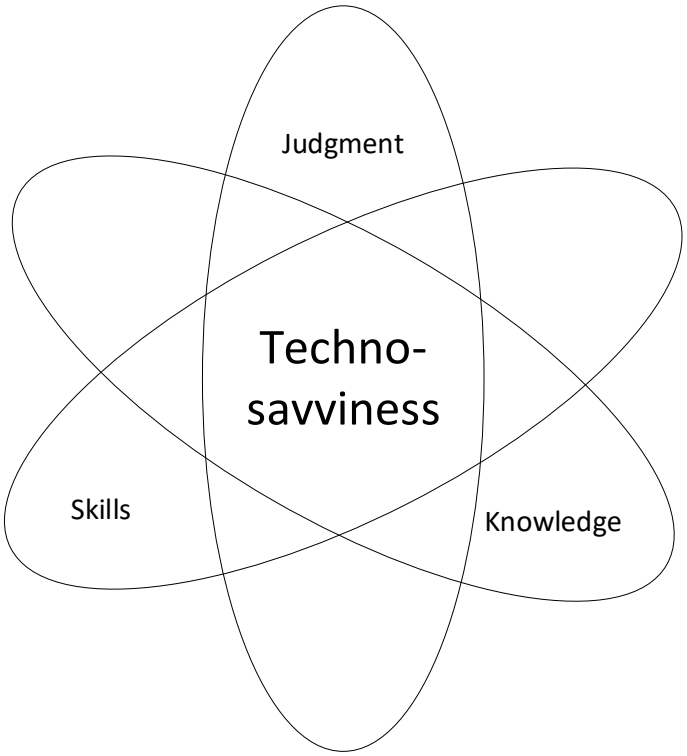

Figure 2. Tripartite Conceptualization of Techno-Savviness

We can apply this tripartite conceptualization the types of techno-savviness that we discuss in Section 2.2. The general conceptualization applies to all three types (and to other types that we have yet to discover). The three types of understanding remain constant; however, the specific skills, knowledge, or judgments that apply to each type do change. Consider techno-savviness in teaching IT. It would involve (among others) communication and organizational skills, knowledge about learning theories and IS concepts, and judgments in what topics to cover and what teaching methods to use. (Note: we include this list as an example only.)

We also apply the way we view techno-savviness to better understand the contextual factors that we discuss in Section 2. Although all three types of understanding would apply for all IS courses, the emphasis may shift based on the course's nature. For example, a programming course might emphasize skills, while a course on IS management might emphasize judgment.

3 Discussion Summary

Among its purposes, the panel explored the techno-savviness concept. The panelists agreed that no single, universal notion of techno-savviness exists. Rather, multiple types of techno-savviness exist as we mention in Section 2.3 and further delineate in Table 1. All three types affect IS faculty but how much they do so varies based on several contextual factors related to the specific nature of courses, institutions, and faculty members.

These contextual factors also play a role in another issue that the panel discussed: whether IS faculty need to be more techno-savvy than their students. As is often the case, it depends. For courses that focus on specific technologies, the professor should be more techno-savvy than the students. In more survey-oriented or managerial courses, students can typically know more about certain technologies than the professor without issue, particularly when it comes to operational savviness (knowledge about how to perform specific activities with technology). For example, many students would unsurprisingly have more operational knowledge about Snapchat than most faculty. However, that difference in knowledge would not negatively affect the faculty; in fact, faculty could leverage this techno-savviness during class discussions. However, faculty should typically have more knowledge about how organizations are affected by or can use social media. This statement represents another interesting issue that emerged in the panel

discussion: faculty should always have more knowledge than the typical student about analyzing how any given technology would likely impact individuals and organizations.

Course structure and modality also impact requisite techno-savviness. Several panelists mentioned the benefits of flipped or blended course structures. Such modalities may require faculty to have additional techno-savviness. Flipped courses typically involve more active learning than lecture-based courses. The uncertainty associated with active learning may mean that professors need to have knowledge about technologies under consideration in particular. Generally, more learner-centered structures that shift faculty's role require faculty to have more agility, which may mean the need for greater techno-savviness. (Of course, the need for faculty to have agility would increase in importance in courses that focus on specific technologies.) Active learning methods, especially those that rely on collaboration, offer good opportunities to leverage student techno-savviness.

Another important conclusion from the panel discussions concerns the need for both faculty and students to become continuous learners with respect to technology. Technology continuously changes; thus, as IS faculty members or IS professionals, we can never complete our learning, which has implications for techno-savviness. First, it illustrates the need for one to have the ability to learn and the ability to teach technology. We may consider the ability to learn technology a core skill for both IS students and faculty. Both students and faculty should be savvy about how to learn about and understand emerging technologies. By extension, IS faculty also need to know how to help students gain the ability to scan the environment for interesting new technologies and to project how these emerging technologies may impact the world. Then, as they recognize the important role that some technologies may play in society, IS graduates (as IS professionals) need to be able to understand how to use and operate them.

So, although the specific technologies in play will inevitably shift over time, the panelists agreed that it will remain important for IS faculty to maintain their techno-savviness when it comes to the three dimensions we identified (i.e., knowledge about how to use and manage technologies, how to learn about new technologies and their operation, and how to teach technology).

The COVID-19 pandemic dramatically illustrated the need for students and faculty to display techno-savviness in all dimensions. To make an effective transition, faculty often had to use their judgment to select appropriate technologies such as lecture-capture systems, videoconferencing systems, video-editing software, and so on. Faculty needed to quickly and effectively acquire the skills necessary to use these systems. Faculty also had to use their knowledge to cobble these technologies into cohesive learning environments.

Students had to learn how to effectively use collaboration systems and needed to learn to use familiar systems in new ways. For example, for classes that included team activities, students may have had to quickly become familiar with document-sharing services such as Dropbox and Google Drive. Many students also needed to become familiar with the new features of learning management systems. When courses did not prescribe specific systems, students had to learn about potentially useful applications (e.g., their capabilities) and had to use their judgment to choose from among alternatives. Once they selected an appropriate technology, students had to gain skills in using it. While the pandemic magnified the need for students to possess techno-savviness, we should remember that more techno-savvy faculty had a better position to guide and assist students as they came to grips with new technologies, which supports the notion that, in rapidly changing times, faculty require techno-savviness.

Techno-savviness clearly plays an important role in IS education. Despite its importance, the concept has lacked refinement. In many respects, techno-savviness constitutes a term that everybody understands broadly but not in sufficient detail to allow serious research. Based on the panel discussion, we developed an initial definition for the techno-savviness construct that may help move research into techno-savviness forward. Although readers should consider this definition a preliminary one, it should provide a useful starting point for further refinement.

4 Conclusion

This panel report builds on an enthusiastic conversation at the 2019 ACM SIGMIS Computer and People Research conference and reflections before and after the panel discussion. The panel largely comprised senior or emeritus faculty who have been dedicated to IS education for decades, which made the panel insightful and inspiring. While we discussed various questions and topics during the panel, we focus on three aspects in this panel report. First, we define techno-savviness and clarify its scope in IS education

and the IS profession. The responses to the first question (i.e., should IS professors be more techno-savvy than students) prompted our discussion into a second and third question (i.e., whether IS professors should be more techno-savvy than students and how we should perceive the imbalance between professors' and students' techno-savviness, respectively). As a result, our panel extends the literature on IT competency and agility (e.g., Aasheim et al., 2019; Bharadwaj, 2000; Byrd & Turner, 2001; Fink & Neumann, 2007; Ho & Frampton, 2010; Lee & Lee, 2006; Todd et al., 1995) to the IS education and teaching context. We suggest three coherent and corroborative dimensions of techno-savviness: savviness in learning, in using and managing, and in teaching IT. The learner-centered paradigm shift in education (Barr & Tagg, 1995; Norman & Spohrer, 1996; Weimer, 2002) inspired these dimensions, and they echo the spirit of participatory democracy in IS, our own area (e.g., Barki & Hartwick, 1989; Hirschheim, 1985; Markus & Mao, 2004; Spears & Barki, 2010). Similarly, both IS professors and students use and contribute to IT and IT-learning systems. Like a focus group, our rudimentary techno-savviness conceptualization sheds light on the concept's multidimensionality while providing opportunities for future research.

On the one hand, one could conduct an IS educational inquiry based on our panel discussion and subsequent deliberation on techno-savviness in the classroom before collecting data from students. Researchers could apply qualitative, quantitative, or mixed methods to conduct such a study. On the other hand, researchers with an interest in IS competencies and skills in using and managing IT may consider constructing or reconstructing an organizational techno-savviness. One can even apply the dimension savviness in teaching that we discovered in the learning context to organizational settings since training and teaching techno-savvy employees are prevalent in contemporary companies.

Based on discussing main questions, we illustrate practical ideas, thoughts, and experience about how to teach technical IS courses in the Appendix. Again, we praise a pedagogical approach based on global, social techno-savviness rather than local and dictatorial one. Hopefully, some thoughts along this line from our panel can help IS educators in promoting the mastery over techno-savviness in their communities of learning.

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Appendix: Panel Presentation and Additional Comments by Panelists

Thomas Ferratt: A Veteran's View on Techno-savviness and IS Education

I offer my comments based on personal experience as a professor over a 40-year span from about 1975 to 2015. Prior to that, I served as a COBOL programmer and systems analyst in the late 1960s and completed a doctoral program in the early 1970s. The courses that contribute the most to my comments comprise undergraduate programming, systems analysis and design (SA&D), and capstone courses. The programming courses included teaching Visual Basic based on an event-driven paradigm and, later, Java based on an object-oriented paradigm (Ritzhaupt & Zucker, 2006). I mainly taught the SA&D courses as structured analysis and design rather than object-oriented analysis and design (Nerur, Slinkman, & Mahapatra, 2005). In later offerings of the SA&D courses, I introduced iterative/agile/ rapid application development (Beynon-Davies, Mackay, & Tudhope, 2000, Larusdottir, Gulliksen, & Cajander, 2017, Mahadevan, Kettinger, & Meservy, 2015). I also introduced use cases from the object-oriented approach. The capstone courses involved teams of students working on real information systems projects that various for-profit and non-profit organizations sponsored over a two-semester period.

The broader educational context of my experience in teaching these courses is the IS curriculum for IS majors (Bell, Mills, & Fadel, 2013). It includes IS core topics, which can be combined into one or more courses, for developing any IS professional; in addition, it includes elective topics that pertain to specific IS career tracks. Overall, the topics prepare IS professionals who can meet the demands of employers for information technology (IT)-reliant systems in organizations.

The theoretical context for IT-reliant systems is the work system theory (Alter, 2013). This theoretical context considers information technology as just one component of the work system that generates business results. Other essential components include people and business processes. While one needs to understand a work system's IT aspects, one also needs to understand other aspects that an organization needs to generate business results.

To answer the first question, I believe that techno-savviness refers to understanding the information technology associated with the topics in courses that comprise an undergraduate curriculum for IS majors. That includes understanding what the technology can do, being aware of technology's strengths and limitations, and being able to contribute knowledgeably to discussions about when and how to use technology to address work-related problems or opportunities and meet organizational objectives/business requirements. This answer concurs with the undergraduate IS curriculum as an applied curriculum that focuses on educating students to become IS professionals who can contribute to an organization's IT-reliant systems.

To answer the second question, I believe that professors need to be able to guide students to help them understand the information technology associated with the topics the courses they teach. That allows for at least two possibilities regarding the professor's techno-savviness relative to their students. In the first possibility, the professor has more techno-savviness than students and guides them based on that greater techno-savviness. In the other possibility, students have more techno-savviness than the professor. Technical skills required for IS professionals change over time and with their work context (Niederman & Sumner, 2016). Given the extent and speed of change and the variety of work contexts, it would not be surprising that, in some skill areas, some IS students, particularly those with experience in one or more work contexts, could be more techno-savvy than a professor teaching a specific course in the IS curriculum. In such instances, particularly when the professor understands the IT associated with one or more topics in the course at a level lower than what the professor needs to guide students to develop the needed understanding, the professor would need to have assistance in some form. That assistance could be an educational program that would provide the preparation needed to appropriately guide students or a resource person who could provide the needed guidance for the students. In instances where the professor understands IT at an appropriate level but some students have more advanced knowledge in one or more technical areas, the professor may develop opportunities for cooperative learning (Fellers, 1996).

Examples from Experience

In teaching programming courses, to help me understand application development in Visual Basic, I developed programs on my own prior to teaching it to students. I became familiar with the event-driven programming paradigm and the syntax of the language through reading and through examining and

writing programs. Having learned other programming languages previously, such as COBOL, FORTRAN, Basic, assembly language, and machine language, I did not find learning the language syntax challenging. However, I found the shift from a procedural to an event-driven paradigm much more challenging, and I needed time to understand and appreciate it. My eventual understanding helped prepare me to guide students based on solidly understanding Visual Basic as an application development technology.

Learning Java required another considerable mind shift to grasp the object-oriented paradigm. I tried learning it on my own but found my progress inadequate. I took a short summer course for faculty interested in learning Java from an experienced computer science professor and sat through a semester-long course coincidentally taught by a former undergraduate MIS student of mine who also taught various courses in our MIS program as an adjunct faculty member. These educational programs helped me understand Java and the object-oriented paradigm. That preparation provided the solid understanding I needed to guide students in learning this application development technology. Besides MIS students, I also had computer science students take this course occasionally. Typically, they found the material easier to grasp, and some may have better understood the technology in some respects than me. The class had significant time devoted to students individually developing programs while sitting together in a lab setting. I would assist students when they asked or became stuck. They could also ask other students for assistance. The course regularly featured that form of cooperative learning. More knowledgeable students could and did contribute to the learning that occurred.

Teaching the SA&D courses had a minimal prima facie requirement for techno-savviness. Students needed to provide a baseline project plan and update it using project management software as they completed work on a team SA&D project during the semester. They also needed to present various diagrams (e.g., data flow diagrams, use-case diagrams, and entity-relationship diagrams) using diagramming software. I understood the project management and diagramming software adequately enough to provide tutorials on using the software's basic elements. Students could go beyond those tutorials and help each other individually and in/across teams as they applied those technologies to generate required individual deliverables and project deliverables in their teams. I would not be surprised if various students developed greater techno-savviness than I did in the project management or diagramming software.

Designing a system such as databases, forms and reports, and interfaces and dialogs) (Hoffer, George, & Valacich, 2014) did not require students to specify a technology to implement the design. Indeed, I directed students to specify a system's logical design to meet system requirements and delay selecting physical technology until implementation, which the SA&D courses did not feature. The logical system design involved specifying the content of databases, forms, reports, interfaces, and dialogs. Beyond that logical design specification, I also directed students to specify the system design's format. For example, I requested visual representations/prototypes of forms and reports without expecting them to specify or use technology that they would actually use to generate those system artifacts. The lack of emphasis on IT to implement system designs basically made faculty' and students' relative techno-savviness with respect to IT for system implementation irrelevant for the SA&D courses I taught.

Even so, teaching a course where system design does not move to the next implementation step using a specific technology did not necessarily free me from the felt need to at least be aware of constantly changing IT. However, it did allow me to limit where I thought I needed to pay the most attention. I chose to try to recognize the possibilities for human-computer interaction that could potentially impact the design of forms, reports, interfaces, and dialogs. This choice led me to adopt a smartphone and watch earlier than I might have otherwise so that I would understand that technology better through using it directly. For example, I now much better recognize possibilities for using voice, images, and gestures that could be part of an interface or dialog or, in some instances, substitute for a form or report.

One other major choice I made in teaching SA&D courses concerned using the structured analysis and design approach rather than the object-oriented analysis and design approach. One could view those approaches as technologies for SA&D. In teaching SA&D earlier on, I did not adequately understand the object-oriented approach/technology. That provided the impetus for me to learn object-oriented programming. I thought that better understanding object-orient programming would help me understand object-oriented analysis and design. Indeed, I believe it did. That led me to select structured analysis and design as the approach/technology to teach but to include use cases from the object-oriented approach as a valuable supplement. Conceptualizing use cases and drawing use case diagrams could potentially help students struggling to understand major processes in a system and represent them in data flow diagrams.

For the capstone courses, student teams worked with representatives from the organizations sponsoring the information system projects that students had to complete. In a typical project, students worked with members from the sponsoring organization to understand the project's business and information requirements, articulate them in a statement of requirements, develop system design specifications to meet those requirements, and implement the design. Students had learned an approach to developing systems through prior coursework, and many had work experience with IT-reliant systems by the time they took the capstone course. That background facilitated their adaptation to the IT and development environment of the organization that sponsored their project. A team that included two to three faculty members guided the students through the capstone project as guides on the side rather than sages on the stage (Danchak & Huguet, 2004) given the students' prior preparation. I and the other faculty did not likely adequately understand aspects of the IT they would encounter in the various sponsoring organizations. Thus, we asked probing questions and offered advice where appropriate, but we expected the students to seek guidance on the development approach and IT for implementation from the sponsoring organization members; furthermore, we expected them to learn what they needed to know through their own individual and cooperative team efforts.

Concluding Comments

Neither techno-savviness's meaning in IS education nor whether IS professors need to be more techno-savvy than their students has a simple answer. My experience suggests that the answer for each depends on the topics that define the courses IS professors teach. To teach programming courses, I needed to adequately understand the application development technology. I engaged in self-development activities to build that understanding. Although some students might have better understand some aspects of the application development technology and could assist other students in developing their understanding, I needed enough understanding to guide students in developing their understanding. To teach SA&D courses, which did not involve implementing system design specifications, I did not feel constrained by a need to understand specific IT for implementing design specifications. As a result, in the SA&D courses, IS professors' and students' relative techno-savviness basically lacked relevance respect to IT for system implementation. Nevertheless, through experience using a widely available smartphone and watch technology, I sought to understand current technological developments in human-computer interaction that could affect the design of forms, reports, interfaces, and dialogs. In capstone courses, students work on projects in sponsoring organizations with various system development methodologies and information technologies. Professors' techno-savviness regarding those technologies will be subsidiary to members of the sponsoring organizations and eventually to the students as they become familiar with the technology. The professors in these capstone courses serve as guides for the overall project experience.

Michael Gallivan: "A Guide on the Side" vs. "A Sage on the Stage"

In my panel discussion, I basically argued that, as IS faculty in business schools, we are not necessarily experts in *using* information technology systems and apps (and especially not in using all systems and application); rather, we have degrees and expertise in *understanding* the business and organizational issues about how IT deliver value in organizations. Thus, the expectation (that students or we may have) that we are experts in knowing how to use every latest system or app is incorrect. Of course, we should be expected to be "aware" of technologies that organizations (or higher education institutions) widely use,, how these technologies deliver value (or not), and what organizational issues exist. I explain as much when explaining to students what the "IS discipline" is and what it is not, which includes how it differs from computer science.

I use the "flipped classroom" approach in my teaching (which some people also call "blended learning", although they differ slightly in definition). Either way, my approach to teaching concurs with the "flipped classroom" philosophy in that I act more as a coach in creating a suitable learning environment for undergraduate or MBA students and, thus, as a "guide on the side" rather than a "sage on the stage". Thus, I am not an expert on every topic who will lecture or talk at students for most of the class—they can access information outside class via other means (reading assigned materials, viewing assigned videos, finding other relevant videos on their own, engaging in organized discussion boards with other students). In the classroom, I try to keep lectures to a minimum (perhaps 25% of the entire class time), and I perform active exercises in the classroom where students can demonstrate that they have read/viewed/absorbed the assigned materials and then apply them to a mini-case or other exercise (both individual and small-group activities). Either way, I allocate a fair percentage of time in the classroom to having students do these activities, and then I have some or all students orally summarize what they did, how they answered

the question, and so on. In the panel, I mentioned one example about Blockchain and virtual currency technologies. Rather than giving a lecture about these technologies or even using PowerPoint slides that came with the textbook on the topic, I instead organized students into small groups with three to four students and assigned each group to a virtual currency company. I then gave each group 20 to 30 minutes to prepare answers to some questions before the groups made short informal presentations in which they answered the specific questions as they applied to that virtual currency company (e.g., how long it had existed for, whether it traded on any stock exchange, its currency's value, where/what countries they operated in, and other interesting news items about the company).

With the approach above, I have found that students participate more actively in the classroom than if they just listened to my lecture. Moreover, the students develop skills in working together (possibly even dividing up the questions and having different subgroups working simultaneously to answer them) and then presenting their results together. Typically, I try to record the different groups' answers in some way (e.g., by using the whiteboard or filling in the spaces on a Word table or Excel spreadsheet with the various groups' answers and then saving it to the course management system).

Based on my philosophy of being the "guide on the side" rather than the "sage on the stage" and using flipped learning approaches, I try to consistently send the message that I have expertise in understanding how to create a suitable learning environment where motivated students can actively acquire assigned information (outside the classroom) and work actively on tasks with other students (inside the classroom) to achieve the course objectives. I also reinforce the message that, as an IS professor, my knowledge lies in understanding (in general) the challenges and opportunities that organizations (either business, educational, or government ones) face in using different types of IT. I am not myself the expert in all things about "using IT", although I do happen to be a super user of some types of IT (specifically statistical software and spreadsheets). Still, that does not mean that I know about all the same applications and systems that students themselves may know about and use.

Yaojie Li: Learning in Space and Time

As we outline in the scenarios in Section 1, we can attribute the challenges we confront currently to Internet technologies that provide information way faster than traditional classrooms do. At the earliest, one can renew textbooks and other learning materials annually, regardless of professors' acceptance attitude and students' budget. Acquiring knowledge from the Internet or Internet-based learning platforms such as MOOCs, students may exceed the course schedule and, thus, cast doubts on instructor-delivered courses' timeliness and meaningfulness. As such, professors' reputation and power in an instruction-centered classroom could suffer.

Indeed, the Internet could cause a tremendous threat to traditional teaching and education but not their end. In a speech at the height of the Civil War, Abraham Lincoln remarked: "Do I not destroy my enemies when I make them my friends?". Even IS educators and teachers should treat the Internet more like a friend than a foe as we understand and embrace it in our educational venues. To that end, I would suggest following a fundamental shift from an instructional paradigm to a learning paradigm in the IS area, which Barr and Tagg (1995) originally proposed. Barr and Tagg (1995) argued that, in the instruction paradigm, faculty represent disciplinary experts to deliver knowledge via lecturing. In contrast, in the learning paradigm, faculty design learning environments in which they introduce the best methods for producing learning and achievement. Based on Barr and Tagg's (1995) work, Weimer (2002) further delineated a comprehensive practical work concerning learner-centered teaching in higher education classrooms. Also, Saulnier, Landry, Kibgebecjer, and Wagner (2008) and Landry, Saulnier, Wagner, and Longenecker (2008) extended the learner-centered paradigm and constructs into IS courses. In the following paragraphs, I make several comments concerning the panel discussion questions as someone who advocates for the learner-centered paradigm.

As for the first question, techno-savviness in IS discipline refers to one's IT proficiency in addressing business problems and issues. Proficiency or techno-savviness often indicates one's practical IT knowledge and skills should be, at least, above average. While general business knowledge for bachelor's degree programs and higher include techno-savviness, the below AACSB (2018) section well demonstrates its scope for IS students:

> *Evidence-based decision making integrates current and emerging business statistical techniques, data management, data analytics, and Information technology in the curriculum…*

> *Student experiences integrate real-world business strategies, privacy and security concerns, ethical issues, data management, data analytics, technology-driven changes in the work environment, and the complexities of decision making.*

In IS education and learning, we need to distinguish instructors' techno-savviness from students' techno-savviness due to their different goals. Instructors' techno-savviness may relate more to their professional roles: theoretically and practically mastering how to use information technologies in business and managerial scenarios. Undoubtedly, instructors need techno-savviness to sustain their power and credibility in traditional instructor-centered classrooms. However, the learner-centered paradigm seems to urge instructors to acquire a nascent type of techno-savviness—creating an environment that facilitates student becoming techno-savvy. From a traditional perspective, techno-savviness for students may involve using various business software and applications in class. In the lens of the learning paradigm, students or learners should develop their techno-savviness beyond the classroom. In other words, students should bring new technological concepts and applications to the class and share with other learners. The instructor-centered paradigm stresses the importance of instructors' "self" techno-savviness and, hence, in maintaining a hierarchical control over the classroom. The classroom appears to be competitive and individualistic and as leading to a win-lose dilemma (Barr & Tagg 1995). Clearly, the above scenarios reveal this paradigm's drawback: the Internet could be more techno-savvy than instructors and, thus, "steal" their power and reputation in the classroom.

In contrast, the learner-centered paradigm implies learners' "social" techno-savviness, which aims to flourish the collective learning community. In a cooperative, collaborative, and supportive learning community (Barr & Tagg 1995), all community members can contribute. For example, students, along with their faculty, can innovate course content while adding novel technical concepts and skills that they learned from the Internet or elsewhere. While your "enemies" work for you, they are your "friends" (Lincoln's speech). To sum up, social techno-savviness constitutes meaningful techno-savviness; individual techno-savviness does not.

As for second question, I answer yes: faculty should be more techno-savvy than their students in terms of developing an avid learning environment to produce techno-savviness. Again, I base my argument on the comparison between instructor-centered and learner-based paradigms. The instructor-centered class assumes that instructors should maintain an absolute advantage in being techno-savvy than their students. This assumption, however, is unrealistic due to the ease with which students can obtain knowledge and information via the Internet nowadays. Thus, the Internet has reduced the gap between instructors' and students' techno-savviness radically. In learner-centered environments, faculty will confront less pressure because they just need a relative advantage in being techno-savvy than students. Faculty do not represent an actor—a techno-savvy sage on a stage—but an inter-actor interacting with a community of techno-savvy learners (see Barr & Tagg ,1995; King, 1993). In other words, the instructor should focus primarily on learning and applying the best methods for learning IT in the class.

As for the ideal balance between instructors' and students' techno-savviness, it depends on the course or the learning community per se. As an example, many IS colleagues have devoted time and effort in taking new courses and training seminars in face-to-face or online fashion. That is, they should continuously update their knowledge bank in order to maintain a relative techno-savviness advantage in the class. Also, instructors should learn about techniques concerning how to develop an active learning community and how to generate more techno-savviness in it.

In conclusion, I would suggest that IS educators should rethink and redefine their role in educating the next generation of IS professionals while facing many challenges from inside and outside the classroom. Creating a learning community with students could span the boundary of the instructor's own technical knowledge and skills (space), whereas we can extend our horizon beyond obsolete textbooks and materials by gaining new information and knowledge from the Internet (time).

Thomas Stafford: Ruminations on Elephants and Classroom KM

The "elephant in the classroom" topic at our conference seminar tends to imply that some faculty lack contemporary technology knowledge compared to the students that they teach and that it might cause problems. On its face, this proposition seems sensible: programming teachers who have poorer coding skills than their students will likely face a credibility problem that will lead to low morale, high absenteeism in class, and poor teaching evaluations.

IS department chairs have always faced challenges in staffing their technological courses with capable technology instructors. When I was a marketing professor, we chose advanced statistical methods as our "technology", and the technologists allied with that knowledge area where what we called "quant jocks". In the IS discipline, we just tend to call our gifted programming and database teachers "techies" and leave it at that. Us non-techies seldom seek to or are asked to teach "techie" classes; I think it is a matter of general conventional wisdom that IS professors specialize in areas they feel well-skilled in and, subsequently, (in most cases) teach the topics that they have qualifications in.

That said, one technology area in the classroom that most any colleague could do with some additional training and introspection: let's call it "the new media" as marketers did early on the Internet day. I use this term to connote the rapid intersection and synthesis of online education, rich media course enhancements, and social media. I think we can take it as gospel that the average millennial student will run circles around the average Generation X or Baby Boom professor when it comes to social media. It simply amounts to something that not everyone cares to participate in. I do not, for example. However, I do not really feel that my general disinterest in Twitter and Facebook/Instagram gives me any less credibility with my students. They know, as do I, that social media have a largely casual and non-educational nature; they also know that I am a "security guy" and have tremendous privacy and security issues with online social media.

I consider the few efforts I have seen to meld social media presence with online course production to be problematic. I say that because, while some colleagues will excel at twittering their online course presence, others will see it as either a hindrance, an inappropriate level of familiarity, or an unnecessary pedagogical tool. I find things such as Facebook and Twitter largely aspects of one's private life—as one's non-student or non-professor public persona; I do not see it as contributing to a formal academic class's professional image or demeanor. They do not lend as much to enhancing online education as they potentially do to distracting from it, I tend to feel. I also cannot escape the concern that interacting with my students on social media bridges an important culturally established relation barrier between student and professor that prohibitions against "fraternization" best characterize. In my view, you tweet with your peeps; you don not with your professor.

That said, I freely admit to being a Baby Boomer who has little interest in social media for casual social-life purposes and do not sufficiently recognize its ability to add an important aspect of pedagogical discourse to teaching online classes. I find that a Twitter feed could give me nothing that email and a blog/chat room functionality on my courseware page (we use Moodle) would provide but better and less problematically. Readers who would argue that I am expressing Luddite notions and not being progressive about leveraging the new media to its fullest extent need only consider my primary concern about integrating social media with online course delivery: the Family Educational Rights and Privacy Act of 1974 (FERPA). Social media are in no way secure or private; they readily retail out their content to the highest bidder, which may be potentially problematic for preserving student confidentiality.

I do not know how it is in other places, but Louisiana in the United States has legal protections in place for student information, and we all know how "leaky" and invasive social media are when it comes to permissive third party access to the content that users post and their profile data. Some aspects in the student encounter should not even be on email let alone in vastly unsecure social media that promulgate our world.

Furthermore, considering that I have delivered online education for 25 years now, I have used every available modality for delivering online courses—from live one-way TV/two-way audio, live two-way TV, H-323 teleconferencing and live IP-based video conference over the leased line, static Web\pages, and three different flavors of courseware solutions. I also conduct and publish research about the efficacy of online education. So, the view which I express below constitutes my primary deliverable to this panel and comes from a point of strong credibility.

The elephant in the room with technology equivalencies in today's IT classroom has to do with online education. Students today, our Millennials, focus on multimedia. They do not always know as much about things like the Internet and social media as they profess to do, but that is not the point. The point is that they have high expectations for rich course content delivery in online contexts. They do not find static PowerPoint slides or canned videotaped copies of live lectures impressive. Instructors need to skill up on and deliver a "flip format" perspective, which means rich media enhanced lecture recordings posted online alongside live access either in lab sections or office encounters or even small group encounters that permit these new learners to merge the online content they access with in-person question-and-answer

(Q&A) and feedback. I typically use a utility called Camtasia to record narrated versions of my live class PowerPoint slides, and, after producing the voice-over narration, I go back and enhance the presentation (which stores and presents as an MP4 movie) with graphic emphasis points (e.g., pop-ups, key issue balloons, highlighted key content passages, etc.). I essentially add a third information channel to a voice-over narrated PowerPoint lecture that emphasizes and reinforces key points just as live Q&A and feedback would permit me to do in a live lecture.

I find this approach works well for my students and that they come to expect it in my online courses. However, it takes a lot of time: a standard lecture presentation might take an hour or two to produce; another hour at least to narrate it in Camtasia; and over an hour more to annotate, highlight, and graphically emphasize the important aspects of the lecture for extra consideration. Add another hour or so post-production to edit out the coughs and throat-clearings (that you swear you never knew you did so often until you hear yourself on a recording) and you have what amounts to about five hours preparation time for a one-hour online rich media lecture delivery.

If you would like to see how one looks like, drop me a line to stafford@latech.edu, and, if your email account permits large attachments (typically in excess of 25mb), I can send you a copy of a lecture to see what I do.

I will close with a thematic phrase I used to close editorials with back when I edited an association newsletter in my early days: “Life is good, research is fun, and teaching is our gift to the future!”. Enjoy your work in the classroom; students will pick up on your enthusiasm and enjoy it right along with you if done right.

Mary Sumner: Credibility in the Room

Panel questions and my answers.

How would you Define Techno-savvy?

- Ability to learn systems—enterprise platforms, navigation, applications, reporting, documentation, training, testing.
- Ability to support the IT infrastructure—configuration, troubleshooting, technical support, documentation, testing.

Should IS Professors be more Tech-savvy than Students?

The best teacher enables students to learn. Once I taught a finance class. Even though I am not a finance expert, I did know how to teach.

What Skills and Knowledge do we Really Try to Develop in our Students?

- Critical thinking skills
- Problem-solving skills
- Ability to learn how to learn
- Decision-making skills.

What Teaching-learning Methods Most Effectively Build These Skills?

- Hands-on learning that provides opportunities for problem-solving, feedback, and learning.
- AHIMA VLAB, SAP Academic Alliance, Business Analytics.
- In the Master’s in Clinical Informatics, the learning goal is: sign-on to seven different clinical information and electronic medical records systems, learn navigation, learn the applications (EMR, Tableau, and document management systems), and so on.
- In the SAP curriculum, the hand-on experience is the learning platform for understanding the processes that the SAP system is designed to support. The learning goal is business process integration (order to cash, procure to pay), but the tools are an integral part of the learning curve.

- So, from a teaching-learning vantage point, the instructor facilitates learning in these hands-on environments and manages the learning process.

How do you Get the Ideal Balance between Professors and Students' Techno-savviness?

- Defining performance objectives.
- Determining how successful achievement of these performance objectives will be measured.
- Creating teaching-learning opportunities which will engage the students and give them an opportunity to achieve these performance goals.
- Being able to assess learning outcomes.

Consider an example from the SAP techno-skill environment:

- Goal: to understand the order-to-cash process in SAP.
- Measure: successfully fulfilling the process as measured by the document flow.
- Teaching-learning method: hands-on exercises, demonstration, and success in completing the process steps.
- What actually happens in the classroom: instructor helping diagnose and troubleshoot errors?

Skills and knowledge needed (as an instructor): system knowledge, hands-on technical skill, management of the learning process, communications, classroom management, coaching, facilitating, mentoring, and evaluation of learning outcomes. Liken this to a role as a project manager.

How would you Define and Describe Techno-inquiry in the IS Discipline? Can we Use Techno-inquiry rather than Techno-savvy to Sustain the Instruction-learning Relationship in Class?

Here, I summarize the definitions of techno-savviness and relevant techno-savviness from several studies.

Study 1: Carter, Grover, and Thatcher (2011)

This paper asked similar questions: should IT leaders have IT skills? What technical credibility should IT leaders have? Findings indicate that CIO's/IT leaders with stronger tech backgrounds are likely to participate in internal leader roles and to develop a network of contacts. Further, CIO's with higher technical credibility are also more likely to be directly involved as resource allocators and change management (decision-making) roles. CIO's with technical credibility are stronger internal IT leaders.

Specifically, an IT strategist's arsenal of skills includes:

- Define the strategic role of IT.
- Identify changes in technology and competition which affect the business.
- Educate the organization on the strategic role of IT.
- Convert business opportunities into profitable IT investments.
- May focus on traditional tasks of overseeing IT projects at the expense of developing business relationships.

It is worthwhile to point out that a technology focus may limit a CIO's capability to act strategically, and it often receives criticism for using technical language to discuss business problems.

Study 2: Niederman and Sumner (2004)

This paper looks at these issues from the perspective of what skills/knowledge/competencies are needed by our students and defined by the job descriptions and the IT job analysis. Common denominators for all jobs in IT include problem-solving skills, communications skills, and analytical skills. IT jobs (in infrastructure, security, help desk, database, and networking) require these skills and other specific technical expertise skills. IT professionals need to master both aforementioned technical expertise and

soft skills. So, techno-savviness may need to consider a range of disparate skills, some of which are not technology specific.

Study 3: Lea, Mirchandani, and Sumner (n.d.)

This unpublished study focuses mainly on techno-savviness related to ERP use and on understanding predictors of ERP learning performance (learning a complex enterprise system). It examines how individual factors (personality types (5-factor personality inventory), prior computer experience, learning motivation, and critical thinking skills influence learning performance. There may be parallels to how students gain techno-savviness.

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