

# Reflections from Recent Graduates on a Computer Information Systems Culminating Experience

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## Abstract

Baccalaureate curricula in computer information systems regularly culminate in a capstone experience, a consummate exercise of practice that applies the knowledge and skills a student accumulates over years of study. This culminating experience usually, but not always, explores the wider range of behavior normative to professional competence. We report on a pilot study that gathers young professional's perception of what impact their culminated experience had on their transformation from student to professional. Besides extending our own understanding of the experience's contribution to preparedness and confidence for real world tasks, we wish to concretize our pedagogy of competencies that emulate system development in a professional context. This study analyzes our graduates' perception of lessons learned against the backdrop of their work on an agile, team-based culminating experience. Our findings are based on 14 semi-structured interviews of recent graduates of Bentley University. We also analyze team performance through the lens of social capital theory, where instead of firms working to achieve an organizational advantage, we examine teams working to design and develop superior applications. Finally, we explore each graduate's perception of the dispositional factors at play in "figuring out how to work together" during a handful of development iterations embedded within a one-semester course.

**Keywords:** capstone experience, transformative learning, professionalism, dispositions, social capital, curriculum design.

## 1. INTRODUCTION

The paper asks and answers two research questions. First, what are the critical best practices for teaching a team-based capstone within computer information systems (CIS) in

order to improve the undergraduate student experience and to maximize the value of the capstone? Second, what are the student best practices for working on a significant team project in a CIS capstone course in order to create the opportunity for a transformative learning

experience? This research was centered around a popular pedagogy in the discipline, namely an agile system development project lasting one semester with team sizes averaging six or more students. At Bentley University, this project is embedded within a technology-based project management course that typically serves a student population that is more than 95% majors and approximately 90% fourth-year students.

An important objective of this pilot study was to understand and analyze what impact a CIS culminating experience had on our students' journey to becoming post-baccalaureate professionals. This study, therefore, builds on and elaborates the work of others in computer science (Dugan, 2011), other computing disciplines (Clear et al., 2001), and information systems. The present study, because of its focus on recent alumnae and alumni, is more akin to the work of Richards (2009) on student team formation or McGill (2012) on the capstone experience than practice-based research, for example, work by Yuan et al. (2009) and Han and Novav (2013).

Capstone is a common label for a course and the content that culminates a baccalaureate computing program (Clear et al., 2001; Dugan, 2011; Havelka, 2019; Steiger, 2009), "a stone on top of something, typically a wall." In practice a capstone is not the terminus that the word might imply, but a convergence of learning dimensions that lays a career foundation for IS professional service to society. *Computing Curriculum CC2020's paradigms for future baccalaureate computing education* (Clear & Parrish et al., 2020) emphasizes this convergence. CC2020 also frames the behavior of responsible IS professionals as they serve an organization's information needs and advance the goals of their client, their firm, and society (Topi, 2017).

Our findings, based on an interpretive analysis (Hovorka & Lee, 2010) of 14 semi-structured interviews, identify the most challenging and the most valuable aspects of the students' culminating experience as CIS majors at Bentley University. Our findings also demonstrate which competencies (and dispositions) were most important to student team project success and also which learning outcomes were most important to the students, in retrospect. Specifically, we found that teamwork and focus on a shared mission were the most important factors in designing and developing a high-quality working artifact, which, in most cases, was accompanied by a high level of student satisfaction and superior learning outcomes. Our findings also highlight the design-basis and

management-interdependence of the CIS discipline.

We adopt *social capital theory* (Nahapiet & Ghoshal, 1998) as the lens through which to develop and analyze our findings connected to student teams and their work on various projects. Social capital theory directly addresses both team effectiveness and efficiency by conceptualizing team (or group) structures, group dynamics, and group assets. Within social capital theory, group structures (and how they evolve) are encapsulated within what is called *structural capital*. Similarly, group dynamics—and how they are impacted by individuals, their relationships, and their behavior—are part of *relational capital*. Finally, relevant group assets, e.g., shared knowledge, are part of *cognitive capital*.

The remainder of this paper is organized as follows: Section 2 describes the student journey towards becoming a professional, our perspective on a collection of significant team projects, and how they relate and connect. Section 3 describes the 460 course at Bentley University, which is the culminating course in a technology-intensive CIS program. Section 4 presents our main findings with respect to student learning and development, including in what ways they were transformative. Finally, we revisit the case for a capstone course in CIS based on our findings and provide some insights at the curriculum and course level.

## 2. STUDENT TRANSFORMATION AND CAPSTONE TEAM PROJECTS

Most computer information systems programs include a capstone experience for their students before graduation. Such an experience is a manifestation of a *threshold concept* (Meyer, Land & Baillie, 2010); a portal through which students must pass before they begin their career as IS or IT professionals. The experience is also a cementing process for students in which knowledge is received, developed, integrated, and extended (Haber-Curran & Tillapaugh, 2015; Meyer, Land & Baillie, 2010).

Students are transformed as part of their education as they internalize threshold concepts. In the context of an IS or IT education, *transformative learning* occurs both outside and inside the discipline. Thus, Elias' (1997, p. 3) definition applies — "transformative learning is the expansion of consciousness through the transformation of basic worldview and specific capacities of the self; transformative learning is facilitated through consciously directed processes

such as appreciatively accessing and receiving the symbolic contents of the unconscious and critically analyzing underlying premises.” In a business-focused curriculum, transformative learning is best supported when a capstone experience requires that students learn to innovate, engage in significant projects, and understand the impact of their work product (Kosnik, Tingle & Blanton, 2013).

At many colleges and university such a capstone experience is required for graduation. At present, this is not the case at Bentley University.

At Bentley the culminating experience is provided in a one-semester technical project management course. As is best practice (Gardner & Van der Veer, 1998), this experience requires students to integrate knowledge and skills learned within and beyond their computer information systems curriculum. Furthermore, this culminating experience is team based (Richards, 2009), requiring students to learn the art and science of effective teamwork through practice, e.g., (Hoegl and Gemuenden, 2001; Lindsjörn et al., 2016; Smith, 2013).

Effective teamwork in product design and development is directly connected to team performance; however, the vast majority of previous research has studied this connection in commercial or government contexts, e.g., (Cha, Park & Lee, 2014; Druskat & Pescosolido, 2006). Efficient teamwork has also been studied in these and other contexts (Clopton, 2011; Smith 2013), including recent analyses of agile and DevOps methodologies that focus on maximizing value while minimizing waste (Forsgren, Humble & Kim, 2018; Lwakatara, Kuvaja & Oivo, 2016).

### **Research Methodology**

This research was conducted by gathering student reflections on a culminating CIS experience at Bentley in 14 semi-structured interviews conducted using an online video platform, which allowed us to record and replay our conversations. Six of these interviews were conducted with students who had taken the technology-intensive course in the spring of 2019. The remaining eight took the same course in spring of 2020. Initial interviews were conducted in June and July of 2020. At this time, the student interviewees all had graduated between one and fourteen months prior, i.e., in May of 2019 or 2020. All but one of these interviews had two of the authors present to guide the inquiry.

By framing our findings using social capital theory, we analyze how structural, relational, and cognitive capital impact student team performance. This analysis is informed by previous research in the context of organizational information systems, e.g. (Goh & Waskco, 2012; Robert, Dennis, & Ahuja, 2008; Schenkel & Garrison, 2009; Singh, Tan & Mookerjee, 2011). However, our interest was to understand if the organizational advantage (in a business or social context) gained by accruing social capital (Nahapiet & Ghoshal, 1998) translates to a team advantage (in a product design and development context). In other words, does social capital theory help identify student best practices during the stages of student team storming, norming, performing, and adjourning (Tuckman & Jensen, 1977), which all occurred during one semester?

### **3. CULMINATING PROJECT MANAGEMENT COURSE AT BENTLEY UNIVERSITY**

Good teachers are able to distinguish between the different types of knowledge they impart to their students, e.g., tacit and explicit (Polanyi, 1958, 2009). Good teachers also understand that such knowledge is internalized by most students in a hierarchy of knowing with distinct but interdependent dimensions (Ryle, 1949). Within the technology-intensive CIS curriculum at Bentley, the knowing “what” dimension lays out scientific and technological knowledge of computing fashioned in a domain of practice that forms foundational tools for defining and manipulating data and information. The “how” dimension expresses the levels of skill, the requisite depth of understanding, appropriate to effectively applying knowledge.

The “why” dimension encompasses a respect for the social context of their choices, empathy for others (Cherns, 1976; Goleman, 2001), and behavior that impacts their coworkers, their clients, and society at large (Frezza, Daniels & Wilkin, 2019). CC2020 labels these three dimensions as: knowledge, skills, and dispositions – where skill is a proficient application of knowledge moderated by dispositions [See (Clear & Clear et al., 2020), Figure 1, and Table 4 in the Appendix]. Dispositions enfold attitudes, beliefs, values,

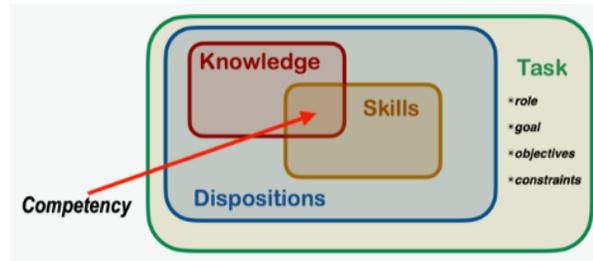


Figure 1. Competency as Knowledge, Skills, and Dispositions Applied in the Context of a Task [Source: Clear & Parrish et al. (2020)]

and motivations that align to service an organizational and social common good (Frezza, Clear & Clear, 2020; Gray, 2015; Shiveley & Misco, 2010). Translating the what, how, and why to the project management course of interest in this study, it is intentional that the learning objectives of this course (see Table 1) draw on the personal and social professional skills described in Goldman (2001). For reference, these socio-emotional skills are listed in Table 3 in the Appendix.

<b>Learning Goal (Domain)</b>
The main objective of the course is to help you learn through experience what it means and what it takes to be an IT professional and manage the challenges professionals face daily in their work. (Personal Professionalism)
In addition, you will learn essential software project management concepts in an applied context. After this course, you will understand better the importance and nature of schedule planning, resource allocation and management, team organization and maintenance, balancing of resources, etc. (Project Management)
You will also learn to practice methods for software construction, and start to see the true importance of metrics, testing, and quality assurance. (Design and Development)
It is important to emphasize four specific commitments on which this course will focus: Commitment to the client, commitment to the team, commitment to continuous learning, and commitment to the professional community. (Social Professionalism)

Table 1. Description and Domain of Learning Goals in 460 at Bentley University

We observe that the culminating project management course in this study, like most “capstones” in our experience, is prefaced by computing prerequisites that focus almost exclusively on computing knowledge applied with

a particular level of skill (Krathwohl, 2002). Therefore, our discussion herein is framed with a particular attention to the capstone’s effect on inculcated or reinforced dispositions and the graduate’s perception thereof (Gill & Ritzhaupt, 2013).

### **Methodology and Technology for Team Project in 460**

The student team project in 460 uses agile system development with typical team sizes. A strength of the agile methodology for a system development and project management capstone, lies both in the empirical underpinnings and iterative discovery “baked into” the ontological and epistemological assumptions of methods such as Scrum (Rubin, 2012). As a process, although replete with rituals, habits, and prescriptive elements, Scrum affords a team (whole and parts) an opportunity to comprehend and explain the balance of stakeholder sufficiency and satisfaction and technical feasibility in the designs and constructions required to produce a working artifact. The co-evolution and ephemerality of both the organizational organism and artifact, coupled with the flux of technology and the team’s comprehension of feasibility within the media of construction are emergent (Hsu & Hung, 2013; Mulder, 2017).

Since 2015, 460 has taught Scrum and Kanban as the preferred agile methodologies, but adopted the practices of Scrum for the team project. Most of the coursework outside of class time is focused on the team project and each semester has included three sprints. Scrum highlights two of the commitments in the learning goals for the course (see Table 1); commitment to continuous learning and commitment to the team. These commitments are reinforced by systematic reflective practice (Dingsøyr, Dybå & Moe, 2010; Tably et al., 2006), including rigorous sprint reviews (Rubin, 2012). These Scrum practices are supported by the twelfth agile principle: “At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.” (Stellman & Greene, 2014)

The most important technology for system design and development in 460 is Mendix, a “low code” platform. This platform supports model-driven design and development that is integrated with basic agile development tools, visualization, and metrics, e.g., user stories and burn down charts (Mew & Field, 2018). Applications that run on this platform have an execution model that separates the user interface, back-end storage, and business logic. Students using Mendix can run applications on their laptop during prototyping,

initial development, and unit test, and host their team application in the cloud during integration and demonstration.

#### **4. STUDENT TRANSFORMATION DURING AND AFTER 460**

##### **Competencies, Dispositions, and Learning**

The practical experience of interviewees ranged from one to 12 months of work experience after the 460 course. And although this study is preliminary, there were themes that emerged consistently in the students' shared reflections on their culminating project experience.

**Team building** — Although the general and business education components of the students' baccalaureate curriculum included numerous project team experiences, most student reflections included pronounced team building and team rhythm issues. For many students the agile sprint construct played prominently in the students' realization that regular, consistent, and timely communication was necessary to achieve a momentum of progress in establishing shared requirements and eventually a working system. Invariably, the first sprint demonstrated weaknesses in communication and coordination that impaired progress, suggesting that accrual of relational capital within most teams was minimal until after the first sprint. This motivated the need for a shared commitment to coordination and collaboration and a strong commitment to the team (Hackman, 1987; Lindsjorn et al., 2016; Tiwana, 2008) if the pace of progress was to permit even a passable product delivery. If we assume that some of the challenges faced by a team in 460 mirror those experienced by entrepreneurial teams in industry, Blatt (2009, p. 534) offers some guidance about how newly-formed teams might accrue relational capital: "entrepreneurial teams can counteract the challenges of novelty by adopting communal relational schemas (caring about one another's needs) and contracting practices (making expectations explicit and transparent)."

**Project organization** — The identification of team roles and the acceptance of the role's importance to the project's progress required failure-as-teacher for some members. The remedy usually involved the team's sober return to the details of the methodology of Scrum with a commensurate and expanded commitment to mindful engagement. Successful project organization required sufficient accrual of at least structural capital—to embrace assigned roles (Balijepally, Mahapatra & Nerur, 2006)—and relational capital—to collectively figure out how to work

together (Attle & Baker, 2007). In their reflections, students found Scrum's connection of project and team organization to workflow management to be most helpful. Specifically, their insights into effective release (and sprint) planning are perhaps best articulated by Smith (2013), who reminds us that "the first step in organizing is to develop a work breakdown structure that divides the project into units of work."

**Self-confidence and Responsibility** — Students with greater prior experience involving extra-mural responsibility (e.g. as an older sibling of multiple siblings, varsity-level team sports, internship with direct management contact, etc.) readily translated their prior experience into the Scrum framework and embraced leadership opportunities where they arose regardless of their individual role assignments. Students with lesser developed self-confidence sometimes teeter on the fence of latent, but underdeveloped, confidence and relied on their more mature peers or the subtle intervention of the supervising instructor to emancipate their self-confidence and activate their responsibility. The normalizing structure of the project methodology along with an etiquette of mutually respectful interaction among team members encourages the fence-sitters to venture out into full membership in the team. Perhaps most importantly, self-confidence and responsibility are two of the 20 socio-emotional skills that Goleman (2001) identifies as critical to success in the workplace. Table 3 in the Appendix enumerates these skills.

**Technology challenge** — Although the Mendix tool was chosen for its "low code" characteristics, many students with only two or three prior courses requiring application development found the execution model difficult to master. Some students "begged off" of development tasks by gravitating toward clerical project functions, for example, presentation development. Others attempted to restrict their efforts to client interaction. Those who accepted software development roles almost exclusively aimed at feasibility rather than efficiency or effectiveness in application design. As a result, there was relatively little refinement or polishing of minimally achieved function in many cases and limited usability testing. There were a few individuals, however, who dove into the tool and were able to produce significant functionality in the relevant time period. They did so however, in most cases, by assuming a much greater responsibility for development and reducing their broader engagement with the team (Seleim, Ashour & Bontis, 2007).

Intellectual capital, produced as social capital that is accrued and shared among teammates, seemed to be important in climbing the technology learning curve. If a sufficient number of students on a team were determined to learn the 460 technology, put in the time, and let go of their frustration, these factors had a significant impact on team performance and was transformative for many students. Perhaps the best coaching for students here can be borrowed from Yoda: "Do. Or do not. There is no try." This statement reflects some tough love (Blatt, 2009) that Yoda gives to Luke in the *Empire Strikes Back*, to remind him that success requires committing oneself to something completely, regardless of the outcome.

**Professionalism and Dispositions** — It is fair to say that any gauge of disposition tended to reveal itself in evidence of a focus on or interpretation of success. Although skillful application of computing knowledge was consistently evident in the interviewees' understanding of their experience, it was likewise evident that attitudes and motivation were equally critical to the students' self-confidence and sense of "being" professional. But developing or reinforcing this sense was not at the forefront of their reflections. The interviews did not reveal any explicit or concerted team effort to develop a shared concept of "success" in their project performance (Clear, 2017) or in their individual achievement. It was obvious, however, that students with an accountability and pride in their effort extended their contributions beyond their teammates who appeared to them as satisfied with "sufficing."

Finally, using a lens of professionalism is an important way to holistically view the competencies identified in our pilot study. As Clear and Clear et al. (2020) explain:

The notion of competence is relational. It brings together disparate things—abilities of individuals (deriving from combinations of attributes) and the tasks that need to be performed in particular situations. Thus competence is conceived of as complex structuring of attributes needed for intelligent performance in specific situations. Obviously it incorporates the idea of professional judgment. This approach has been called the 'integrated' or holistic approach to competence. (Hager, Gonczi & Athanasou, 1994, as quoted by Clear & Clear et al., 2020).

### **Social Capital and Teamwork**

With respect to learning outcomes and team performance, teamwork and focus on a shared

mission were the two themes that anchored most of the student reflections. Based on the insights shared by the students, teamwork was most strongly supported by structural and relational capital whereas mission focus was most strongly supported by relational and cognitive capital. The transformative learning about teamwork that we heard from our interviewees is perhaps best summarized by Attle and Baker (2007, p. 78):

Students intending to embark on professional careers must learn how to work collectively to achieve appropriate objectives. Effective professional preparation for managers, marketers and practitioners fosters well-adjusted individuals who are able to contribute to the team in order to accomplish shared goals.

This finding is particularly important since teamwork, leadership, and communication are all "soft skills" that are highly valued by employers (Nwokeji, Stachel, Holmes & Orji, 2019).

Perhaps the most interesting connection between social capital and teamwork was that high-performing teams accrued cognitive capital by solving problems together. This behavior occurred either as the whole team swarmed to solve a problem or as two or more teammates joined forces until they made a necessary breakthrough. These joint activities are examples of Scrum practices that provided student teams with cognitive capital that increased in value over time. Such practices are learned initially through the naming and framing of supporting concepts and through visual depictions of how to apply them using Scrum. As an example, Figure 2 provides a visualization of 13 critical practices of the Scrum framework depicted in three categories (Rubin, 2012). Although the degree to which cognitive capital was important to individual and team development was a surprise to these authors, the phenomenon of high-functioning, peer-led student teams learning to excel at solving structured and unstructured problems has been reported in other fields (Weimer, 2013).

The findings in this pilot study provide evidence that social capital theory can be applied to analyze the organizational advantage (Nahapiet & Ghoshal, 1998) gained by student teams working together on a design and development project, even one that lasted only one semester. However, social capital is by no means the only theory that is useful for understanding teamwork, mission focus, and team performance. For example, Cha, Park, and Lee (2014) show that psychological proximity among teammates can

increase team quality (Hoegl and Gemuenden, 2001) and team performance, and that social distance can impede them. Likewise, the theories that underpin agile methodologies (Nerur & Balijepally, 2007) are probably a better fit for understanding how teams conducted their workflow management, in particular how teammates integrated into the task process (Vyakarnam & Handelberg, 2005).

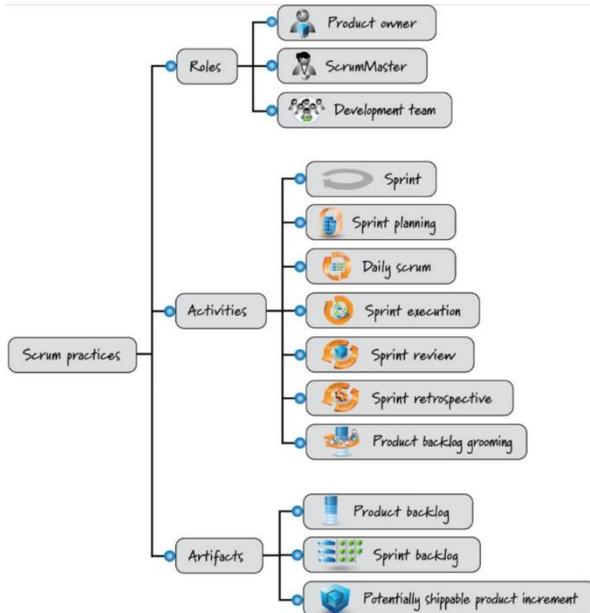


Figure 2. Scrum Practices as Roles, Activities, and Artifacts [Source: Rubin (2012)]

### Social Capital and Mission Focus

The teammates that were alumnae or alumni of the most successful 460 teams were deeply committed to working hard and working collaboratively during their culminating experience. What we heard echoed in their reflections were enablers of a generative and positive team culture. Clear (2017, p. 20) provides examples of these as:

Shared goals, definition of success, incentives; Shared ways of working, responsibility, collective ownership; Shared values, respect and trust; Constant, effortless communication; Continuous experimentation and learning.

In our interviews, we also heard that mission focus had the most impact when a team-defined mission was shared. Embracing a shared mission elicited a collective mindset that tended to produce the best work from the individual members of the team. In these cases, teammates

developed relational resources with their teams—trust, obligation, norms, and identification (Goh & Waskco, 2012; Nahapiet & Ghoshal, 1998). The latter, identification, “the extent to which individuals see themselves as one with another person or collective” (Goh & Waskco, 2012, p. 867) often yielded a shared goal commitment that was infused into the team early in semester and was perpetuated by a sustained focus on the team mission.

Another important component of social capital that supported focus on a mission was trust. Social capital appeared to accrue quickly, and almost effortlessly, in high-trust teams (Druskat & Pescosolido, 2006). Catalyzed by constant communication and effective task-focused processes, these high-trust teams were likely to experience individual and collective transformations. Their learning appeared also to be accelerated by knowledge leadership and knowledge sharing through the mediating role of social capital. This phenomenon has been observed by others as developing a shared vision and collaborative environment in design-intensive projects (Zhang & Cheng, 2015).

Conversely, lack of focus on a shared mission often yielded mediocre team performance. It was difficult for students to explain why this had occurred in their 460 experience; however, we speculate that the absence of a shared reality (Yuan et al., 2009) among teammates was one of the factors that triggered dysfunctional team dynamics throughout their semester.

## 5. DISCUSSION, IMPLICATIONS, AND CONCLUDING REMARKS

### Revisiting the Case for a Capstone Project Management Course in CIS

There are a few arguments to make in favor of a requisite and indispensable view of the capstone: the importance of experience in the cementing process, and the reconciliation of the social and technical as a process of appreciation.

Arguably then, the computer information systems (CIS) capstone provides a design experience that is appreciative in nature (Vickers, 1983). The unfolding events of the capstone—surprises, discoveries, challenges, disappointments, and victories—situate against facts and valuation of the technical skills of design and construction. Regardless of student performance—the excellence begat by motivation, enthusiasm, and diligence, or the struggle of disengagement, confusion, and negligence—all share an

experience that is tangible and relevant (Meyer, Land & Baillie, 2010).

Cherns (1976) provides a set of principles for sociotechnical design that is useful in illustrating the essential nature and function of the capstone experience in CIS undergraduate curricula. In appropriating these principles, we agree with a significant tenet: sociotechnical design is, at its essence, organizational in nature and a social construction (Potter, 1996). However, what sets CIS apart is the spanning and bridging opportunities in the design choices where the social and technical are mutually shaping (Hackman, 1987; Han & Hovav, 2013). For the students, it is an awareness of the role they play in this wider dynamic that is among the greatest aims of a capstone experience within a continuum of practice that stimulates a sociological imagination upon which to draw. Mills (2000) suggests that awareness of how experience reconciles with wider society constitutes the sociological imagination necessary for students to “see” themselves in a professional light, with all attendant rights, responsibilities, and obligations.

Returning to Cherns (1976), we proffer that the student reflections, suggestive of the essential and experiential substance of the capstone, are poignantly apt, salient, and reflective of sociotechnical design. Table 2 in the Appendix provides an account of Cherns’ (1976) principles for sociotechnical design and an extrapolation to summarize the student reflections analyzed in the present study.

We propose that the capstone experience in a CIS curriculum not only aligns well with these principles, but also underscores how student perceptions reflect and resonate with these principles. As such, the selection of Scrum is not only topically and disciplinarily consistent but is also philosophically and epistemologically consistent, assuming that computer information systems is taught as a discipline of design.

### **Implications for CIS Curricula**

If an undergraduate curriculum in computer information systems were a purely technical endeavor, then a cumulative, sum-of-parts approach might suffice. An assumption could be made then that the application of tools and techniques, alone, would provide a sufficient point of departure from which the graduate could embark into professional practice at a novice level. Whereas technical aspects of knowledge and skills—with logical and systems design, with data analysis and design, and with the infrastructure required to deploy and maintain

systems—are a vital component of CIS undergraduate development, they are incomplete in the absence of dispositions. Thus, it is critical that the learning goals for a culminating experience balance validating and applying domain knowledge with learning and practicing professional competencies, e.g., see Table 1. The learning goals of the experience expressed in this table reflect outcome-driven best practices for teaching a team-based capstone within Bentley’s CIS curriculum. An important limitation of this study, however, is that without additional interviews, including with more experienced professionals, it is premature to suggest in what ways these learning goals can be improved and to what extent they can be adapted and used within other curricula.

With a heavy reliance on the context of application—familiarity and acuity within a domain of practice—the CIS student must also develop social, organizational, and design competencies. To balance the technical and social realms, although perhaps a relatable and comprehensible task, requires skill and sensitivity that is often honed through conscious and reflective practice over time (Schön, 1983). As such, the assumptions of a capstone experience, potential misnomer notwithstanding, imply that an applied experience which provides the synthesis between the technical and social, is necessary for an initial “coating” of tacit-generating experience.

As the reflections the students shared were lucid and the experiences clearly impactful, it would be reasonable to support the essential role of the capstone within a curriculum. Particularly, to the degree to which CIS programs also wish to enhance and shape the dispositional qualities of their graduates, we find Cherns’ (1976) sociotechnical design principles are consistent with and are supported by the elements of social capital theory. As a process and application of appreciative system development, the capstone, as a sociotechnical design activity intended to culminate students’ progress through the fundamental elements of their curriculum, builds upon the structural, relational, and cognitive dimensions of social capital. To have cemented these provides a significant running start for students as they progress to the next steps of their professional journey and validates empirically the transformations that we often allude to, or perhaps promise, as critical benefits of a CIS curriculum.

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## Appendix

<b>Design Principle</b>	<b>Essence in Culminating Experience</b>
<b>1: Compatibility</b>	Students learn that problem definition and comprehension are not trivial pursuits.
<b>2: Minimal Critical Specification</b>	Scrum and experience teach students to plan and design iteratively and adaptably.
<b>3: Sociotechnical Criterion</b>	Transparency, inspection, and adaptation afford early comprehension of variance and causality of variance.
<b>4: Organism vs Mechanism</b>	Fundamental importance of a comprehension of the elements that are organic to the client organization best shape the mechanics of the solution.
<b>5: Boundary Location</b>	Demarcating and navigating the operational boundaries, edge cases, and delineations that dispositionally define both the team and the client.
<b>6: Information Flow</b>	Tacit and explicit communication to maintain an empirical basis for the understanding that informs design choices.
<b>7: Support Congruence</b>	The habits and rituals of Scrum should reinforce the efficacy of the team and focus on providing customer value.
<b>8: Design and Human Values</b>	The team has an obligation and responsibility to engage in and produce high-quality work. Scrum teams are self-organizing.
<b>9: Incompletion</b>	Scrum and agile methods acknowledge design and development as reflective and appreciative processes and, as such, a degree of incompleteness surrounds any project.

Table 2. Principles for Sociotechnical Design (Cherns, 1976) with Essence Expressed Through the Voices of Students (McGill, 2012)

	<b>Personal skill</b>	<b>Social skill</b>
<b>Awareness</b>	Emotional self-awareness Self-assessment Self-confidence	Empathy Orientation towards the client Organizational awareness
<b>Management</b>	Emotional self-control Formality Responsibility Adaptability Motivation for success Initiative	Development of others Influence Communication Conflict management Leadership Catalyzing change Building alliances Team-working

Table 3. Socio-Emotional Skills in the Goleman (2001, p. 28) Model

<b>Disposition</b>	<b>Elaboration</b> , adapted from (Baron & Kenny, 1986; Clear, 2017; Gray, 2015; Nwokeji, Stachel, Holmes & Orji, 2019)
<b>Proactive</b>	<i>With Initiative / Self-Starter</i> Shows independence. Ability to assess and start activities independently without needing to be told what to do. Willing to take the lead, not waiting for others to start activities or wait for instructions.
<b>Self-Directed</b>	<i>Self-motivated / Self-Directed</i> Demonstrates determination to sustain efforts to continue tasks. Direction from others is not required to continue a task toward its desired ends.
<b>Passionate</b>	<i>With Passion / Conviction</i> Strongly committed to and enthusiastic about the realization of the task or goal. Makes the compelling case for the success and benefits of task, project, team or means of achieving goals.
<b>Purpose-Driven</b>	<i>Purposefully engaged / Purposefulness</i> Goal-directed, intentionally acting and committed to achieve organizational and project goals. Reflects an attitude

	towards the organizational goals served by decisions, work or work products. e.g., Business acumen.
<b>Professional</b>	<i>With Professionalism / Work ethic.</i> Reflecting qualities connected with trained and skilled people: Acting honestly, with integrity, commitment, determination and dedication to what is required to achieve a task.
<b>Responsible</b>	<i>With Judgement / Discretion / Responsible / Rectitude</i> Reflect on conditions and concerns, then acting according to what is appropriate to the situation. Making responsible assessments and taking actions using professional knowledge, experience, understanding and common sense. E.g., Responsibility, Professional astuteness.
<b>Adaptable</b>	<i>Adaptable / Flexible / Agile</i> Ability or willingness to adjust approach in response to changing conditions or needs.
<b>Collaborative</b>	<i>Collaborative / Team Player / Influencing</i> Willingness to work with others; engaging appropriate involvement of other persons and organizations helpful to the task. Striving to be respectful and productive in achieving a common goal.
<b>Responsive</b>	<i>Responsive / Respectful</i> Reacting quickly and positively. Respecting the timing needs for communication and actions needed to achieve the goals of the work.
<b>Meticulous</b>	<i>Attentive to Detail</i> Achieves thoroughness and accuracy when accomplishing a task through concern for relevant details.
<b>Inventive</b>	<i>Exploratory / Inventive</i> Looking beyond simple solutions. Examining alternative ideas and solutions; seeks, produces, and integrates appropriate alternatives.

Table 4. Prospective Dispositions Summarized in the CC2020 Report (Clear & Parrish et al., 2020)