Communications of the Association for Information Systems

Volume 51 Article 2

10-25-2022

Student, Interrupted: Can Digital Badging Improve Programmatic Agility and Help IS Students During Crises?

Terry M. McGovern
University of Wisconsin-Parkside, USA

Janis L. Gogan
Bentley University, USA

Recommended Citation
McGovern, T. M., & Gogan, J. L. (2022). Student, Interrupted: Can Digital Badging Improve Programmatic Agility and Help IS Students During Crises?. Communications of the Association for Information Systems, 51, pp-pp. https://doi.org/10.17705/1CAIS.05119

Communications of the Association for Information Systems

Education Article DOI: 10.17705/1CAIS.05119 ISSN: 1529-3181

Student, Interrupted: Can Digital Badging Improve Programmatic Agility and Help IS Students During Crises?

Terry M. McGovern
University of Wisconsin-Parkside, USA

Janis L. Gogan
Bentley University, USA

Abstract:

We propose that a stackable badged micro-credential system could increase academic programmatic agility, in turn helping university students cope with personal crises (illness, accidents, family emergencies), and societal-level crises (pandemics, natural disasters, geopolitical events). We demonstrate how our proposed system would certify students' mastery of several modules comprising a required graduate-level Strategic IS Management course. This proposed system will provide helpful structure (through a modular design and reliance on well-accepted faculty governance, including the traditional college registrar role), and temporal flexibility (enabling students to receive credit for course modules taken in different terms/semesters, and taught by the same or different instructors) and portability (given that micro-credentials provide valid evidence of specific skills or knowledge a student has acquired, regardless of learning modality or instructor). This stackable badged micro-credential system would help students during crises, by making it easy for them to temporarily drop out of a course when circumstances impede effective learning and making it easy for them to resume studies when they are ready and able to do so. We discuss technical challenges that university administrators may face in implementing micro-credentialing in IS classes, offer suggestions for pilot-testing the proposed system, and suggest possible future extensions of this idea.

Keywords: Digital Badge, Open Badge, Micro-credential, Flexible Learning, Pathways.

This manuscript underwent peer review. It was received 12/03/2021 and was with the authors for five months for two revisions. Mary Granger served as Associate Editor.

1 Crises Necessitate Agile IS Classes and Programs

1.1 Crises Add Pressure to a Profession Subject to Continual Change

A stackable badged micro-credential system can improve programmatic agility, by making it easier for IS faculty and program directors to help students temporarily drop a course when circumstances impede effective learning, and to resume their studies when ready and able to do so. In this paper we focus primarily on multi-section required IS courses. In many IS programs, these courses already have common learning objectives across sections, as well as similar assigned content and learning assessments.

The ACM and AIS recognize that IS knowledge and skills evolve rapidly (Topi et al., 2010; Topi et al., 2017), necessitating adjustments in IS research (Swanson, 2017) and IS teaching (Gefen et al., 2012; Topi et al., 2014). As software, hardware, data technologies and systems change, IS faculty continually introduce updated content into our courses. For example, rapidly proliferating mobile devices and applications, social media use, and cloud computing necessitated new business intelligence/analytics content and learning activities (Sidorova, 2013; Mitri & Palocsay, 2015; Schiller et al., 2015). Digital innovation material is also being rapidly incorporated into IS curricula (Drechsler et al., 2020).

Rapid IT evolution also affects how IS faculty teach. Improved bandwidth, internet access, and acceptance of online course management systems led many universities to launch fully-online or partially-online "hybrid" courses and programs in the first two decades of this century (Al-Busaidi, 2012; Ferran et al., 2019; Freeman & Urbaczewski, 2019) -- and sparked faculty debates about how to best ensure that online courses support high-quality learning (Niederman et al., 2016). Numerous studies explored determinants of, and outcomes from, online learning (Guo et al., 2012; Yan Dang et al., 2019; Zhao et al., 2020) and mobile learning (Krotov, 2015; Osatuyi & Passerini, 2016).

In 2020, the coronavirus pandemic "changed the world abruptly and (possibly) irreversibly" (Van Slyke, 2021, p. 477). When COVID-19 started to spread rapidly in winter 2020, some universities' IS programs were able to quickly move faculty and students online (in hopes of limiting the spread of this highly contagious virus). Other programs did not pivot as quickly; their instructors needed to be trained in online course design, pedagogy, and the necessary technical skills needed for effective online teaching. Whether classes did or did not move online, and whether students remained on campus or not, COVID-related public health, economic and social disruption created tremendous stress for students, instructors, and administrators. In the 2021 CAIS Special Issue on COVID-19, Learning. Pedagogy, and Education Systems, one paper advised faculty to "build flexible course plans to weather COVID-19" and other crises (Connolly & Mutchler, 2021). The introduction to The Special Section: COVID-19, Learning, Pedagogy, and Educational Systems concluded that, to cope effectively during future crises, "Schools and universities, IS departments and IS faculty need to develop agility with respect to their programs and courses" (Van Slyke, et al., 2021, p. 477). We address this need for greater agility in traditional undergraduate and graduate-level IS programs, by proposing a solution that combines modular course designs and stackable badged micro-credentials.

1.2 Can Digital Badges Help Academic Programs be More Agile?

A digital badge is a "web-based token of learning and accomplishment" (Casilli & Hickey, 2016; Henthaler et al., 2016). An "open" digital badge is "a digital representation of skills or accomplishments recorded in a visual symbol that is embedded with verifiable data and evidence" (Liyanagunawardena et al., 2017). A badged micro-credential can represent informal (not-for-credit) or formal (for-credit) learning (Brown et al., 2021). The badge can recognize small accomplishments (e.g., participation in an event or quiz grade) or substantial accomplishments (e.g., mastery of one module of a three-module course, a final course grade, or earning a certificate based on satisfactory completion of multiple courses). Some universities deploy badged portfolios to chronicle students' not-for-credit participation in internships and other co-curricular activities (Carey & Stefaniak, 2018). Other universities confer badged micro-credentials for course grades (Ash, 2012).

Each digital badge contains metadata describing or containing evidence of the achievement it represents (per agreed-upon criteria) and pointing to a trusted party authorized to confer the badge (such as the instructor or an independent examiner). Stacking describes a structured way to assemble badged micro-credentials that "add up" to a more-valuable level of achievement. Vertical badge stacks represent a progression from basic skills or knowledge to more advanced skills and knowledge mastery in a particular

domain. Horizontal badge stacks signify a learner has successfully applied particular skills or knowledge to multiple contexts; these stacks imply no "ordinal ranking or prerequisites" (Williamson & Pittinsky, 2016). The description of each achievement and its supporting evidence is what enables a badge or stack of badges to function as a micro-credential.

Thus, portfolios of separate (unstacked) or stacked badged micro-credentials capture evidence of student learning over time and learning venue. The United Kingdom's Quality Assurance Agency for Higher Education (QAA, 2021) endorses micro-credentials for several types of learners and programs:

- Independent: each badge stands alone.
- Entry or Accreditation of prior learning (for admission, transfer of credit, or pre-requisite review).
- Embedded: non-credit badges issued by various entities may be embedded in a "practice-based capstone project or [other] real-world learning" experience required by a university.
- Embedded Stacking: for-credit badges that can stack with other badges (from multiple authorized sources) and with other higher education modules toward formal degrees.

As symbols of achievement, digital badge images reportedly engage and motivate primary and secondary education students (similar to physical achievement badges in the Boy Scouts and Girl Scouts). Studies in post-secondary education contexts reported varied findings on this topic (see literature review, below). Importantly, our proposal makes no claim about badges' effects on learners' engagement or motivation. Instead, we argue that digital badges can help "interrupted" students (those who need to temporarily stop participating in a course) to stop when needed and resume later – provided the badging system supports alternative learning paths for that course, with the same or different instructor and in one or more sections taught in one or more modes (e.g., face to face, fully online, hybrid).

In a multi-section IS course with a modular design, we propose that a badged micro-credentialing system can improve programmatic agility by providing structure, flexibility, and portability:

- Structure is provided via the modular course design, a reliance on well-accepted faculty governance and the well-accepted registrar role, and other affordances.
- Flexibility is provided by allowing a student to pay for and receive credit for course modules taken in different terms/semesters, led by the same instructor or different instructors who teach via a variety of synchronous or asynchronous online or offline modes.
- Portability is provided via a within-institution or across-institutions governance structure that accepts badged micro-credentials as valid evidence of specific skills or knowledge, acquired in various learning modes and under the tutelage of one or several instructors.

Just as structure and flexibility help organizations (including universities) respond to crises (see section 2, below), we contend that programmatic structure, flexibility, and portability (together forming programmatic agility) can make it easier for instructors and program directors to help students cope during personal or public crises. Some universities already utilize digital badging for final course grades and for purposes of transferring credits across institutions governed by articulation agreements (for example, some Northeastern University IS programs accept digital badges that verify students' mastery of IBM training modules). In this paper, we propose an initial design for a system for issuing and exchanging digital badges, within a single university-based for-credit IS program. We envision that such a system could be extended for other uses in the future.

When a crisis impedes effective learning, our proposed system will enable students to disengage from a course so they can focus on coping with the crisis circumstances. When ready and able to learn again, they can resume doing so. Badged course modules provide a more flexible course-completion schedule than is provided in traditional semester-long structures. Temporal flexibility and portability might be especially helpful for our most disadvantaged students (on whom personal and economic circumstances place especially heavy stress during crises). Our proposed system also supports learning mode flexibility, by enabling students to take some modules synchronously, some asynchronously, in traditional face-to-face or fully online or hybrid/blended modes (see Literature Review section below).

A 2018 essay saw digital badging as a "valuable personalized learning tool that facilitates goal setting and improves the quality, effectiveness, flexibility, and accessibility of learning" (Cheng et al., 2018, p. 193):

> *Instead of tracking time spent on structured courses, the modularity or… atomicity of skills and knowledge recorded [on digital badges] can represent very nuanced progress in learning. It makes it possible to switch interests and adjust learning pathways to fit one's individual goals that are always changing. For example, future [badging] design could consider a 'navigation panel' that connects different layers/tiers of knowledge or skills, providing opportunities for learners to jump down or up among different tiers of competencies and to try different teaching styles for the same skill or knowledge at the same tier.* (Cheng et al., 2018, p. 196)

Like Cheng et al. (2018), our proposal recognizes that modularity is a helpful enabler of flexible learning pathways. Unlike Cheng et al. (2018), we do not propose highly granular badges. Nor do we propose to revolutionize higher education. We do aim to improve programmatic agility in higher education.

1.3 Why Start with IS Programs?

IS faculty and IS program directors are well positioned to deploy badged micro-credential systems, since:

- Many IS instructors use online and digital technologies in their courses, already teach online or hybrid classes, and are reasonably likely to accept digital badges.
- Many IS programs conform to a standard IS curriculum for undergraduate (Topi et al., 2010; Gupta et al., 2015; Ramesh & Gerth, 2015) and graduate (Topi et al., 2014; Topi et al., 2017) programs. A system that provides portability across instructors and learning modes align nicely with a standardized curriculum, which provides a helpful structure to support this proposed innovation (for example, by specifying that multiple sections of a required course must deliver highly similar content and rely on agreed-upon learning objectives and assessments).
- Many IS faculty conduct action design studies of emerging IS. Some of these researchers may see value in developing and pilot-testing our proposed digital badging solution.

No prior paper has proposed how or why badging could improve university academic programs' crisis-response agility. Our proposal breaks that new ground. It is organized as follows:

- Section 2 briefly reviews how organizations prepare for likely crises (aiming to limit harm to employees, customers, and other stakeholders), and why effective crisis preparation anticipates a need for both structure and flexibility when responding to crises.
- Section 3 reviews prior empirical studies of digital badging impacts on students' attitudes, behavior, and learning outcomes.
- Section 4, reflecting on findings and gaps evident in prior research, describes how digitally-badged micro-credentials can support a modular-design Strategic IS Management course.
- Section 5 discusses practical implications and a suggested research agenda.

2 Agile Crisis Management

2.1 How Structure and Flexibility Contribute to Agile Crisis Responses

Both personal crises and public crises disrupt normal routines. When a student has an accident or becomes ill, it typically falls to one or several instructors to improvise helpful solutions to address the student's private crisis (such as by issuing an incomplete grade or authorizing an alternative independent learning project). Public crises – such as devastating earthquakes, floods, wildfires, terrorism, war, and pandemics – have highly disruptive short-term impacts and can also have long-lasting personal and societal consequences. The coronavirus pandemic and other rapidly-evolving recent crises (including as this draft is written, Russia's invasion of Ukraine), reveal that programmatic agility is much-needed in higher education. In this section we explain why academic programs need helpful structure (e.g., clear curriculum, modular course designs, well-defined crisis-response roles, and procedures) and helpful flexibility (e.g., alternative student learning pathways and authorization for instructors and administrators to improvise in some situations).

Contingency plans provide useful structure to guide organizations' responses to various crises, by specifying needed roles, responsibilities, and communication mechanisms (Quinn, 2008; Reynolds &

Quinn, 2008; Watkins & Bazerman, 2013). Crisis planners hold workshops, in which constituents from different functions and backgrounds identify foreseeable scenarios (e.g., in California, a university prepares contingency plans for earthquake and wildfire scenarios; a northern U.S. university prepares for blizzards). Planners then evaluate each scenario, in light of available information about similar past events and forecasts of future such events, to gauge the likelihood of occurrence and possible scope of impact of each scenario. Focusing first on high-likelihood/high-impact scenarios before considering lower-likelihood/high-impact scenarios, planners identify resources and processes needed to respond effectively during specific types of crises. Knowing they cannot anticipate every possible type of crisis, planners recommend that crisis responders be granted some flexibility to improvise on the fly (Spagnoletti & Reca, 2008). A revelatory case study (Njenga & Brown, 2012) explored this duality of structure and flexibility in the context of information security response, and a 2018 information security review observed:

> *Because incidents unfold in many ways and with varied impacts, it is not feasible to specify how to respond to every scenario. Some managers believe their teams should be allowed to improvise to some extent, so they can deal effectively with unpredictable situations.* (McLaughlin & Gogan, 2018, p. 251)

2.2 The Coronavirus Pandemic Revealed a Need for Agile IS Programs

Many people experienced the pandemic as an unexpected crisis (Avishal, 2020). Yet, for years state and U.S. public health authorities had known that a pandemic was likely (Gibbs & Soares, 2005; Sipress, 2009; Walsh, 2017), and they created and updated public health crisis contingency plans accordingly (see, e.g., Commonwealth of Massachusetts, 2020). Some universities updated their plans, too.

Although these contingency plans provided a helpful structure to guide responders, high uncertainty about the course of the disease, risks posed by COVID-19 variants, and several other factors (e.g., initially-unreliable diagnostic tests, supply chain shortages of personal protective equipment, subsequent unanticipated surges that constrained hospitals' capacity, and unexpectedly high resistance to vaccination and masking) led some university administrators and faculty to improvise on behalf of students who fell ill or suffered secondary effects of the pandemic disruption that compromised their ability to learn.

As the disease alternately waxed, waned, and waxed again, daily life was dramatically disrupted, and improvisation became increasingly burdensome. Some students needed to be isolated or quarantined, and students' and instructors' relatives got sick or lost jobs. Everyday routines (such as eating out) were disrupted, and many students and faculty became anxious as they juggled multiple roles at home. When schools shut down or shifted to online learning, and when helpful personal services (cleaning, babysitting, etc.) were curtailed, students, faculty, and administrators grew ever more anxious.

During the pandemic crisis, rapidly unfolding information and varied interpretations of its meaning put pressure on universities' contingency plans. Unsure how fast the disease would spread, some leaders kept most students on campus and offered a mix of f2f and hybrid classes. Unsure how soon the disease would be contained, other university leaders sent many students home. Some students lacked necessary tools and private space to study effectively at home, or to participate in online courses, and some had pre-existing conditions or worked in customer-facing service jobs that increased their risk of falling ill. Such burdens fall more heavily on low-income families, especially Blacks and other disadvantaged groups (Johnston, 2021; Krueger, 2021).

By spring 2020 many program directors realized their academic programs needed greater agility. Yet, in 2021, other devastating crises unfolded, even as the pandemic continued -- including fires in the West, flooding in the South, and other natural disasters that left many Americans homeless, hungry, or without electricity and/or water. Adding to the collective unease, the U.S. political system was disrupted by claims of a "stolen" election, calls for civil war, and other social turmoil. In this tumultuous multi-crisis context, faculty and students struggled to teach and learn, and program directors and deans struggled to take effective action -- further amplifying the need for programmatic agility.

In late Fall 2021, the situation stabilized at many universities. By then, many students and faculty were vaccinated, and many IS instructors were skilled at delivering a mix of f2f, online, and hybrid-format classes (one indicator of improved programmatic agility). Papers in the above-mentioned CAIS Special Issue described how IS courses and programs were redesigned for online delivery early in the coronavirus pandemic (Chen & Roldan, 2021; Dreschler, 2021; Gottipatti & Shankaranaraman, 2021; Mavengere, et al., 2021). Other papers offered advice for adapting f2f courses to online mode (Haslam et al., 2021; Li et al., 2021; Stahr & Davis, 2021; Toney et al., 2021; Toon et al., 2021; Zha & He, 2021) or more generally

for teaching during crises (Boor & Cornelisse, 2021; Dick, 2021; Raman et al., 2021). This evidence of an improved course-delivery capability is an encouraging indicator of early progress towards developing more resilient course offerings. We argue that badged micro-credentials for multi-section modular-designed courses can further improve programmatic agility, by making it possible for instructors and program directors to help students whose learning is interrupted by personal or public crises.

3 Prior Empirical Studies on Digital Badging in Higher Education

Digital badging has been tested in formal and informal educational contexts (Muilenburg & Berge, 2016). In primary and secondary education and in extra-curricular or informal contexts, proponents claim that as achievement symbols, badges increase students' engagement (Pedro et al., 2015). Yet, in for-credit post-secondary education, some studies suggest this symbolic representation has little or no influence on students' engagement or motivation. Some early reviews claimed that badging improves student retention (Gibson et al., 2015; Mah, 2016) -- yet a 2016 panel-of-experts study cautioned that empirical evidence of this effect was not yet definitive (Casilli & Hickey, 2016).

Several reviews addressed digital badging studies in specific post-secondary contexts, such as undergraduate courses on writing (Reid et al., 2015) and science (Hensiek et al., 2017), and undergraduate or graduate-level health care courses (Noyes et al., 2020). One review proposed that portfolios consisting of badges for both course work and extra-curricular activities help college students develop "holistic" identities (Kehoe & Goudzwaard, 2015). Empirical studies reported both positive and negative impacts of badging in higher education (early studies are summarized in Chou and He (2017, p. 1098)); see Table 1, below. Other reviews addressed digital badging in open learning contexts, such as non-credit MOOCs (Chauhan, 2014; Finkelstein et al., 2013; Law, 2015).

Table 1. Positive and Negative impacts of Digital Badges in Higher Education (Chou & He, 2017, p. 1098)

Positive impacts of Digital Badges	Negative impacts of Digital Badges
Stimulate desirable behaviors (e.g., ask/answer/questions)	More focus shifts on competition, less on performance
Students complete more assignments	Students get frustrated when they do not earn all badges
Reinforces content learning; engages low-achieving students	Distracts high-performing learners
Increases students' achievement motivation	Decreases intrinsic motivation

To gauge recent findings not covered in prior reviews, we reviewed a set of empirical digital badging studies published since 2015 (and a 2013 study that was not mentioned in Chou & He 2017). We focused on studies conducted in traditional for-credit undergraduate or graduate courses in degree- or certificate-granting programs (see also Wilson et al., 2016). Table 2 summarizes these 19 studies.

3.1 Empirical Studies of Digital Badging in Graduate Programs

Of five graduate-level badging studies listed in Table 2, two involved f2f classes and three involved online classes. A 2017 study reported that pharmacy students participating in a voluntary achievement badging program in a face-to-face course had positive attitudes about it (Fajiculay et al., 2017). A 2017 study focused on nursing students in a hybrid (offline + online) course (Rohan et al., 2017) reported similarly positive findings. However, in a f2f library management class, students who were awarded badges for earning grades in the A range were "underwhelmed … in terms of their motivation [and badges'] perceived usefulness" (Harmon & Copeland, 2016).

In an online web development course, peers' critiques of classmates' designs yielded instructor-issued digital badges (O'Connor & McQuigge, 2013). Students' evaluations of this class were comparable to students' evaluations in a course section that did not issue badges for peer critiques. Qualitative analysis of the peer evaluations indicated that peer critiques demonstrated critical thinking skills (since students expanded on the quality criteria that the instructor laid out). Two other graduate-level badging studies reported mixed or negative findings. In a study involving graduate-level teacher education courses (Chou & He, 2017), badges were awarded for student "participation" (student posts responding to instructor-assigned questions); other badges were awarded for student-to-student "interaction" (students' quality assessments of other students' posted answers). Those participation badges had no significant effect on students' subsequent participation. However, badges awarded for interaction significantly increased the frequency of students' subsequent peer quality comments.

Thus, in five graduate-level courses, digital badging studies yielded mixed findings. Next, we describe 14 empirical badging studies conducted in undergraduate programs.

Table 2. 20 Empirical Studies of Badging Effectiveness in Higher Education

5 GRADUATE-LEVEL	Findings	F2F	Online	For-Credit	Non-credit	Faculty award	Peer award	Dependent Variable: Attitudes	Dependent Variable: Behavior
f2f courses:									
Fajiculay et al., 2017	+	√		√		√		√	
Harmon & Copeland, 2016	negative	√		√	√	√		√	
online courses:									
O'Connor & McQuigge, 2013	+		√				√	√	
Chou & He, 2017	mixed	√	√	√		√	√		√
Rohan et al., 2017	+	√	√	√		√		√	
14 UNDERGRADUATE	Findings	F2F	Online	For-Credit	Non-credit	Faculty award	Peer award		
f2f courses:									
Towns et al., 2015	+	√		√		√		√	√
Yidirim et al., 2016	+	√		√		√		√	√
Pechenkina et al., 2017	+	√		√		√		√	√
Newby & Cheng, 2020	+	√		√		√			√
Reid et al., 2015	mixed	√		√		√		√	
Foli et al., 2016	mixed	√		√		√		√	
Coleman, 2018	mixed	√			√			√	
Garnett & Button, 2018	mixed	√		√		√		√	√
online courses:									
Hakulinen et al., 2015	mixed		√	√		√		√	√
Olsson et al., 2015	mixed		√	√				√	
Hatzipanagos & Code, 2016	mixed		√				√		
Fanfarelli & McDaniel, 2015	mixed		√	√					√
Fanfarelli & McDaniel, 2017	mixed		√	√				√	√
Kyewski & Kraner, 2018	negative		√	√		√		√	√

3.2 Empirical Studies of Digital Badging in Undergraduate Programs

Eight empirical studies in our review were conducted in undergraduate f2f courses. Of these, four badging studies reported positive findings. In a large f2f Purdue University science class, students earned badges by creating videos demonstrating "how to use a 10mL pipet to dispense liquid." 90% of students whose videos were judged correct also correctly answered a pipetting technique exam question (Towns et al., 2015). This intervention positively affected students' perceived knowledge, confidence about, and experience with the pipetting technique. The study did not separately measure the effects of the video assignment, instructor feedback, and the digital badge. In a f2f Ataturk University programming course,

badges acknowledged three levels of mastery (beginner, intermediate, advanced) in several course modules. Those badges reportedly improved students' motivation to learn, study habits, and final course grades (Yidirim et al., 2016). In another study, those students in gamified accounting and science courses who earned achievement badges in mobile app quizzes also earned higher course grades (Pechenkina et al., 2017). Lastly, students in an educational technologies course who earned badges also earned higher grades than those in the non-badging condition (Newby & Cheng, 2020).

Findings of other recent badging studies in f2f undergraduate classes were less definitive. In a writing composition course, students who expected academic success liked badges, but students who had low expectations did not like badges (Reid et al., 2010). In a study in which badges were awarded for extra-curricular activities, some students described these badges as "childish." The research team concluded: "Although extrinsic motivators were appreciated as a reward, and may be an important factor for student involvement, students need more meaningful and compelling reasons to participate in [a badging] program" (Coleman, 2018, p. 218-219). In another study, students indicated (on Likert-scaled survey questions) that digital badges were "meaningful" and "motivating." However, students' answers to open-ended questions "revealed a range of neutral to positive perceptions of digital badges … [suggesting these students had] polarized opinions of badges' effect on motivation toward learning" (Foli, et al., 2016, p. 642). In an entry-level science course in Australia, students varied in their attitudes toward badges awarded for completing before-class assessments on each day's topic. Early in the course, many students predicted badges would motivate them. However, their interest in obtaining badges declined over the 10-week experience (Garnett & Button, 2018).

In five online undergraduate courses, badging studies yielded mixed results. In an IS course, badges awarded for exceptional academic achievements (e.g., solving a problem with no mistakes, submitting a correct answer several days early) had a small impact on student behavior and attitudes (Hakulinen et al., 2015). Over time during that study, students' initial enthusiasm shifted to boredom. A Swedish university study reported that badges in gamified online courses generated mixed results, whereas progress bars (which depict student's learning progression) had a stronger positive effect (Olsson et al., 2015). Hatzipanagos & Code (2016) reported that badges contributed to students' engagement, but not to their motivation to learn; badges in an open-access online course on computer-mediated communication did not impact students' intrinsic motivation, engagement, or final grades. Students in that study strongly preferred private badges rather than publicly-visible badges (Kyewski & Kramer, 2018).

To explore why some university students like badges and others do not, Fanfarelli & McDaniel (2015) reported that students who exhibited "reactive" behavior traits (Dziuban & Dziuban, 1997) were somewhat more receptive to badging in online learning contexts than other students. Another badging study reported gender differences in engagement and grades (Fanfarelli & McDaniel, 2017).

3.3 Implications from Prior Empirical Studies

Empirical digital badging studies indicate that while some university students value badges for the feedback or rewards they convey, some students are unaffected by badges' symbolic representations of achievement. Future studies are needed to shed a brighter light on whether, how, and to what extent badges motivate post-secondary students to improve study habits, work harder, and so on. Importantly, our proposed badged micro-credentialing system does not rely on theories of engagement or motivation. Instead, consistent with Cheng et al., (2018), we focus on how our proposed system, by providing useful structure, flexibility, and portability for students, can improve programmatic agility.

A 2018 panel-of-experts study concluded that many faculty and administrators are skeptical about the accomplishments badges purportedly represent (Carey & Stefaniak, 2018). This controversy led us to focus on whether and how badging can be helpful in traditional higher education contexts that already rely on faculty members to assess student learning, and that count on existing governance mechanisms to ensure that course content is appropriate and that faculty help students learn. Thus, our proposal focuses on how to use digital badging in coordinated multi-section required courses (a context in which faculty governance and procedures for assuring course quality are presumably strong).

In Section 4 we describe how our proposed badged micro-credentialing system would support interrupted students in a required multi-section Strategic IS Management course for which several optional learning pathways are available. The system offers helpful structure (e.g., clear roles and constraints), helpful temporal and institutional flexibility, and helpful in-program portability (in the future, an extended system might support portability across institutions).

4 Badging Scenarios in IS Curricula

We propose that a digitally-badged micro-credential portfolio system can help students during disruptive crises of many types. When a student's involvement in a term-length course is interrupted due to a crisis, how can digital badging provide help? We illustrate our ideas in the context of a multi-section graduate Strategic IS Management course. Because many MBA and MS-IT program directors recognize IS "has an increasingly strong foundational role in understanding, explaining, and continuously improving how most organized human activities work and can be improved" (Topi, 2019, p. 3), Strategic IS Management is required in many MS-IT programs. The course is also required in many MBA programs. At Bentley University, a three-module Strategic IS Management course is offered in both a 14-week format and 6-week format. This multi-section course is delivered in traditional f2f, synchronous online, and asynchronous online sections and in hybrid sections (some students attend in the classroom, others participate synchronously via Zoom). All sections include some blended learning (a few synchronous opportunities in asynchronous-mode sections; a few asynchronous opportunities in synchronous-mode sections). All Strategic IS Management students purchase a packet of cases and readings from HBS Publishing. Our learning management system (LMS) provides access to other content, including instructor-prepared videos (most are 10-20 minutes in length, and mapped to PowerPoint slide decks). Students are expected to view videos on their own time; class sessions are primarily devoted to extensive discussions of assigned cases. Technology tutorials and news clips are also posted on the LMS, and students also use the LMS to submit written work and participate in some threaded discussions.

We envision a stackable micro-credential system that (based on instructor-provided grades) certifies students' mastery of each course module and a final exam or final project. This is described next.

4.1 Example: A Multi-Section Strategic IS Management Course

The learning objectives for the Strategic IS Management course at Bentley are:

1. Understand how IT (hardware, software, databases, and networks) support business operations.
2. Identify ways to protect systems and information quality and reliability.
3. Identify risks in IS projects or portfolios of projects and offer advice to mitigate them.
4. Describe the evolving roles of the CIO, CTO, CDO and CISO.
5. Assess whether an organization's IT capabilities align with its business capabilities.
6. Describe IT trends and consider how to capitalize on next-generation digital capabilities.

This course is designed in three main modules. In the 14-week synchronous f2f, synchronous online, and hybrid sections, classes meet once a week for about 2½ hours. In Week 1, the Instructor lays out course requirements and discusses a short case with students. In each of Weeks 2-13 students read, analyze, and discuss a full-length "Harvard-style" strategic IT management case (4 cases in each 4-week module). In Week 14 the final exam requires students to analyze a similar full-length case. The course modules are:

- Module 1, Ensure System and Information Quality and Reliability: Cases introduce foundational technical and strategy concepts, in contexts in which systems fail or are attacked (disrupting important business processes) and contexts in which organizations seek competitive advantage through IS (whether from data analytics or by introducing new IT-enabled processes or services).
- Module 2, IT Project Risk Assessment and Mitigation: Cases focus on IT projects characterized by varied levels and types of risk.
- Module 3, Align IT and Business Priorities: Cases explore IT governance and strategic alignment issues in big old companies, young startups, and mid-sized organizations.

A 6-week writing-intensive asynchronous online section also conforms to the 3-module design and assigns similar cases and readings. In this section, participation is not graded; instead, grades are based on students' best 8 of 12 written case analyses (10 points each), plus a case-based final exam (20 points).

Since the learning objectives align across all four delivery modes, four badges could be issued in each section: one for modules 1, 2 and 3, plus a final exam badge (Figure 1). In this particular *Strategic IS Management* course, both modules 2 and 3 rely on the foundation provided in module 1, yet either module 2 or module 3 can be scheduled as the second or third module in the sequence (it is customary to switch

these, based on unique aspects of the college calendar in each semester, such as Thanksgiving break in November). In our proposed system, instructors would award module and final exam badges directly to students. The college registrar would continue to oversee the authoritative repository for instructor-submitted final grades. Involvement of the registrar preserves traditional governance and control elements, consistent with our modest aims (as contrasted with Cheng et al.,'s (2018) more radical vision).

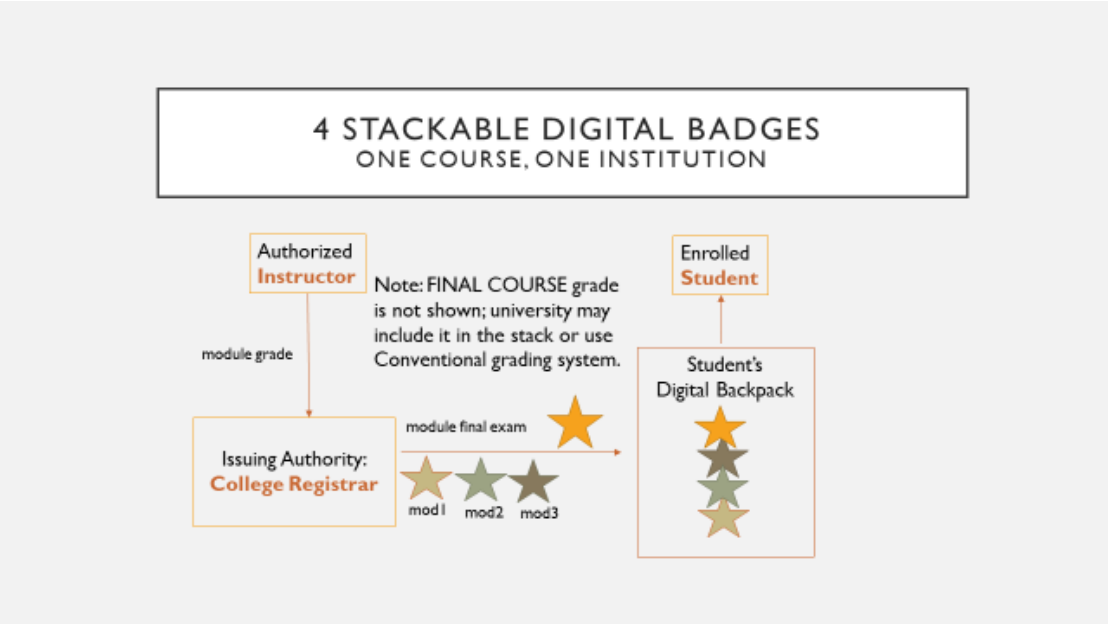

Figure 1. Four Stackable Badges for a Required Strategic IT Management Course

At some point in the future, final course grades recorded by the registrar could also be stored as badges in portable student portfolios (making it possible for participating employers or other educational institutions to verify that a student completed a particular major or minor, for example, or to spot those courses in which a student earned better grades or less-impressive grades).

We next consider how this modular badge course design would support a few crisis scenarios.

4.2 How Badged Micro-Credentials Support Students Affected by Crises

Scenario 1: An illness, accident or other crisis disables a student who has completed all three modules but has not yet taken the final exam. Once this student recovers, the instructor can arrange an alternative final exam on an improvised basis (traditional approach), or else direct the student to take the final exam with another section of this course, when it is scheduled (badge-supported instructor-independent solution).

Scenario 2: A pandemic, natural disaster or other public crisis triggers an administrative decision to shift all f2f and hybrid classes to fully-online mode. Many Strategic IS Management students who are already enrolled in a fully-online synchronous section or asynchronous writing-intensive section would continue as usual (except that those students whose ability to continue is compromised can choose to pause their participation). A requirement to move fully online also may have little or no impact on those students in a hybrid course section who normally participate online. However, many students in a f2f course section, and some hybrid section students (those who normally participate in the physical classroom), may not be able to shift immediately to online synchronous or asynchronous mode. For whatever reason, a student who cannot easily shift online can choose to pause until the crisis passes (or until the program, instructor, or student can help clear away the obstacles that impede these students' readiness to learn).

Scenario 3: A student in a f2f or hybrid section misses most of Module B. Since in this course, the learning objectives and content for Modules B and C are not interdependent, the instructor can let students participate in Module C (if they are ready to do so when it starts). Before sitting for the final exam, this interrupted student needs to take Module B (by temporarily joining another section of this course, in the 6-week asynchronous section, a f2f section, another hybrid section, or a fully-online synchronous section). Some universities might require this student to receive credit (and a grade) just for Module A and wait to join a new section when its second module starts. Some universities might permit this student to drop

Module A (and get most of their tuition back) and subsequently pay for all three modules of a new section (the existing Drop/Add policy usually covers this possibility).

In each crisis scenario, badging can help some students, but is not necessary for all students. For the required Strategic IS Management course, our proposed system complements the existing helpful structure (modular course design, similar content across sections and modes), with essential data provided by the instructor for the module and final exam badges. It provides temporal flexibility for all interrupted students, and learning-mode flexibility for those f2f or hybrid students who want to move fully-online (synchronously or asynchronously) so they can complete their work that semester.

The instructor also benefits from the system's structure, flexibility, and portability. In some student interruption scenarios, the instructor can improvise as they do today (e.g., require a student to drop the course and re-register in a subsequent term, or give a student an Incomplete grade and personalized plan to complete the necessary work). However, by adding structure, flexibility and within-institution portability in several typical scenarios, a badged micro-credentialing system can reduce the improvisation burden currently weighing on instructors' shoulders.

4.3 What about Elective IS Courses?

The above required Strategic IS Management course is based on a 3-module design. An elective 6-module Strategic IS Management course (in an MBA or MS-IT program that does not require this course) might be designed just like the required course, or it might be designed quite differently. Some elective courses offer students greater freedom to explore appropriate topics that interest them. For example, based on 12 middle weeks of a 14-week semester, this elective course could be designed with six 2-week modules:

- Modules A, B, and C might offer less-extensive coverage of Strategic IS Management topics. These module grades may be based on some combination of participation, essays, and quizzes.
- In module D, students learn about and report on IS issues in a business function of their choosing (e.g., marketing, finance, operations).
- In Module E, students learn and report on IS management issues in an industry of their choosing (e.g., banking, consulting, healthcare, hospitality, retail).
- In Module F students learn about ethical topics in strategic IS management (e.g., privacy, intellectual property, unanticipated consequences of weak algorithmic explainability).

In this elective course, half of the time and content (in modules D, E, and F) is personalized to students' professional interests.

Other IS courses (based on 12 middle weeks of a 14-week semester), can also subdivide work into modular designs. A course that covers many instances of a broad topic – such as Digital Innovation – can work very well in a 4-module, 5-badges form, designed (and updated annually) around a technologies-of-interest list (such as lists produced by the Society for Information Management, IT research firms Forrester or Gartner, industry associations like the AICPA, or consultancies like McKinsey):

- A 3-week Foundations module introduces ten technologies of interest and pertinent topics, such as diffusion of innovations or disruptive technologies, culminating in a Module A test (Badge A).
- In three 3-week modules, some students present reports on a topic, and other students critique the reports. Students' grades for Reporting, Critiquing, and/or module quizzes would be reflected in the Module B, C, and D badges.
- A final examination, project, or paper assesses students' understanding of key business digital innovation topics and their application in particular contexts.

Figure 2 depicts this 5-badge scenario.

A student who misses two weeks' work would make it up by repeating one module (if the calendar cooperates) or possibly two modules (if the two missed weeks span two modules), or by asynchronously completing some or all of the work, under faculty supervision.

Other 3-, 4-, 5- or 6-module badged courses can be personalized to students' varied interests.

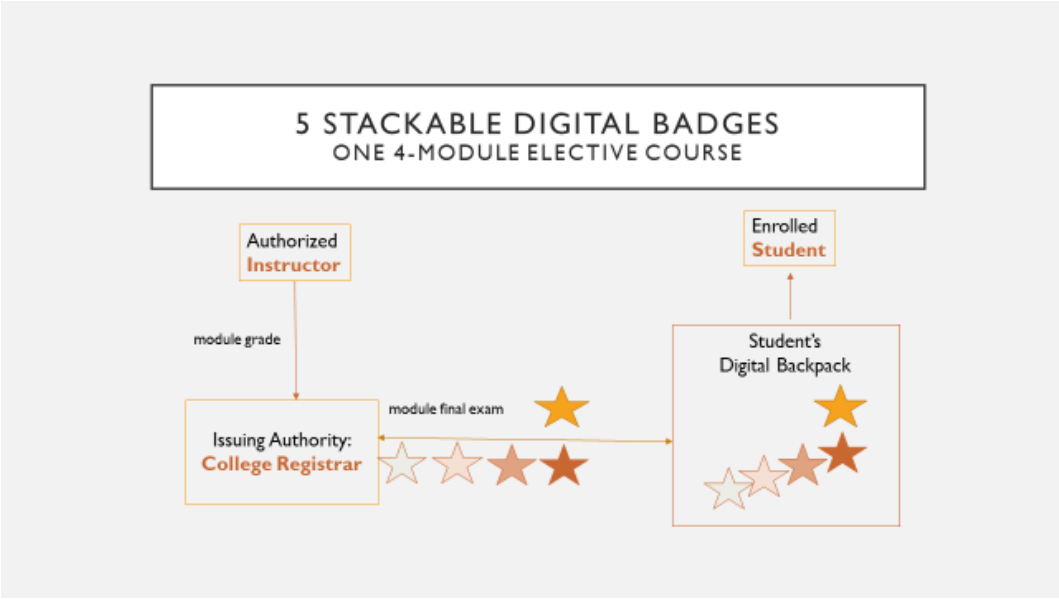

Figure 2. Five Stackable Badges for an Elective Digital Innovation Course

5 Implications, Limitations, Future Research, and Conclusions

5.1 Implications: The Administrative Point of View on Badged Micro-Credentials

Our proposal envisions that an interrupted student (who is sidelined due to illness, calamity, or other crisis) can resume coursework at a later time, possibly with a different instructor and possibly at a different institution. Universities already deal with such special circumstances; a "student interrupted" scenario is not unusual. The cost of these ad hoc arrangements is currently not measured; this lack of data on costs that instructors, program directors, and college registrars incur when they improvise solutions on behalf of interrupted students is problematic. Since badging solutions can be automated, it seems reasonable to assume that a registrar's cost to administer stackable course module badges should be low (once the system is developed, integrated with existing course registration and grading systems, and in routine use). Thus far, the development cost of this as-yet uncoded badging system is not known. This is a limitation of this paper. Another limitation is that thus far, we have merely scratched the surface in considering badging across academic programs. So far, we contend that our proposed badged micro-credential system can support interrupted students in synchronous or asynchronous fully online or hybrid courses. We believe the system can support residential academic programs that are committed to heavy reliance on f2f pedagogy (settings such as Harvard Business School and many small private place-based colleges, where most students reside on campus). We thus contend that modular-design courses and badged micro-credentials can improve programmatic agility, even in settings where program administrators do not want to over-commit (in their view) to online learning.

The pandemic placed a great deal of stress on students (Barber, 2021; Hvalshagen et al., 2021) and on faculty (AbuJarour et al., 2021). At large and small academic programs alike, instructors and program directors aim to support all students, and especially those whose circumstances place added stress on them during already-stressful crises. Students from disadvantaged backgrounds face many obstacles that can impede their ability to learn at all, learn at home, or learn online. They might not own appropriate equipment. Some live in settings that limit their ability to participate in case discussions or online teamwork (e.g., a student who shares a bedroom or computer with other members of their household). If a family member becomes disabled or is laid off, these students are more likely to take on a new job, possibly on top of an existing job (many IS students and business students do hold part-time jobs). This, too, can impede their ability to participate in a course (whether due to the buildup of personal stress one would experience in such a situation, or due to logistical challenges of getting to/from work, combined with the above equipment and space issues). A digitally-badged micro-credentialing system might offer these students both optimal structure and optimal flexibility. Temporal flexibility may be especially helpful to

students who (for emotional, financial and/or logistical reasons) need more time to get back on their feet and ready to learn.

Some students live with medical conditions that amplify crisis-related stress (e.g., attention deficit disorder, autism, blindness, cancer, deafness, dyslexia, paralysis). Online learning might amplify the stress some of these students experience. Badged online learning might be fine one course at a time, but too stressful at full load (even students with no medical conditions reportedly suffered "Zoom fatigue" during the pandemic; see Scott et al. (2021)). We hope badge-enabled flexible options will help many students make choices that suit their individual needs and circumstances. For example, f2f and hybrid courses will likely remain important options for these students.

Some international students come from limited means (during crises, these students' needs for suitable study space and other accommodations may be similar to needs identified among our domestic disadvantaged students). Other international students who study in the U.S. come from affluent families. At times during the pandemic, neither category of international student could return home. Thus, stress likely temporarily impeded many international students' ability to learn – but in diverse ways and at different levels of intensity. An ability to interrupt study during a crisis and resume work later without big financial penalties will likely be much appreciated by many students.

At any time, a student or instructor may have an accident, fall sick, give birth, or otherwise need to step away from a course before the end of the term. Our proposed digital badging system can also help these students. Likewise, a similar badging system could provide helpful support to instructors (by making it easier for a department chair or program director to identify a substitute instructor to fill in for the duration of a course or module, and to arrange compensation for the substitute). An exchange-of-coverage system could track the instructors whose work is interrupted, and the substitute instructors who step in to help. The system's database would indicate which instructors "owe" future coverage, and perhaps provide a way for instructors to "bank" coverage for future crises (or predictable events such as giving birth), by substituting for incapacitated instructors. This extension of our proposed badging system would thus support instructors similarly to how our proposed system would support students (both types of badging system would support programmatic agility by providing helpful structure and flexibility).

Lastly, we note that students and instructors can derive benefits from modularity, even if administrators do not invest in digital badging. Indeed, a recent paper contends that "rhythmic" modular designs provide helpful structure, especially in case-method courses that rely on students' active engagement, in the context of loosely-structured constructivist learning (Daniel & Gogan, 2021).

5.2 Study Limitations

Inter-university solutions that cross national boundaries will bring further challenges. Around the world, countless families, businesses, and cultural and social institutions experienced pandemic-related disruption, and many countries experienced devastating natural and human-made disasters that brought severe social and economic turmoil. A limitation of this paper is its U.S.-centric focus (both authors teach in U.S. universities). We have not (yet) considered whether and how cultural and institutional differences in other regions would give rise to unique badging system design challenges. Also, by focusing on traditional IS programs, we have not yet considered whether and how older students or other non-traditional students might view badged micro-credentials.

Our digital badging solution would be but one tool in an academic program director's kit. Strong contingency plans are critically important during crises. During the coronavirus pandemic, many administrators provided extra financial aid and loaner equipment to their neediest students (Prinsloo & Singh, 2021). Some provided safe on-campus residential or study spaces for students who could not move home (or who preferred not to). Universities that updated their crisis contingency plans based on these experiences are now better positioned to support needy interrupted students when future crises arrive – with or without our proposed digitally badged micro-credentialing system. However, we do not know how many universities have such contingency plans, nor do we know how many universities actually updated those plans, after learning from their pandemic experiences.

Our focus on traditional IS programs is also an important limitation. Is badging a disruptive innovation for higher education (Christensen et al., 2008 That remains an open question. The top U.S. colleges and universities still attract high-caliber traditional students (young full-time undergraduates and masters-level students with a few years of on-the-job experience). Yet, university administrators fear their institutions confront significant risk in the coming "enrollment cliff" (when the U.S. will see a big drop in the number of

high-school seniors; see Kline (2019)). Some higher education innovators focus on non-traditional older students or previously underserved students (e.g., students with specific learning conditions and students who, of necessity or choice, study part-time or resume their education much later in life). Some universities and non-traditional for-profit providers have invested heavily in online education, and recently some traditional college-bound students have opted for these less-expensive options (Jakab, 2021). Meanwhile, some universities and some non-traditional providers invested in digital badging systems. We do not yet see strong evidence that badged micro-credentials help challengers attract students away from elite universities, but there is some evidence that some challengers are attracting price-sensitive students (including first-generation students and other non-traditional students) away from less-elite universities. Many more studies are needed, in varied institutional and socio-economic contexts, to investigate whether and how digital badging is disruptive. We have explained how digital badging would support programmatic agility during crises. Digital badging might also help academic programs avoid disruption, thanks to the future options provided by stackable micro-credentials.

Another limitation: we have not compared the current costs of existing crisis practices (specified in contingency plans) versus expected crisis-response costs when digitally badged micro-credentials are implemented. Many universities participate in articulation agreements that recognize other universities' courses; badging can more efficiently support this form of inter-institutional collaboration. Expanded articulation agreements could make it possible for students to take digitally-badged specialty courses or course modules offered by other colleges and professional- or business-based certification programs (such as those offered by ISACA, Google, Microsoft, and the Project Management Institute). Once such agreements are supported by a system that reconciles digital badges with college registrars' course grades systems, the operational costs to transfer credits across institutions should be lower than at present. Yet, an expanded set of inter-institutional arrangements will bring many new challenges, in terms of interoperability and quality standards, accreditation issues, and conflicting stakeholders' perspectives (Kehoe & Goudzwaard, 2015). This is fertile ground for future research.

Every emerging technology is a double-edged sword -- including a digital badging system designed to provide structure, flexibility, and portability. A new system can increase an organization's digital options (for future value) or erode value through technical debt (Sambamurthy et al., 2003) -- defined as the time and effort necessary to overcome design choices that subsequently prove to be problematic (Woodard et al., 2013). For example, back in the 1960s and 1970s, punch-card limits led developers to represent a "year" field with two digits. This design choice created the technical debt in date-sensitive code that would not work correctly after January 1, 2000 (the so-called "Y2K Bug"). Today's attempts to build blockchain-based digital badging systems (Jenkins, 2019; Jirgensons & Kapenicks, 2018) might also create technical debt (blockchain changes often require the creation of hard forks, which add complexity that might constrain future options). Technical debt may also arise from some developers' choices to use data fields and definitions that do not conform to a de jure or de facto standard (such as the IMS Global Open Badge Infrastructure, OBI) (IMS Global, 2018). A longitudinal case study could track and evaluate badging system design choices that yield problematic technical debt and those that yield attractive digital options.

5.3 Research Directions

Most students are pragmatic; they appreciate the flexibility that hybrid course designs offer, and (we predict) will appreciate badged module micro-credentials that help them cope more effectively during unexpected crises. Modular course badging provides helpful structure, helpful flexibility, and helpful portability. Far better for interrupted students to confront crisis circumstances directly and return to coursework when they are again ready to learn (from a psychological, logistical, and financial perspective). Because digital badging is new in the context of higher education (especially for the purpose proposed here), there is still plenty of scope for further research.

Although proponents contend that digital badging is a transformative or disruptive innovation for higher education (Jacobs, 2012; Mehta et al., 2013; Hurst, 2015), thus far, empirical research has not yielded strong evidence about this. Clay Christensen contended that big old companies (incumbents) embrace potentially disruptive innovations later than startups, because incumbents' best customers appreciate the incumbents' products and services (Christensen et al., 2008). His disruptive innovation theory proposed that startup companies do not initially target incumbents' most loyal and profitable customers; they offer new products or services aimed at different, often price-sensitive customers. As startups mature, they improve their offerings in ways that do attract some customers of some incumbent companies. Also, over time, born-digital startups capitalize on heretofore unexploited technology affordances, to offer new

functionality. By the time an incumbent recognizes that these startups are stealing some of their customers, they may be two or three years behind the startups, in learning how to work with newer technologies. This disruptive innovation process might already be underway with digital badges.

While many prior digital badging studies focused on student acceptance, engagement, and motivation, few (if any) prior empirical studies examined digital badging in higher education from an administrative point of view. By proposing a micro-credentialing system for IS courses designed in modules, we have laid a foundation for future empirical research that asks: Can a digital badging solution support programmatic agility? Future studies can investigate how stakeholders, organizations, and other influential factors collectively and separately affect whether and how micro-credentialed course modules are accepted, and whether and how universities and their students and faculty benefit from the structure, flexibility, and portability that these micro-credentials offer. Action design research, case studies, and scenario-based experiments can yield helpful practical evidence and theoretical contributions about badges' potential for improving programmatic agility, as we discuss next.

Action design research can accumulate empirical evidence about the technical, operational, and financial feasibility of badged micro-credential systems in IS classes or programs, and in other undergraduate or graduate-level programs. Such studies will follow an already-vibrant digital badging research tradition of evaluation studies and pilot testing. An IS program can "start small" by pilot-testing alternative badging system designs in one or a few courses. Building on lessons learned in multiple small-scale pilot tests, the implementation team can create and test a robust system design. A badged micro-credential system and related processes can be designed to provide helpful structure (such as conformance with de jure or de facto data standards or agreed-upon use cases, both subject to approvals by trusted entities).

Action design research can be informed by the double-edged sword of digital options and technical debt (see above) and also by the theory of resource complementarity (Hess & Rothaermel, 2011). For example, a digital badge's expiration date can be a complementary in-system function, if designed to trigger a re-certification requirement (reflecting the expected year when a particular badged skill will become obsolete). Today, Visicalc and Lotus 1-2-3 spreadsheet design and analysis skills are obsolete, while Microsoft Excel modeling skills remain relevant. Similarly, COBOL expertise is nearly obsolete, while scripting language skill continues to rise. Expiration date triggers thus can be a valuable designed-in complementary function in a digital badge application in skill-based contexts (e.g., in many IS courses).

In proposing our system in the context of a traditional degree-granting program, we assume that existing faculty governance procedures will continue to ensure the quality and content coverage of each course module. We also assume that existing procedures will continue to verify instructor qualifications, resolve disputes regarding student misconduct or unfair grading, and so on (i.e., familiar governance structures will complement a badging system's technical affordances). Badging-related processes can also complement the system's helpful flexibility. Designing the system as configurable software would enable adopting instructors or program directors to fit the badging software to their requirements, by selecting from a menu of system features (similar to configuring SAP, Salesforce, and other enterprise software packages). Universities (and program directors) will vary in terms of how much flexibility they want to allow. For example, one IS program might require a student whose learning is interrupted to complete course requirements within 12 months of the interruption (limited temporal flexibility); another might allow 24 months. Configuration options will be quite important for the design of this system.

Case research is a strong method for exploring how and why academic programs respond to crises and whether and how badging helps. Comparative case studies could thoroughly investigate alternative badged micro-credential system designs that vary in terms of the extent and types of designed-in structure and flexibility and related administrative processes. Which software and process designs best support students during personal or societal crises? Case research is also a strong method when the context of use greatly matters. IS faculty and IS programs vary considerably in their choices to emphasize individual versus team assignments, whether and to what extent multiple drafts of student reports are graded, which hands-on computing skills they require, what role multiple-choice tests play in comparison with tests designed to assess students' critical thinking skills, how student cheating is prevented and detected, and many other factors. Case researchers thus need to carefully study on-the-books policies versus actual policies-in-use. For example, a two-case comparison study might extensively study the implementation of a highly structured digital badging system at a military academy or other college that relies on strict academic conduct standards, versus a loosely structured badging system in a program that prides itself on offering optimal flexibility for, and support to, instructors and students.

Case research is also an excellent method for eliciting opinions from and observing the behaviors of various stakeholders. Faculty vary in their opinions about the opportunities and threats of digital badging. Well-designed case studies can help reveal unresolved controversies that sink badging initiatives, and specific techniques and appeals that facilitate some badging initiatives. Might a strong digital badging capability improve student retention? Longitudinal single-case or multiple-case studies may address this issue. A within-institution case study in which our proposed badged micro-credentialing system is utilized during a future crisis, can compare student retention data with comparable data gathered during the 2020-202x coronavirus pandemic. Other case studies can compare student-retention in traditional programs that do not utilize badged credentials to coordinate with other institutions' programs, versus programs that sign multiple articulation agreements that rely on badged micro-credentials. Surveys can subsequently confirm or challenge case findings on a larger scale.

Scenario-based experiments can ask faculty, administrators, and students to select badged or non-badged solutions for different interrupted student scenarios, and analyze the relative importance of structure, flexibility, portability, and (possibly) other affordances not yet identified. Studies can theorize about optimal configurations of these characteristics in different contexts. For example, in a multi-section required IS course, a 2X2 experimental design can evaluate student attitudes and outcomes under four conditions: (1. Modular, badged, 2. Modular, not badged, 3. not modular, but all course elements badged; 4) not modular, not badged).

At a higher level of abstraction, studies based on the theory of resource complementarity can investigate whether and how other IS-related agile capabilities complement badge-enabled programmatic agility. Does a strong agile software development capability contribute to badge-enabled programmatic agility in higher education? This question about the relationship of one IS-related capability to another is important, since competitive advantage comes to those organizations with hard-to-imitate bundles of valuable and complementary assets and capabilities (Mata et al., 1995; Bhardwaj, 2000; Wade & Hulland, 2004; Banker et al., 2006; Prieto & Easterby-Smith, 2006; Dong et al., 2009; Li et al., 2010; Mithas et al., 2011; Ibrahim et al., 2012) – especially following technological discontinuities (Rothaermel & Hill, 2005) and in contexts and situations in which organizational agility is especially important (Lu & Ramamurthy, 2011).

6 Conclusions

We argue that digital badging can improve programmatic agility that enables university program directors to help interrupted students. Although our arguments draw on our first-hand experience as U.S. college professors, it is likely that badged micro-credentialed course modules can also be helpful beyond the U.S. The duality of structure and flexibility provides a minimum conceptual foundation for designing further studies on this topic, based on a variety of research methods, informed by a variety of theories, and set in a variety of national and pedagogical contexts.

From a practical perspective, a necessary first step is to identify IS courses that can easily be redesigned in a modular form (suitable for micro-credentialing). Consider starting with a required multi-section course that is offered at many different times and in many modes (synchronous vs asynchronous, online vs f2f). That variety of time and approach gives interrupted students more possibilities to re-enter at a suitable time and in a suitable learning mode. Whether a course is offered in a 3-, 4-, 5-, or 6-module design, each module should address a well-defined theme or skill, and include a graded faculty assessment of learning (test, report, or project, guided by a rubric that reflects faculty-specified learning objectives). Some program directors may find that the exercise of re-organizing existing courses into modular course designs is beneficial, without a full digital badging solution. We believe modular course designs do help students learn, and that modular design provides a helpful foundation that will complement digital badging (when a college or graduate school is ready for it). We predict that both faculty and students will appreciate the temporal, locational and financial benefits of a badged micro-credentialing system.

When an IS program director and some faculty choose to move forward, it seems prudent to start pilot testing a badged micro-credentialing system in a few courses. Each pilot test should be based on a strong experimental design with strong outcome metrics (e.g., student behavioral engagement, learning outcomes, and other metrics). After evaluating a few pilot tests, carefully select other courses to badge, based on variables of interest (e.g., number of modules per course, required versus elective courses, the extent to which each course is highly or loosely structured, emphasis on skill acquisition versus knowledge application, etc.). For example, compare designs that are based on only a few modules/courses (e.g., our initial 3-module example) versus those with a more granular breakdown (e.g.,

a 6-module course). More modules would offer greater temporal flexibility since they make it easier for a student to fit into a new module without losing credit for already-completed modules. It might also be easier to attract substitute instructors to cover 2-week modules rather than the longer modules in a 3-module design. Yet, what if a many-modules design leads to poorer student outcomes? In that scenario, might instructors have fewer opportunities to guide students to critically assess how specific badged skills and concepts inform a higher integrated level of knowledge? In the case-based Strategic IS Management course described above, instructors encourage students to do cross-case within-module comparisons and also compare across modules. These tasks help students learn to generalize from the specific situations described in the assigned cases, to other IS management situations in the news or in their careers. In the final exam for some course sections, students whose analyses include strong insights from comparing the focal case to a case analyzed earlier in the course earn stronger grades, which are reflected in the final exam badge. A study that compares student outcomes across different sections can help researchers theorize about whether and how micro-credentials support narrow skills versus whether and how they support students' mastery of complex integrated concepts, and whether students develop relevant managerial judgment.

By the time badging has been evaluated in several courses, one or more innovation champions may emerge among the faculty. Capitalize on their enthusiasm, by providing funding for them to attend standards-setting meetings and relevant conferences, so they can join the emergent community of digital badging scholars and practitioners. Once a college or program director has attained sufficient expertise to take the next step, these champions will be equipped to help implement cross-institutional innovation.

IT innovation requires some big decisions and coordination of many actors, with insightful attention to internal and cross-jurisdictional politics. The same is true of meaningful digital badging innovation in higher education. We hope some readers will conduct carefully designed studies to critically assess digital badging opportunities -- before higher education is hit with the next wave of challenging crises, and before our own universities lose out to disruptive innovators.

References

AbuJarour, S., Ajjan, H., Fedorowicz, J., & Owens, D. (2021). How working from home during COVID-19 affects academic productivity. *Communication of the Association for Information Systems*, *48*, 55-64.

Al-Busaidi, K. A. (2012). Learners' perspective on critical factors to LMS success in blended learning: An empirical investigation. *Communication of the Association for Information Systems, 30*, 11-34.

Ash, K. (2012). *Colleges use 'digital badges' to replace traditional grading*. Education Week. Retrieved from https://www.edweek.org/teaching-learning/colleges-use-digital-badges-to-replace-traditional-grading/2012/06.

Avishal, B. (2020). *The pandemic isn't a black swan, but a portent of a more fragile global system*. The New Yorker. Retrieved from https://www.newyorker.com/news/daily-comment/the-pandemic-isnt-a-black-swan-but-a-portent-of-a-more-fragile-global-system

Banker, R. D., Bardhan, I. R., Chang, H., & Lin, S. (2006). Plant information systems, manufacturing capabilities, and plant performance. *MIS Quarterly*, *30*(2), 315-337.

Barber, C. (2021). From stress to success: Leveraging the online experience for information systems students. *Communication of the Association for Information Systems*, *48*, 125-132.

Bharadwaj, A. S. (2000). A resource-based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly*, *24*(1), 169-196.

Boor, I. & Cornelisse, S. (2021). Digital innovation during COVID-19: Transforming challenges to opportunities. *Communication of the Association for Information Systems, 48*, 15-25.

Brown, M., Mhichil, M. N. G., Beirne, E., & Mac Lochlainn, C. (2021). The global micro-credential landscape: Charting a new credential ecology for lifelong learning. *Journal of Learning for Development*, *8*(2), 228-254.

Carey, K. L, & Stefaniak, J. E. (2018). An exploration of the utility of digital badging in higher education settings. *Educational Technology Research & Development, 66*(1), 1211-1229.

Casilli, C., & Hickey, D. (2016). Transcending conventional credentialing and assessment paradigms with information-rich badges. *The Information Society*, *32*(2), 117-129.

Chauhan, A. (2014). Massive Open Online Courses (MOOCS): Emerging trends in assessment and accreditation. *Digital Education Review*, *25*, 7-17.

Chen, Y. & Roldan, M. (2021). Digital innovation during COVID-19: Transforming challenges to opportunities. *Communication of the Association for Information Systems, 48*, 15-25.

Cheng, Z., Watson, S. L., & Newby, T. J. (2018). Goal setting and open digital badges in higher education. *TechTrends*, *62*(2), 190-196.

Chou, C.C., & He S-J. (2017). Effectiveness of digital badges on student online contribution. *Journal of Educational Computing Research*, *54*(8), 1092-1116.

Christensen, C., Horn, M., & Johnson, C. (2008). Disrupting class: How disruptive innovation will change the way the world learns. McGraw-Hill

Coleman, J. (2018). Engaging undergraduate students in a co-curricular digital badging platform. *Education and Information Technology, 23*(1), 211-224.

Commonwealth of Massachusetts Department of Public Health. (2020). *Massachusetts infectious disease emergency response plan, February 2020, version 2.0*. Retrieved from https://www.mass.gov/doc/mdph-infectious-disease-emergency-response-ider-plan/download.

Connolly, A. J., & Mutchler, L. A. (2021). A course plan for principles of IS programming to withstand COVID-19. *Communication of the Association for Information Systems*, *48*, 1-7.

Daniel, C., & Gogan, J. L. (2021). Teaching IS cases online? Set a rhythm. In *Proceedings of the 2021 European Conference on Information Systems (ECIS)*.

Dick, G. (2021). Teaching online: Creating student engagement. *Communication of the Association for Information Systems, 48*, 65-72.

Dong, S., Xu, S. X., & Zhu, K. X. (2009). Information technology in supply chains: The value of IT-enabled resources under competition. *Information Systems Research, 20*(1), 18-32.

Drechsler, K., Gregory, R., Wagner, H.-T., & Tumbas, S. (2020). At the crossroads between digital innovation and digital transformation. *Communication of the Association for Information Systems, 47*, 521-538.

Dziuban, J. L., & Dziuban, C. D. (1997). Adolescents and teaching: Reactive behavior patterns in the classroom. In *Proceedings of the National Conference on Teaching and Learning* (pp. 1-19).

Fajiculay, J. R, Panikh, B. T., Wright, C. V., & Sheehan A. H. (2017). Student perceptions of digital badges in a drug information and literature evaluation course. *Currents in Pharmacy Teaching & Learning*, (9), 881-886.

Fanfarelli, J. R., & McDaniel, R. (2017). Exploring digital badges in university courses: Relationships between quantity, engagement, and performance. *Online Learning, 21*(2), 144-165.

Fanfarelli, J., & McDaniel, R. (2015). Individual differences in digital badging: Do learner characteristics matter? *Journal of Educational Technology*, *43*(4), 403-428.

Ferran, C., González, M. A., Esteves, J., Gómez Reynoso, J. M., & Guzman, I. (2019). AMCIS 2017 panel report: Experiences in online education. *Communication of the Association for Information Systems*, *45*, 433-463.

Finkelstein, J., Knight, E., & Manning, S. (2013). The potential and value of using digital badges for adult learners. *American Institutes for Research*, *16*.

Foli, K. J., Karagory, P., & Kirby, K. (2016). Exploratory study of undergraduate nursing students' perceptions of digital badges. *Journal of Nursing Education*, *55*(11), 640-644.

Freeman, L., & Urbaczewski, A. (2019). Critical success factors for online education: Longitudinal results on program satisfaction. *Communication of the Association for Information Systems*, *44*, 630-645.

Garnett, T., & Button, D. (2018). The use of digital badges by undergraduate nursing students: A three-year study. *Nurse Education in Practice, 32*, 1-8.

Gefen, D., Ragowsky, A., McLean, E. R., Markus, M. L., Rivard, S., & Rossi, M. (2012). ICIS 2011 panel report: Are we on the wrong track and do MIS curricula need to be reengineered? *Communication of the Association for Information Systems, 30*, 161-170.

Gibbs, W. W., & Soares, C. (2005). Preparing for a pandemic. *Scientific American*, *293*(5), 45-54.

Gibson, D., Ostashewski, N., Flintoff, K., Grant, S., & Knight, E. (2015). Digital badges in education. *Education & Information Technologies*, *20*(2), 403-410.

Gottipati, S., & Shankaranaraman, V. (2021). Rapid transition of a technical course from face-to-face to online. *Communication of the Association for Information Systems, 48*, 7-14.

Guo, Z., Li, Z., & Stevens, K. J. (2012). Analyzing students' technology use motivations: An interpretive structural modeling approach. *Communication of the Association for Information Systems, 30*, 199-224.

Gupta, B., Goul, M., & Dinter, B. (2015). Business intelligence and big data in higher education: Status of a multi-year model curriculum development effort for business school undergraduates, MS graduates, and MBAs. *Communication of the Association for Information Systems, 36,* 449-476.

Hakulinen, L., Auvinen, T, & Korthonen, A. (2015). The effect of achievement badges on students' behavior: An empirical study in a university level course. *International Journal of Emerging Tech in Learning*, *10*(1), 18-29.

Harmon, J., & Copeland, A. (2016). Students' perceptions of digital badges in a public library management course. *Education for Information*, *32*(1), 87-100.

Haslam, C. R., Madsen, S., & Nielsen, J. A. (2021). Problem-based learning during the COVID-19 pandemic: Can project groups survive? *Communication of the Association for Information Systems*, *48,* 161-168.

Hatzipanagos, S. & Code, J. (2016). Open badges in online learning environments: Peer feedback and formative assessment as an engagement intervention for promoting agency. *Journal of Educational Multimedia and Hypermedia*, *25*(2), 127-142.

Hensiek, S., DeKorver, B. K., Harwood, C. J., Fish, J., O'Shea, K., & Towns, M. (2017). Digital badges in science: A novel approach to assessment of student learning. *Journal of College Science Teaching*, *46*(3), 28-33.

Henthaler, D., Bellin-Mularski, N., & Mah, D. K. (Eds). (2016). *Foundations of digital badges and microcredentials*. Springer.

Hess, A. M., & Rothaermel, F. T. (2011). When are assets complementary? Star scientists, strategic alliances, and innovation in the pharmaceutical industry. *Strategic Management Journal*, *32*(8), 895-909.

Hvalshagen, M., Nittala, L., Raman, R., Sullivan, N., & Zolbanin, H. M. (2021). When worlds collide: Framing students' challenges with stay-at-home learning during COVID-19, through the lens of conflicting role identities. *Communication of the Association for Information Systems, 48*, 227-235.

Hurst, E. J. (2015). Digital badges: Beyond learning incentives. *Journal of Electronic Resources in Medical Libraries*, *12*(3), 182-189.

Ibrahim, M., Ribbers, P. M., & Bettonvil, B. (2012). Human knowledge resources and inter-organisational systems. *Information Systems Journal*, *22*(2), 129-149.

IMS Global Learning Consortium. (2018). Open badge infrastructure (OBI) v2.0, IMS final release. 12 April. Retrieved from https://www.imsglobal.org/sites/default/files/Badges/OBv2p0Final/index.html.

Jacobs, J. (2012). *Digital badges threaten colleges' monopoly on credentials*. U.S. News and World Report. Retrieved from https://news.yahoo.com/digital-badges-threaten-colleges-monopoly-credentials-195223760.html.

Jakab, S. (2021). *The $670 billion college-industrial complex is under threat from online schools*. The Wall Street Journal. Retrieved from https://www.wsj.com/articles/the-670-billion-college-industrial-complex-is-under-threat-from-online-school-11624636809.

Jenkins, W. (2019). *Is blockchain the future of academic credentials?* The Chronicle of Higher Education. Retrieved from https://www.chronicle.com/article/is-blockchain-the-future-of-academic-credentials/.

Jirgensons, M., & Kapenieks, J. (2018). Blockchain and the future of digital learning credential assessment and management. *Journal of Teacher Education for Sustainability*, *20*(1), 145-156.

Johnston, K. (2021). *COVID death rates in some occupations higher among workers of color*. The Boston Globe. Retrieved from https://www.bostonglobe.com/2021/02/04/nation/covid-death-rates-some-occupations-higher-among-workers-color/.

Kehoe, A., & Goudzwaard, M. (2015). ePortfolios, badges, and the whole digital self: How evidence-based learning pedagogies and technologies can support integrative learning and identity development. *Theory into Practice, 54*(4), 343-351.

Kline, M. (2019). *The looming higher ed enrollment cliff*. Higher Ed Magazine. Retrieved from https://www.cupahr.org/issue/feature/higher-ed-enrollment-cliff/.

Krotov, V. (2015). Critical success factors in m-learning: A socio-technical perspective. *Communication of the Association for Information Systems, 36*, 105-126.

Krueger, H. (2021). Hundreds of *medical professionals* call on *Baker* to *prioritize vaccine* access for *Black* and *immigrant communities*. The Boston Globe. Retrieved from https://www.bostonglobe.com/2021/01/19/metro/hundreds-medical-professionals-call-baker-prioritize-vaccine-access-black-immigrant-communities/.

Kyewski, E. & Kramer, N. (2018). To gamify or not to gamify? An experimental field study of the influence of badges on motivation, activity, and performance in an online learning course. *Computers & Education, 118*, 25-37.

Law, P. (2015). Digital badging at the open university: Recognition for informal learning, open learning. *The Journal of Open, Distance and eLearning*, *30*(3), 221-234.

Li, L., Xu, L., Da, H., Yuming He, H., W., Pribesh, S., Watson, S. M., & Majo, D. M. (2021). Facilitating online learning via zoom breakout room technology: A case of pair programming involving students with learning disabilities. *Communication of the Association for Information Systems, 48*, 88-100.

Li, S., Shang, J., & Slaughter, S. A. (2010). Why do software firms fail? Capabilities, competitive actions, and firm survival in the software industry from 1995 to 2007. Information Systems Research, *21*(3), 631-654.

Liyanagunawardena, T., Scalzavara, S., & Williams, S. (2017). Open badges: A systematic review of peer-reviewed published literature (2011-2015). *European Journal of Open, Distance, and E-Learning, 20*(10).

Lu, Y. & Ramamurthy, K. (2011). Understanding the link between information technology capability and organizational agility: An empirical examination. *MIS Quarterly*, *35*(4), 931-954.

Mah, D. K. (2016). Learning analytics and digital badges: Potential impact on student retention in higher education. *Technology, Knowledge and Learning, 21*(3), 285-305.

Mata, F. J., Fuerst, W. L., & Barney, J. B. (1995). Information technology and sustained competitive advantage: A resource-based analysis. *MIS Quarterly*, *19*(4), 487-505.

Mavengere, N. B., H-B., J., Passmore, D., Mayes, H., Fakorede, O., Coles, M., & Atfield-Cutts, S. (2021). Applying innovative technologies and practices in the rapid shift to remote learning. *Communication of the Association for Information Systems, 48*, 185-195.

McLaughlin, M. D. & Gogan J. L. (2018). Challenges and best practices in information security management. *MIS Quarterly-Executive, 17*.

Mehta, N. B., Hull, A. L., Young, J. B., & Stoller, J. K. (2013). Just imagine: New paradigms for medical education. *Academic Medicine*, *88*(10), 1418-1423.

Mithas, S., Ramasubbu, N., & Sambamurthy, V. (2011). How information management capability influences firm performance. *MIS Quarterly*, *35*(1), 237-256.

Mitri, M., & Palocsay, S. (2015). Toward a model undergraduate curriculum for the emerging business intelligence and analytics discipline. *Communication of the Association for Information Systems, 37*, 651-669.

Muilenburg, L., & Berge, B. (Eds.). (2016). *Digital badges in education: Trends, issues, and cases*. Routledge.

Newby, T. J. & Cheng, Z. (2020). Instructional digital badges: Effective learning tools. *Educational Technologies Research and Development*, *68*, 1053-1067.

Niederman, F., Butler, B. S., Gallupe, R. B., Tan, B. C. Y., & Urquhart C. (2016). Electronic pedagogy and future university business models. *Communication of the Association for Information Systems, 38*, 157-170.

Njenga, K. & Brown, I. 2012. Conceptualizing improvisation in information systems security. *European Journal of Information Systems*, *21*, 592-607.

Noyes, J. A., Walch, P. M., Johnson, J. W., & Carbonneau, K. J. (2020). A systematic review of digital badges in health care education. *Medical Education*, *54*(7), 600-615.

O'Connor, E. A., & McQuigge, A. (2013). Exploring badging for peer review, extended learning and evaluation, and reflective/critical feedback. *Journal of Educational Technology Systems*, *42*(2), 87-105.

Olsson, M., Mozelius, P., & Collin, J. (2015). Visualization and gamification of e-learning and programming education. *Electronic Journal of e-Learning*, *13*(6), 441-454.

Osatuyi, B. & Passerini, K. (2016). Twittermania: Understanding how social media technologies impact engagement and academic performance of a new generation of learners. *Communication of the Association for Information Systems, 39*, 509-528.

Pechenkina, E., Laurence, D., Oates, G., Eldridge, D., Hunter, D. (2017). Using a gamified mobile app to increase student engagement, retention and academic achievement. *International Journal of Educational Tech in Higher Education*, *14*(1), 1-12.

Pedro, L., Santos, C., Aresta, M., & Almeida, S. (2015). Peer-supported badge attribution in a collaborative learning platform: The SAPO campus case. *Computers in Human Behavior*, *51*, 562-567.

Prieto, I. M., & Easterby-Smith, M. (2006). Dynamic capabilities and the role of organizational knowledge: An exploration. *European Journal of Information Systems*, *15*(5), 500-510.

Prinsloo, T., & Singh, P. (2021). COVID-19: Leapfrogging 8,000 students from face-to-face to online learning in three weeks. *Communication of the Association for Information Systems, 48*, 71-79.

QAA (Quality Assurance Agency for Higher Education). (2021). *Which way for micro-credentials?* Quality Compass. Retrieved from https://www.qaa.ac.uk/docs/qaa/news/quality-compass-which-way-for-micro-credentials.pdf?sfvrsn=25c6d481_8.

Quinn, S. C. (2008). Crisis and emergency risk communication in a pandemic: A model for building capacity and resilience of minority communities. *Health Promotion Practice*, *9*(4), 18S-22S.

Raman, R., Sullivan, N., Zolbanin, H., Nittala, L., Hvalshagen, M., & Allen, R. (2021). Practical tips for hyflex undergraduate teaching during a pandemic. *Communication of the Association for Information Systems, 48*, 218-225.

Ramesh, V., & Gerth, A. B. (2015). Design of an integrated information systems master's core curriculum: A case study. *Communication of the Association for Information Systems*, *36*, 301-316.

Reid, A. J., Paster, D., & Abramovich, S. (2015). Digital badges in undergraduate composition courses: Effects on intrinsic motivation. *Journal of Computers in Education*, *2*(4), 377-398.

Reynolds, B., & Quinn, S.C. (2008). Effective communication during an influenza pandemic: The value of using a crisis and emergency risk communication framework. *Health Promotion Practice*, *9*(4), 13S-17S.

Rohan, A. J., Fullerton, J., Escallier, L. A., & Pati, S. (2017). Creating a novel online digital badge-awarding program in patient navigation to address healthcare access. *Journal for Nurses in Professional Development, 33*(3), 106-112.

Rothaermel, F. T., & Hill, C. W. (2005). Technological discontinuities and complementary assets: A longitudinal study of industry and firm performance. *Organization Science*, *16*(1), 52-70.

Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly*, *27*(2), 237-263.

Schiller S., Goul M., Iyer L. S., Sharda R., Schrader D., & Asamoah D. I. (2015). Build your dream (not just big) analytics program. *Communication of the Association for Information Systems, 37*, 811-826.

Scott T., Ligh J. T, & Urbaczewski A. (2021). Fighting Zoom fatigue: Keeping the Zoombies at bay. *Communication of the Association for Information Systems, 48*.

Sidorova, A. (2013). Business analysis as an opportunity for IS programs in business schools. *Communication of the Association for Information Systems, 33*, 521-540.

Sipress, A. (2009). *The fatal strain: On the trail of avian flu and the coming pandemic*. Viking.

Spagnoletti, P. & Reca, A. (2008). The duality of information security management: Fighting against predictable and unpredictable threats. *Journal of Information Systems Security*, *4*(3), 46-62.

Stahr, L. C. & Davis, K. C. (2021). Effective shifting of software capstone demonstrations to an online experience. *Communication of the Association for Information Systems, 48*, 115-124.

Swanson, E. B. (2017). Theorizing information systems as evolving technology. *Communication of the Association for Information Systems, 41*, 1-17.

Toney, S., Light, J., & Urbaczewski, A. (2021). Fighting Zoom fatigue: Keeping the Zoombies at bay. *Communication of the Association for Information Systems, 48*, 40-46.

Toon, A., Toon, T., & Emoke, S. (2021). Fine-tuning the evaluation focus in the university cooperative learning mode in relation to the pandemic. *Communication of the Association for Information Systems, 48*, 196-204.

Topi, H. (2019). Reflections on the current state and future of information systems education. *Journal of Information Systems Education*, *30*(1), 1-9.

Topi, H., Conboy, K., Donnellan, B., Ramesh, V., Van Toorn, C., & Wright, R. T. (2014). Moving toward the next generation of graduate degree programs in information systems. *Communication of the Association for Information Systems*, *34*, 693-710.

Topi, H., Karsten, H., Brown, S. A., Carvalho, J. A., Donnellan, B., Shen, J., Tan, B. C. Y., & Thouin, M. F. (2017). MSIS 2016 global competency model for graduate degree programs in information systems. *Communication of the Association for Information Systems, 40*, MSIS-i-MSIS-107.

Topi, H., Valacich, J. S., Wright, R. T., Kaiser, K. M., Nunamaker, J. F., Jr., Sipior, J. C., & de Vreede, G. J. (2010). *IS 2010 curriculum guidelines for undergraduate degree programs in information systems*. Association For Computing Machinery (ACM), Association for Information Systems (AIS). Retrieved from https://www.acm.org/binaries/content/assets/education/curricula-recommendations/is-2010-acm-final.pdf.

Towns, M., Harwood, C. J., Robertshaw, M. B., Fish, J., & O'Shea, K. (2015). The digital pipetting badge: A method to improve student hands-on laboratory skills. *Journal of Chemistry Education*, *92*(12), 2038-2044.

Van Slyke C., Topi H., & Granger M. J. (2021) Special Section: COVID-19, Learning, Pedagogy, and Educational Systems, Communication *of the Association for Information Systems, 48*.

Wade, M., & Hulland, J. (2004). The resource-based view and information systems research: Review, extension, and suggestions for future research, *MIS Quarterly, 28*(1), 107-142.

Walsh, B. (2017). The world is not ready for the next pandemic. *Time, 189*(18), 32-39.

Watkins, M. D., & Bazerman, M. H. (2003). *Predictable surprises: The disasters you should have seen coming*. Harvard Business Review. Retrieved from https://hbr.org/2003/04/predictable-surprises-the-disasters-you-should-have-seen-coming.

Williamson, J., & Pittinsky, M. (2016). *Making credentials matter*. Inside Higher Education. Retrieved from https://www.insidehighered.com/views/2016/05/23/understanding-differences-what-credentials-are-being-stacked-and-why-essay.

Wilson, B. G., Gasell, C., Ozyer, A., & Scrogan, L. (2016). Adopting digital badges in higher education: Scoping the territory. In D. Ifenthaler, N. Bellin-Mularski, & D. K. Mah (Eds.), *Foundation of digital badges and micro-credentials* (pp. 163-177). Springer.

Woodard, C. J., Ramasubbu, N., Tschang, F. T., & Sambamurthy, V. (2013). Design capital and design moves: The logic of business strategy. *MIS Quarterly*, *37*(2), 537-564.

Yan Dang, M., Zhang, G. Y., & Amer, B. (2019). Peer TAs and instructors and their impacts on student learning in the blended environment: A model development and testing social networks among students. *Communication of the Association for Information Systems, 44*.

Yidirim, S., Kaban, A., Yildirim, G., & Çelik, E. (2016). The effect of digital badges specialization level of the subject on the achievement, satisfaction and motivation levels of the students. *Turkish Online Journal of Educational Technology, 15*(3), 169-182.

Zha, S., & He, W. (2021). Pandemic pedagogy in online hands-on learning for IT/IS courses. *Communication of the Association for Information Systems, 48*, 80-87.

Zhao, Y., Bandyopadhyay, K., & Bandyopadhyay, S. (2020). Evaluating complex online technology-enabled course delivery: A contextualized view of a decomposed IS success model. *Communication of the Association for Information Systems, 46*, 209-229.

About the Authors

Terry M. McGovern Assistant Professor in the Department of Business at the University of Wisconsin-Parkside, earned the following degrees: B.A., University of Iowa, M.S. in Management, Air Force Institute of Technology, M.H.S., Providence University, M.P.L. University of San Francisco, Doctor of Management, University of Phoenix, and Doctor of Business Administration, University of South Florida. He served for 20 years as a United States Air Force officer in nuclear missile operations, satellite operations and other roles, including as a speech writer and running a research program while serving at the Pentagon. McGovern was named an early-career Case Research Association Paul R. Lawrence Fellow in 2019. He teaches courses on project management, strategy, organizational behavior, and operations management, and conducts research on digital badging and other topics. McGovern has presented papers at the Academy of Management and HICSS conferences.

Janis L. Gogan Full Professor of Information & Process Management at Bentley University, earned Ed.M., MBA, and DBA degrees from Harvard University. She has authored nearly 60 journal publications and 120 conference papers on health care IT, emerging-IT pilot testing, information security incident preparation and response, and other strategic IT management topics. Gogan co-chaired AMCIS 2017 and served as NACRA President, Senior Editor at *Journal of Information Technology* and on editorial boards of *Case Research Journal, International Journal of Electronic Commerce, Journal of the Association for Information Systems, Journal of Management Information Systems*, and other journals. She regularly reviews for these and other journals and several conferences (e.g., AMCIS, ECIS, ICIS, HICSS). In 2021 she was awarded Fellow of the North American Case Research Association (NACRA), in recognition of her many discussion cases on strategic IT management topics and advocacy of “double-impact” research.