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Student Engagement in IT Programs: What NSSE Captures and What It Misses

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Abstract

Are IT students truly disengaged, or do our assessment tools fail to recognize their unique modes of engagement? This work examines how well the National Survey of Student Engagement (NSSE) captures student engagement in Information Technology (IT) programs. The NSSE emphasizes group work, class discussions, and cross-disciplinary assignments, activities that diverge sharply from the common practices in IT, which often include solo work, lengthy periods of concentration, and complex system design. IT students also differ in how they interact with technology, engage with peer students, and learn, but NSSE does not account for these differences. As a result, NSSE data tends to underrepresent the real engagement of IT students. This misalignment underestimates the support and challenges IT students experience and motivates IT educators to change teaching practices to match the survey instead of the students. As a discipline, we need new measures that reflect how our students actually learn and work. Better tools will support improved teaching, more accurate engagement data, and higher rates of degree completion.

Keywords: National Survey of Student Engagement (NSSE), Information Systems Education, Computer Science Education, Student Engagement Measurement, ABET, Higher Education.

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Student Engagement in IT Programs: What NSSE Captures and What It Misses

James Wolf and Pruthikrai Mahatanankoon

1. INTRODUCTION

Results from the National Survey of Student Engagement (NSSE) and similar international instruments suggest that information technology (IT) students consistently self-report low student engagement scores (Butler et al., 2016; Morgan et al., 2018a, 2018b), leading some IT educators to suggest the need to strengthen student engagement as a key component in solving many of computing education's well-known troubles (Morgan et al., 2018a, 2018b). Yet the unique nature of IT learning itself offers plausible explanations for the low NSSE scores among IT students. This context leads to an intriguing question: Are IT students truly disengaged, or have our assessment tools failed to accurately measure their unique modes of engagement?

NSSE, pronounced "Nessie" like the mythical Scottish lake creature, is the most widely used benchmark for assessing North American undergraduate student engagement. Although the survey is respected and validated (Kuh et al., 2008), it is geared toward more traditional classes, with items covering the number of papers written, the length of papers, and the frequency of class presentations (Kuh, 2001). Meanwhile, IT classes focus less on the types of collaborations NSSE measures, such as including diverse political, religious, racial/ethnic, and gender perspectives or connecting learning to societal problems or issues. Indeed, many of NSSE's items have little to nothing to do with instruction or assessments commonly employed in IT classes, whose curriculum is typically skill- and logic-oriented, emphasizing technical skill acquisition over other forms of academic interaction. IT education is often characterized by more individualistic learning, with tasks like coding or system design demanding deep, solitary focus.

The distinctive nature of IT education and the narrow focus of the NSSE survey means that it, and other similar surveys, could present a misleading picture of the hours students spend in intense, solitary coding—a highly engaging activity for many IT students, particularly those with autistic traits conducive to "flow states"—as disengagement rather than productive forms of

deep learning engagement (Heasman et al., 2024; Rapaport et al., 2024). Therefore, the low NSSE scores among IT students may not be evidence of a lack of engagement per se, but rather an indication that the instrument does not fully capture these students' modes of engagement.

An added degree of urgency to accurately measure IT student engagement comes from the push to use national student engagement surveys, like NSSE, as performance indicators that affect funding. In the U.S., Australia, and the UK, links between these surveys and tuition fees or funding have been proposed, tested, or dropped (Butler et al., 2016; Morgan et al., 2018b).

2. STUDENT ENGAGEMENT

Student engagement, which refers to a student's psychological commitment to acquiring, comprehending, and excelling in the skills and knowledge required for academic tasks (Lamborn et al., 1992), is one of the most extensively studied constructs in education due to its positive links with academic performance, retention, and graduation (Fredricks & McColskey, 2012; Morgan et al., 2018a, 2018b). Engaged students are more likely to stay in school, learn more, perform better academically, and reach their goals (Fredricks et al., 2004; Kuh, 2001; Morgan et al., 2018a; Morgan et al., 2018b). Student engagement has three distinct components: cognitive, behavioral, and emotional engagement (Fredricks & McColskey, 2012; Wong & Liem, 2022).

Cognitive engagement involves a willingness to invest effort to understand complex ideas and master difficult skills. It can range from "deep" engagement, which involves actively using prior knowledge and creating complex knowledge structures, to "shallow/surface" engagement, characterized by rote processing and mechanical actions such as verbatim memorization (Greene, 2015; Mahatanankoon & Wolf, 2021). Self-regulation, including goal-setting, planning, monitoring, and self-reflection, is also part of cognitive engagement (Greene, 2015; Greene et al., 2004; Greene & Miller, 1996).

Emotional engagement reflects how students feel about their learning experiences. It can include feelings of interest, enjoyment, enthusiasm, vigor, and alertness (Fredricks & McColskey, 2012; Wong & Liem, 2022). Emotional engagement also involves students' identification with their school, including a sense of belonging and valuing their education.

Behavioral engagement refers to students' active participation and involvement in academic, social, and/or extracurricular activities, characterized by their effort and adherence to school and classroom norms (Fredricks & McColskey, 2012; Wong & Liem, 2022). Examples include paying attention in class, exerting effort, persisting in carrying out tasks, completing homework, participating in discussions, attending school, and engaging in extracurricular activities.

The bulk of existing studies on instructional innovation in IT have focused on students' behavioral engagement, as it is the easiest of the three engagement components to observe and measure. Excellent examples of such behavioral work include Davies (2002), Hakkarainen and Palonen (2003), and Hew and Cheung (2008). Similarly, the majority of items in existing student engagement scales, such as NSSE, also capture student behavior (Butler et al., 2016).

NSSE

NSSE was launched in 2000 (Kuh, 2001) and was originally funded by a grant from the Pew Charitable Trusts. By shifting to web-based surveys and attracting more colleges, NSSE became self-sustaining through institutional user fees in 2003 (Kuh, 2009). NSSE was designed as an alternative to college rankings, which often provide little insight into the actual student experience (Kuh, 2001, 2009). Although most collegiate rankings focus on reputation and resources (e.g., student SAT scores, faculty credentials, library holdings), NSSE focuses on active participation in practices linked to enhanced learning and development (Kuh, 2001, 2003, 2009).

Each year, NSSE surveys first-year and senior students at four-year institutions to understand their behavior and experiences related to learning and personal development (Kuh, 2001, 2003). NSSE was adopted rapidly, administered to approximately 75,000 students at 276 schools in its first national administration in 2000, to more than 220,000 students from about 320 institutions by 2001, accumulating data from 285,000 first-year and senior students from more than 600 four-year colleges and universities in its

first three years (Kuh, 2001, 2003). In 2023, 354,067 students at 543 American and Canadian institutions completed the survey (National Survey of Student Engagement, 2023).

Rather than directly assessing student learning outcomes, NSSE measures students' participation in practices associated with educational outcomes and groups the practices into five benchmarks: level of academic challenge, active and collaborative learning, student-faculty interaction, enriching educational experiences, and supportive campus environment (Kuh, 2001, 2003, 2009). These five benchmarks allow for institutional comparisons and the ability to pinpoint areas for improvement.

Student engagement comprises two parts: one linked to the students and the other centered around the institution (Kuh, 2001; Wolf-Wendel et al., 2009). The organization-centered aspect relates to how higher education institutions allocate resources and structure learning opportunities to encourage student participation, whereas the student-centered aspect assesses students' time and effort in their studies (Kuh, 2001). NSSE captures both organization-centered and student-centered aspects of student engagement (Kuh, 2001, 2003).

Studies on the link between NSSE scores and academic success have produced mixed results. Although some find that higher institutional NSSE scores correlate with greater collegiate success (Kuh et al, 2008; Pike, 2013), critics have noted imperfect alignment between NSSE survey items and direct learning measures or student grade point averages (Campbell & Cabrera, 2011; Gordon et al., 2007; Porter et al., 2011; Price & Baker, 2012). Moreover, NSSE was designed for campus-level benchmarking, not for evaluating individual departments or majors (Kuh, 2001, 2003, 2009). For individual departments and programs, higher education relies on specialized accreditations—such as AACSB, ABET, or similar quality assurance processes. As a result, our concerns about the survey are not with NSSE per se, but with the way NSSE data are being misinterpreted by university administrators.

Student engagement matters; how we measure it matters more. Student engagement is widely viewed as central to learning. But it is unclear whether NSSE fits disciplines like IT, where pedagogy, outcomes, and student experience often differ from the norm.

3. UNIQUENESS OF IT EDUCATION

IT professionals, students, and faculty differ from their peers in other fields in how they think, work, and learn. The culture prizes technical skill, structure, and extended periods of individual effort. These traits contrast with the collaborative and discussion-based activities that dominate other disciplines, raising questions about whether current engagement measures fit the field at all. The following sections explore these differences by examining IT education from the perspectives of IT professionals and students.

IT Professionals are Different

IT professionals differ from others in their work culture, required skills, personal traits, and reasons for changing jobs. IT culture values technical skills and informal practices. Professionals rely heavily on jargon, enjoy a great deal of freedom, and deal frequently with change (Guzman et al., 2004; Jacks et al., 2018; Prommegger et al., 2020; Rao & Ramachandran, 2011). This autonomy brings constant pressure and tight deadlines, creating a sense of endless tasks (Ahuja et al., 2007; Armstrong et al., 2015; Joseph et al., 2011; Rutner et al., 2011; Zhang et al., 2012).

Another issue is rapid technological change. Rapid technological change means continuous learning is necessary to remain useful (Benamati & Lederer, 2001; Rong & Grover, 2009); thus, IT professionals must continually update their skills in technical areas, business knowledge, and communication (Gonçalves et al., 2024; Riemenschneider & Armstrong, 2021). In addition, IT jobs blend creativity with logic. Although IT professionals gain respect for their technical skills, they tend to face stereotypes about their poor social skills. They often prefer working with machines and speak in technical terms while ignoring social norms (Glen, 2002; Moore & Love, 2011). These mixed public perceptions—namely, admiration for technical expertise alongside criticism of individuals' poor communication skills—are further strengthened by the fact that the computing profession lacks widely accepted ethical standards or consistent certifications, unlike fields such as law or medicine (Denning, 2001).

Although many IT roles require teamwork, professionals typically have lower social needs but a strong motivation to succeed (Balijepally et al., 2006; Lounsbury et al., 2007; Prommegger et al., 2020). Different career paths and changing job prospects also motivate them to engage in continuous skill improvement (Joseph et al.,

2011; Zhang et al., 2012). Indeed, experienced IT workers prefer roles offering growth, new technologies, and skill development (Niederman et al., 2016; Prommegger et al., 2020). However, heavy workloads drive them away from positions, particularly in agile environments requiring frequent interactions and tight deadlines (Chilton et al., 2010; Meske & Junglas, 2021; Tuomivaara et al., 2017; Zaza et al., 2023). IT workers often feel a loyalty to the profession that outweighs loyalty to an employer; as a result, they frequently switch companies (Jacks & Palvia, 2014; Joseph et al., 2012, 2015; Zaza et al., 2023). To help retain workers, companies should offer meaningful support, including effective tools and fair working conditions (DeConinck & Stilwell, 2004).

Personality also shapes IT professionals' experiences. Computing roles often suit neurodivergent people, particularly those with autism. Tasks tend to be logical, structured, and predictable, matching common autistic preferences (Grandin & Panek, 2013). Not surprisingly, many IT professionals show higher levels of autistic traits compared to the general population, leading them to experience increased stress and lower coping abilities. Such traits relate to lower emotional control and higher burnout risks (Hill, 2004; Hirvikoski & Blomqvist, 2015; Ilen et al., 2024; Jia et al., 2022, 2024).

Yet many IT jobs also involve less emotional labor compared to service roles, thereby reducing stress related to managing emotional expressions (Jia et al., 2024, 2025). Collaboration exists, but tasks like coding provide long periods for individual focus and minimal social interaction (Armstrong, 2012). This mix of structure, low emotional demands, and solo work may offer relief to people who find social ambiguity or emotional display exhausting.

IT Students are Different

Computing majors have historically faced gender and racial diversity issues (Mahatanankoon et al., 2012). Women and students from historically underrepresented backgrounds have lower representation and retention rates in computing programs than white and Asian men (Lehman et al., 2023; Salguero et al., 2021; Whitney et al., 2013). Despite enrollment numbers for women and underrepresented students increasing in recent years, these students leave computing majors at higher rates than their counterparts (Lehman et al., 2023).

IT draws people with specific thinking styles, communication habits, and work preferences. For

example, people with autistic traits have higher intrinsic interest in computing technology (Jia et al., 2022). This interest may reflect neurological patterns that align with the nature of the work (Jia et al., 2022). IT students are motivated by innovative technologies, hands-on experiential learning, and skill development. Research on IT adoption suggests that individuals differ in their uniqueness. Personal Innovativeness in IT (PIIT) also explains why some people strongly engage with technology. Agarwal and Prasad (1998) defined PIIT as "the willingness of an individual to try out any new information technology" (p. 206). PIIT appears in major models, such as the technology acceptance model (TAM) (Davis, 1989) and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003). Rosen (2005) and Rosen and Kluemper (2008) found that traits linked to autism, such as deep focus and narrow interests, often predict higher PIIT, which plays a central role in technology acceptance. These traits often fall outside the norms assumed by standard surveys and evaluations. When those tools fail to reflect the reality of IT learning and teaching, the blame shifts to the people, not the instruments. While NSSE captures engagement for many students, it misses it for others, especially those in computing programs.

In sum, the professional demands of IT careers and the learning needs of IT students underscore the need for appropriate engagement measures in IT programs, centered on traits, interaction with technology, and skill development rather than interpersonal engagement.

4. NSSE ENGAGEMENT PATTERNS AMONG IT STUDENTS

Year in College	ALL	CS	IS
1	35.24	34.46	33.79
4	36.26	33.32	32.56

Table 1: 2023 Average Scores by Year and Major

This section reports annual results from the 2023 NSSE survey (National Survey of Student Engagement, 2023). Throughout this paper, we use "Information Technology (IT)" as an umbrella term that includes all computing majors. In the NSSE dataset, the reported categories that fall within IT are Computer Science (CS) and Information Systems (IS), so we treat them as proxies for IT students. Table 1 shows a summary of 2023 NSSE Engagement Indicator average

scores across all measured constructs for students in all majors, Computer Science (CS) majors, and Information Systems (IS) majors. CS and IS majors tend to have lower average NSSE scores compared to other majors in both their first and fourth years, with the disparity appearing to be more pronounced for fourth-year students. While the average engagement for all majors increased from year 1 to year 4, the average engagement for both CS and IS majors decreased over the same period, further widening the disparity. The first to fourth year decrease in NSSE scores found in the 2023 survey is consistent with earlier findings (Morgan et al., 2018a, 2018b; Sinclair et al., 2015).

Engagement Indicator	All Majors	IS	CS
Collaborative Learning	30.3	20.7	30.8
Discussions with Diverse Others	38.5	34.2	38.0
Learning Strategies	38.7	39.5	36.4
Student-Faculty Interaction	22.7	19.9	20.5
Reflective & Integrative Learning	36.3	34.8	34.3

Table 2: 2023 First-Year IS and CS Students: Engagement Indicators with Large Performance Gaps

Table 2 shows that lower NSSE scores for CS and IS students are apparent even in their first year, though concentrated in specific areas. Information systems students have the largest gap in collaborative learning, scoring 9.6 points below the NSSE average (20.7 vs. 30.3), suggesting significant incongruence with NSSE's proxy for peer-to-peer learning activities. Both majors struggle substantially with student-faculty interaction, with CS students scoring 2.2 points below average and IS students 2.8 points below. CS students also show notably lower scores in NSSE items for learning strategies (-2.3 points) and reflective and integrative learning (-2.0 points). Curiously, IS students score lower on items involving diverse others (-4.3 points), while CS students perform at or near average in this area.

Table 3 shows increased NSSE score gaps by senior year, with both majors now showing substantial gaps across most indicators. The size of these gaps also increases, with reflective and integrative learning becoming the area with the largest gap for CS students (-6.2 points) and collaborative learning remaining the largest gap

for IS students (-7.2 points). Student-faculty interaction deficits worsen for both majors, reaching -4.8 points for CS and -5.4 points for IS.

Perhaps most troubling, new areas of NSSE score gaps emerge by senior year, including learning strategies for CS students (-4.6 points), higher-order learning for both majors (CS: -3.8, IS: -2.0), and effective teaching practices (CS: -3.1, IS: -2.2). This pattern suggests one of two possibilities: either computing students grow less engaged across multiple dimensions of their educational experience, or the NSSE fails to capture important ways IT students engage as they progress through their computing degree programs.

Engagement Indicator	All Majors	IS	CS
Collaborative Learning	31.1	23.9	31.7
Reflective & Integrative Learning	39.3	34.6	33.1
Student-Faculty Interaction	25.1	19.7	20.3
Discussions with Diverse Others	39.0	34.2	36.9
Learning Strategies	39.5	38.3	34.9
Higher-Order Learning	41.1	39.1	37.3
Effective Teaching Practices	40.4	38.2	37.3
Supportive Environment	32.5	30.9	30.3

Table 3: 2023 Senior IS and CS Students: Engagement Indicators with Largest Performance Gaps

Engagement Indicator	All Majors	IS	CS
Quality of Interactions	43.5	45.5	43.2
Quantitative Reasoning	29.4	30.4	30.0
Effective Teaching Practices	38.7	40.0	38.5
Learning Strategies	38.7	39.5	36.4
Higher-Order Learning	38.8	39.3	38.3
Collaborative Learning	30.3	20.7	30.8

Table 4: 2023 First-Year IS and CS Students: Engagement Indicators with Strongest Relative Performance

Table 4 identifies several areas where first-year CS and IS students demonstrate competitive or superior NSSE scores compared to their peers.

Both majors excel in quantitative reasoning, with CS students scoring 0.6 points above average and IS students 1.0 points above, reflecting the mathematical foundations of computing disciplines. Information systems students show particular strength in quality of interactions (+2.0 points), effective teaching practices (+1.3 points), learning strategies (+0.8 points), and higher-order learning (+0.5 points), suggesting they enter college with strong interpersonal and academic skills. Computer science students perform above average in collaborative learning (+0.5 points) during their first year. These relative strengths indicate that computing students possess important capabilities upon entry, particularly in analytical thinking and, for IS students, in several interpersonal and learning domains.

Engagement Indicator	All Majors	IS	CS
Quality of Interactions	43.2	44.7	41.7
Collaborative Learning	31.1	23.9	31.7
Quantitative Reasoning	31.4	31.3	29.7

Table 5: 2023 Senior IS and CS Students: Engagement Indicators with Strongest Relative Performance

Table 5 reveals a dramatic reduction in areas of relative strength by senior year, with only three indicators where either major performs competitively compared to NSSE averages. Information systems students maintain their strength in quality of interactions (+1.5 points) throughout college, suggesting sustained interpersonal competencies. CS students only show above-average performance in collaborative learning (+0.6 points), though this represents a notable shift from IS students' first-year strength in this area. Both majors perform near average in quantitative reasoning, though CS students drop below average (-1.7 points) while IS students maintain near-parity (-0.1 points). NSSE scores show a drop from six areas of relative strength in the first year to only three by senior year. This pattern further suggests that the NSSE survey may be missing key ways computing students engage as they progress through their degree programs.

To support our argument, we also collected ABET's CAC Student Outcomes (see the Appendix) and correlated them with NSSE's learning-related items, i.e., collaborative learning (CL), higher-order learning (HO), learning strategies (LS), and reflective and integrative

learning (RI). ABET's CAC Student Outcomes (see Section 9, the Appendix) are required for any ABET-accredited computing program. We conducted an exploratory stepwise linear regression to determine which NSSE learning engagement indicators best predict ABET's CAC Student Outcomes. While our sample sizes are small (number of students (n)=46), Table 6 reveals that, for CS students, LS ($\beta=.570$, $p<.01$) and CL ($\beta=.298$, $p<.01$) are the best predictors for ABET's Student Outcomes ($R^2=.52$, $F=16.52$, $p<.001$). Only LS ($\beta=.68$, $p<.01$) was a strong predictor for ABET's Student Outcomes ($R^2=.52$, $F=10.34$, $p<.01$) for the IS students.

Major	n	INV	β	p	$R^2(DV)$
CS	33	LS	.570	<.001	.524
		CL	.298	.033	
IS	13	LS	.680	.007	.462

Table 6: NSSE's Predictors (INV) of ABET's Student Outcomes (DV)

The results suggest that IT students are uniquely individualistic because the LS items capture the behaviors that can be accomplished individually. See Section 9, the Appendix. The reason for the significant CL result among CS students could be related to the need for study groups and team efforts on complex coding projects. More data is needed.

5. DISCUSSION

This work explored whether NSSE is a good tool for measuring student engagement in IT programs. More broadly, it asked: *Why do so many accept the claim that IT students are not engaged, despite overwhelming evidence to the contrary? In other words, is NSSE effective for IT students, and to what extent?*

As mentioned earlier, IT students and professionals often think and communicate in distinct ways. They hold technical interests that set them apart, follow social values that differ from the mainstream, and develop work habits that do not match common expectations.

Figure 1 shows that both computer science (CS) and information systems (IS) majors have lower average NSSE scores than other majors in both their first and fourth years. Whereas the average engagement for all majors increased from the first to fourth years, the average engagement for both CS and IS majors decreased over the same period, further widening the disparity. These results are consistent with earlier research (Morgan et al., 2018; Sinclair et al., 2015).

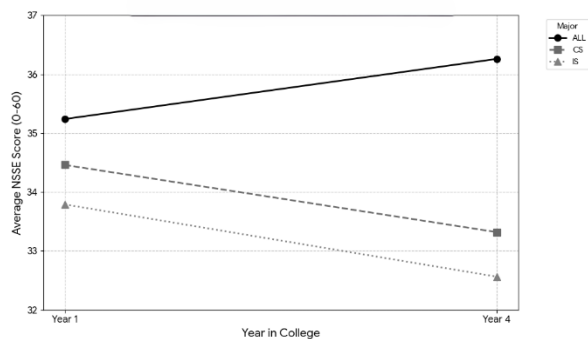


Figure 1: 2023 Overall Average NSSE Scores by Year and Major

This first-year to fourth-year engagement decline suggests that something is amiss with NSSE measures and is perhaps the strongest argument against NSSE's accuracy. NSSE data suggest that fourth-year IT students, who have already passed the notoriously difficult introductory courses and are the nearest to successful degree completion, report lower NSSE scores than first-year computing majors (Morgan et al., 2018; Sinclair et al., 2015). Obviously, given the gaps in understanding, more work is needed to determine the exact cause of the first-year to fourth-year decline in NSSE scores. Nonetheless, Table 6 shows that one of the NSSE measurements, i.e., Learning Strategies, correlates with ABET outcomes. The finding indicates that IT students are engaging in both rote and analytical learning, i.e., reading assignments, reviewing class notes, and summarizing course materials, to build advanced IT skills aligned with ABET's student learning outcomes. But these learning strategies decline over time as IT students approach graduation. Refer to Tables 2 and 3. We can attribute this decline to two factors: 1) the changes in the IT discipline that focus on hands-on practice and the focus of building IT artifacts, which often requires a high level of cognitive effort (Mahatanankoon and Wolf, 2025), and 2) NSSE's Higher-Order Learning does not capture IT's "higher-order" student learning activities or ABET's Student Outcomes. The second reason deserves further investigation.

We observe that NSSE's Collaborative Learning score for IS freshmen is 9.6 points below the NSSE average. Refer to Table 2. But Table 3 shows higher levels of NSSE's Collaborative Learning among senior IT students (+15% for IS; +3% for CS) than among freshmen. It is considered a positive finding as Collaborative Learning is the foundational soft skill for information systems development. While it is difficult for us to increase Collaborative Learning among IS freshmen due to general education

requirements and foundational programming classes, we can design assignments that emphasize collaboration in their sophomore and junior years. The positive changes in NSSE observed among senior IS students suggest we are moving in the right direction.

The decreased levels of NSSE's Quality of Interactions within the campus environment among IT seniors are discouraging, but understandable from an IT standpoint. As students approach their graduation, they focus more on job interviews and less on campus activities.

The preliminary investigation substantiates our original premise that the existing NSSE constructs do not capture the essence of IT student engagement and the student learning outcomes demanded by IT curricula. To some extent, all NSSE's constructs serve as a guide to what any undergraduate major needs to accomplish, but NSSE may not be effective for IT students.

NSSE is invaluable and has been well-established. Higher education and its administrators will continue to use NSSE, but IT educators should modify NSSE's constructs or perform item-level analyses to fit their IT curricula, including adopting some of its measurement items to support their students' learning needs and accreditation process.

Regardless, we caution IT faculty and administrators against gaming the system by "teaching to the survey." To improve NSSE scores, IT faculty might cynically engage in assessment-driven instruction by incorporating more research papers and presentations into the curriculum. However, these changes may improve NSSE scores while having little positive impact on IT student engagement or learning.

6. IMPLICATIONS

Changing the curriculum to "game the NSSE survey" could lead to an engagement paradox, which describes situations in which efforts to increase engagement lead to unintended or contradictory outcomes, such as disengagement, overload, or diminished returns (Elamer & Kato, 2025; Huang & Zhang, 2019; Ludike, 2018; Permann-Graham et al., 2025; Shernoff & Schmidt, 2008). In information systems and management research, this paradox is particularly relevant in areas such as digital platforms, employee experience management, performance systems, and user interactions with social media (Elamer & Kato, 2025; Huang &

Zhang, 2019; Hou et al., 2025; Ludike, 2018).

Other possible unintended consequences of gaming the NSSE survey stem from Campbell's Law and its close cousin, Goodhart's Law. Goodhart's Law states that "when a measure becomes a target, it ceases to be a good measure" (Goodhart, 1984). In other words, when a metric is transformed into a goal, measured entities may strategically alter their behavior specifically to achieve the target metric (Burton-Jones, 2023; Fire & Guestrin, 2019; Treem et al., 2023). The original purpose and validity of the measure are corrupted by this strategic behavior. Strategic behavior is also captured by Campbell's Law, which states that *"The more any quantitative social indicator is used for social decision-making, the more subject it will be to corruption pressures and the more apt it will be to distort and corrupt the social processes it is intended to monitor."* (Campbell, 1979).

Several studies within the IT literature show that fixation on decision-making metrics creates incentives for strategic behavior. For example, reputation systems build user trust and enable online transactions among distant strangers, but these systems are also susceptible to gaming (Dellarocas, 2003, 2005; Friedman & Resnick, 2001). Similarly, He et al. (2022) found that tying monetary rewards to metrics for user-generated content leads to unintended behavioral distortions. Likewise, work in finance (Franco-Santos & Otley, 2018; Jensen, 2003) and health care (Agarwal et al., 2010; Edwards, 2019; Muller, 2018; Rabiei & Almasi, 2022) has demonstrated that basing rewards or penalties on performance metrics inevitably leads to system gaming and information manipulation.

When "test scores become the goal of the teaching process, they both lose their value as indicators of educational status and distort the educational process in undesirable ways" (Fire & Guestrin, 2019). Similarly, if IT faculty adopt strategies to boost NSSE results, effectively teaching to the survey, NSSE scores may go up, but the actual level of engagement or quality of the educational experience may suffer.

A better strategy—and one we endorse—is for IT faculty to develop more accurate discipline-specific measures of *learning performance* and *student engagement*. IT educators desperately need empirically grounded tools and strategies to expand the field's appeal, especially among women and underrepresented groups, while sustaining the curiosity and commitment of

students and faculty intrinsically interested in computing and technology. Mahatanankoon and Wolf (2025) propose that there are different levels of cognitive engagement in computer programming activities and argue for the use of multi-level learning strategies equivalent to those in Bloom's taxonomy. If the educational objectives of CS and IS are to focus on "experiential learning," thereby creating practical IT artifacts during students' senior years, then it would be advantageous to retrofit NSSE's measures or create new ones that can measure IT-based student engagement as students progress through their degree programs.

In the meantime, accredited IT programs can insert additional "performance indicators" and "student outcomes" that go beyond accreditation criteria. These additions may strengthen the dimensions measured by NSSE. In addition, different types of student engagement instruments, i.e., cognitive, behavioral, and emotional, may also be used to indirectly assess student learning outcomes. For example, these engagement measures may ask about assignments that encourage deep learning (cognitive engagement), actively mentoring junior peers (behavioral engagement), or having an affinity toward IT (emotional engagement). Not all degree programs have accreditation. However, those that do can add their own student learning outcomes in addition to the mandatory ones set by the accrediting body (Leidig, 2022).

7. CONCLUSION

The nature of the IT discipline is unique in terms of its skillset, the diversity of its students and professionals, and the nature of its work and careers. The mixed NSSE scores among IT students compared to other majors should motivate us to explore new or enhanced engagement measures. Future measures may include attributes distinctive to IT students, including motivation, IT work culture, skills, gender, personality traits, and neurodiversity. It is our hope that this paper will inspire IT educators and researchers to explore innovative engagement measures in the context of the IT discipline.

8. REFERENCES

- Agarwal, R., Gao, G. (Gordon), DesRoches, C., & Jha, A. K. (2010). The Digital Transformation of Healthcare: Current Status and the Road Ahead. *Information Systems Research*, 21(4), 796–809. <https://doi.org/10.1287/isre.1100.0327>
- Agarwal, R., & Prasad, J. (1998). A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology. *Information Systems Research*, 9(2), 204–215. <https://doi.org/10.1287/isre.9.2.204>
- Ahuja, Chudoba, Kacmar, McKnight, & George. (2007). IT Road Warriors: Balancing Work-Family Conflict, Job Autonomy, and Work Overload to Mitigate Turnover Intentions. *MIS Quarterly*, 31(1), 1. <https://doi.org/10.2307/25148778>
- Armstrong, D. J., Brooks, N. G., & Riemenschneider, C. K. (2015). Exhaustion from Information System Career Experience: Implications for Turn-Away Intention. *MIS Quarterly*, 39(3), 713–727. <http://dx.doi.org/10.25300/misq/2015/39.3.10>
- Armstrong, T. (2012). *Neurodiversity in the classroom: Strength-based strategies to help students with special needs succeed in school and life*. ASCD.
- Balijepally, V., Mahapatra, R., & Nerur, S. P. (2006). Assessing Personality Profiles of Software Developers in Agile Development Teams. *Communications of the Association for Information Systems*, 18. <https://doi.org/10.17705/1CAIS.01804>
- Benamati, J., & Lederer, A. (2001). Rapid Information Technology Change, Coping Mechanisms, and the Emerging Technologies Group. *Journal of Management Information Systems*, 17(4), 183–202. <https://doi.org/10.1080/07421222.2001.11045663>
- Burton-Jones, A. (2023). What Makes a Journal Significant? From the Tyranny of Metrics to True Impact. *MIS Quarterly*, 47(2), i–xiv. Computers & Applied Sciences Complete.
- Butler, M., Sinclair, J., Morgan, M., & Kalvala, S. (2016). Comparing international indicators of student engagement for computer science. *Proceedings of the Australasian Computer Science Week Multiconference*, 1–10. <https://doi.org/10.1145/2843043.2843065>
- Campbell, C. M., & Cabrera, A. F. (2011). How sound is NSSE?: Investigating the psychometric properties of NSSE at a public, research-extensive institution. *The Review of Higher Education*, 35(1), 77–103. <https://doi.org/10.1353/rhe.2011.0035>
- Campbell, D. T. (1979). Assessing the impact of planned social change. *Evaluation and*

- Program Planning*, 2(1), 67–90.
[https://doi.org/10.1016/0149-7189\(79\)90048-X](https://doi.org/10.1016/0149-7189(79)90048-X)
- Chilton, M. A., Hardgrave, B. C., & Armstrong, D. J. (2010). Performance and strain levels of it workers engaged in rapidly changing environments: A person-job fit perspective. *ACM SIGMIS Database: The DATABASE for Advances in Information Systems*, 41(1), 8–35.
<https://doi.org/10.1145/1719051.1719053>
- Davies, C. H. (2002). Student engagement with simulations: A case study. *Computers & Education*, 39(3), 271–282.
[https://doi.org/10.1016/s0360-1315\(02\)00046-5](https://doi.org/10.1016/s0360-1315(02)00046-5)
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.
<https://doi.org/10.2307/249008>
- DeConinck, J. B., & Stilwell, C. D. (2004). Incorporating organizational justice, role states, pay satisfaction and supervisor satisfaction in a model of turnover intentions. *Journal of Business Research*, 57(3), 225–231.
[https://doi.org/10.1016/S0148-2963\(02\)00289-8](https://doi.org/10.1016/S0148-2963(02)00289-8)
- Dellarocas, C. (2003). The Digitization of Word of Mouth: Promise and Challenges of Online Feedback Mechanisms. *Management Science*, 49(10), 1407–1424.
<https://doi.org/10.1287/mnsc.49.10.1407.17308>
- Dellarocas, C. (2005). Reputation Mechanism Design in Online Trading Environments with Pure Moral Hazard. *Information Systems Research*, 16(2), 209–230.
<https://doi.org/10.1287/isre.1050.0054>
- Denning, P. J. (2001). The profession of IT: Who are we? *Communications of the ACM*, 44(2), 15–19.
<https://doi.org/10.1145/359205.359239>
- Edwards, M. S. (2019). The obsession with metrics in contemporary health care. *Journal of Vascular Surgery*, 70(3), 665–671.
<https://doi.org/10.1016/j.jvs.2019.05.026>
- Elamer, A. A., & Kato, M. (2025). Governance dynamics and the human capital disclosure-engagement paradox: A Japanese perspective. *Competitiveness Review: An International Business Journal*, 35(1), 76–99.
<https://doi.org/10.1108/cr-09-2023-0225>
- Fire, M., & Guestrin, C. (2019). Over-optimization of academic publishing metrics: Observing Goodhart's Law in action. *GigaScience*, 8(6), giz053.
<https://doi.org/10.1093/gigascience/giz053>
- Franco-Santos, M., & Otley, D. (2018). Reviewing and theorizing the unintended consequences of performance management systems. *International Journal of Management Reviews*, 20(3), 696–730.
<https://doi.org/10.1111/ijmr.12183>
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School Engagement: Potential of the Concept, State of the Evidence. *Review of Educational Research*, 74(1), 59–109.
<https://doi.org/10.3102/00346543074001059>
- Fredricks, J. A., & McColskey, W. (2012). The Measurement of Student Engagement: A Comparative Analysis of Various Methods and Student Self-report Instruments. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of Research on Student Engagement* (pp. 763–782). Springer US.
https://doi.org/10.1007/978-1-4614-2018-7_37
- Friedman, E. J., & Resnick, P. (2001). The Social Cost of Cheap Pseudonyms. *Journal of Economics & Management Strategy*, 10(2), 173–199.
<https://doi.org/10.1111/j.1430-9134.2001.00173.x>
- Glen, P. (2002). *Leading geeks: How to manage and lead the people who deliver technology*. John Wiley & Sons.
- Gonçalves, R. F., Passos, O. M., & De Amorim, R. X. (2024). Investigating the Competencies and Skills of Computer Professionals. *Proceedings of the 20th Brazilian Symposium on Information Systems*, 1–10.
<https://doi.org/10.1145/3658271.3658308>
- Goodhart, C. A. E. (1984). Problems of Monetary Management: The UK Experience. In C. A. E. Goodhart (Ed.), *Monetary Theory and Practice: The UK Experience* (pp. 91–121). Macmillan Education UK.
https://doi.org/10.1007/978-1-349-17295-5_4
- Gordon, J., Ludlum, J., & Hoey, J. J. (2007). Validating NSSE against student outcomes: Are they related? *Research in Higher Education*, 49(1), 19–39.
<https://doi.org/10.1007/s11162-007-9061-8>

- Grandin, T., & Panek, R. (2013). *The autistic brain: Thinking across the spectrum*. Houghton Mifflin Harcourt.
- Greene, B. A. (2015). Measuring Cognitive Engagement with Self-Report Scales: Reflections from Over 20 Years of Research. *Educational Psychologist*, 50(1), 14–30. <https://doi.org/10.1080/00461520.2014.989230>
- Greene, B. A., & Miller, R. B. (1996). Influences on achievement: Goals, perceived ability, and cognitive engagement. *Contemporary Educational Psychology*, 21(2), 181–192. <https://doi.org/10.1006/ceps.1996.0015>
- Greene, B. A., Miller, R. B., Crowson, H. M., Duke, B. L., & Akey, K. L. (2004). Predicting high school students' cognitive engagement and achievement: Contributions of classroom perceptions and motivation. *Contemporary Educational Psychology*, 29(4), 462–482. <https://doi.org/10.1016/j.cedpsych.2004.01.006>
- Guzman, I. R., Stanton, J. M., Stam, K. R., Vijayasri, V., Yamodo, I., Zakaria, N., & Caldera, C. (2004). A qualitative study of the occupational subculture of information systems employees in organizations. *Proceedings of the 2004 SIGMIS Conference on Computer Personnel Research: Careers, Culture, and Ethics in a Networked Environment*, 74–80. <https://doi.org/10.1145/982372.982388>
- Hakkarainen, K., & Palonen, T. (2003). Patterns of female and male students' participation in peer interaction in computer-supported learning. *Computers & Education*, 40(4), 327–342. [https://doi.org/10.1016/s0360-1315\(02\)00134-3](https://doi.org/10.1016/s0360-1315(02)00134-3)
- He, L., Luo, J., Tang, Y., Wu, Z., & Zhang, H. (2022). Motivating user-generated content: Unintended consequences of incentive thresholds. *MIS Quarterly*, 47(3), 1015–1044. <https://doi.org/10.25300/misq/2022/17369>
- Heasman, B., Williams, G., Charura, D., Hamilton, L. G., Milton, D., & Murray, F. (2024). Towards autistic flow theory: A non-pathologising conceptual approach. *Journal for the Theory of Social Behaviour*, 54(4), 469–497. <https://doi.org/10.1111/jtsb.12427>
- Hew, K. F., & Cheung, W. S. (2008). Attracting student participation in asynchronous online discussions: A case study of peer facilitation. *Computers & Education*, 51(3), 1111–1124. <https://doi.org/10.1016/j.compedu.2007.11.002>
- Hill, E. L. (2004). Evaluating the theory of executive dysfunction in autism. *Developmental Review*, 24(2), 189–233. <https://doi.org/10.1016/j.dr.2004.01.001>
- Hirvikoski, T., & Blomqvist, M. (2015). High self-perceived stress and poor coping in intellectually able adults with autism spectrum disorder. *Autism*, 19(6), 752–757. <https://doi.org/10.1177/1362361314543530>
- Hou, J. (Jove), Jiang, D. L., Ma, X., & Gopal, A. (2025). The Costs of Ambiguous Information Disclosure: On the Unintended Consequences of Providing Restaurant Hygiene Scores on Platforms in the United States. *Information Systems Research*, isre.2023.0137. <https://doi.org/10.1287/isre.2023.0137>
- Huang, L. V., & Zhang, K. (2019). Engagement, formality, and visibility: Managing paradoxes of using mobile instant messaging for work. *International Journal of Communication*, 13(2019), 1919–1938. <https://ijoc.org/index.php/ijoc/article/view/7782/2633>
- Ilen, L., Feller, C., & Schneider, M. (2024). Cognitive emotion regulation difficulties increase affective reactivity to daily-life stress in autistic adolescents and young adults. *Autism*, 28(7), 1703–1718. <https://doi.org/10.1177/13623613231204829>
- Jacks, T., & Palvia, P. (2014). Measuring value dimensions of IT occupational culture: An exploratory analysis. *Information Technology and Management*, 15(1), 19–35. <https://doi.org/10.1007/s10799-013-0170-0>
- Jacks, T., Palvia, P., Iyer, L., Sarala, R., & Daynes, S. (2018). An Ideology of IT Occupational Culture: The ASPIRE Values. *ACM SIGMIS Database: The DATABASE for Advances in Information Systems*, 49(1), 93–117. <https://doi.org/10.1145/3184444.3184451>
- Jensen, M. C. (2003). Paying People to Lie: The Truth about the Budgeting Process. *European Financial Management*, 9(3), 379–406. <https://doi.org/10.1111/1468-036X.00226>
- Jia, R., H. Jia, H., & R. Wolf, J. (2025). Executive Dysfunction, Emotion Dysregulation, and IT Employee Burnout. *Proceedings of the 2025 Computers and People Research Conference*,

- 1-3.
<https://doi.org/10.1145/3716489.3728436>
- Jia, R., Riemenschneider, C., & Jia, H. H. (2024). Neurodiversity, Emotional Labor, and Mental Wellbeing in IT Employees. *Proceedings of the International Conference on Information Systems 2024*. 2024 International Conference on Information Systems. https://aisel.aisnet.org/icis2024/digtech_fow/digtech_fow/4/
- Jia, R., Steelman, Z. R., & Jia, H. H. (2022). What Makes One Intrinsically Interested in IT? An Exploratory Study on Influences of Autistic Tendency and Gender in the US and India. *MIS Quarterly*, 46(3), 1603-1634. <https://doi.org/10.25300/misq/2022/16362>
- Joseph, Boh, Ang, & Slaughter. (2012). The Career Paths Less (or More) Traveled: A Sequence Analysis of IT Career Histories, Mobility Patterns, and Career Success. *MIS Quarterly*, 36(2), 427. <https://doi.org/10.2307/41703462>
- Joseph, D., Ang, S., & Slaughter, S. A. (2015). Turnover or Turnaway? Competing Risks Analysis of Male and Female IT Professionals' Job Mobility and Relative Pay Gap. *Information Systems Research*, 26(1), 145-164. <https://doi.org/10.1287/isre.2014.0558>
- Joseph, D., Tan, M. L., & Ang, S. (2011). Is updating play or work?: The mediating role of updating orientation in linking threat of professional obsolescence to turnover/turnaway intentions. *International Journal of Social and Organizational Dynamics in IT (IJSODIT)*, 1(4), 37-47. <https://doi.org/10.4018/ijisodit.2011100103>
- Kuh, G. D. (2001). Assessing What Really Matters to Student Learning *Inside The National Survey of Student Engagement*. *Change: The Magazine of Higher Learning*, 33(3), 10-17. <https://doi.org/10.1080/00091380109601795>
- Kuh, G. D. (2003). What We're Learning About Student Engagement From NSSE: Benchmarks for Effective Educational Practices. *Change: The Magazine of Higher Learning*, 35(2), 24-32. <https://doi.org/10.1080/00091380309604090>
- Kuh, G. D. (2009). The national survey of student engagement: Conceptual and empirical foundations. *New Directions for Institutional Research*, 141, 5-20. <https://doi.org/10.1002/ir.283>
- Kuh, G. D., Cruce, T. M., Shoup, R., Kinzie, J., & Gonyea, R. M. (2008). Unmasking the Effects of Student Engagement on First-Year College Grades and Persistence. *The Journal of Higher Education*, 79(5), 540-563. <https://doi.org/10.1080/00221546.2008.11772116>
- Lamborn, S., Newmann, F., & Wehlage, G. (1992). The significance and sources of student engagement. In *Student engagement and achievement in American secondary schools* (pp. 11-39). ERIC. <https://files.eric.ed.gov/fulltext/ED371047.pdf#page=16>
- Lehman, K. J., Newhouse, K. N. S., Sundar, S., & Sax, L. J. (2023). Nevertheless, They Persisted: Factors that Promote Persistence for Women and Racially/Ethnically Minoritized Students in Undergraduate Computing. *Computer Science Education*, 33(2), 260-285. <https://doi.org/10.1080/08993408.2022.2086401>
- Leidig, P. (2022). Continuous improvement of information systems curricula and accreditation of programs. *Proceedings of the 2022 EDSIG Conference*, Clearwater, FL, v8 n5809. <https://iscap.us/proceedings/2022/pdf/5809.pdf>
- Lounsbury, J. W., Moffitt, L., Gibson, L. W., Drost, A. W., & Stevens, M. (2007). An Investigation of Personality Traits in Relation to Job and Career Satisfaction of Information Technology Professionals. *Journal of Information Technology*, 22(2), 174-183. <https://doi.org/10.1057/palgrave.jit.2000094>
- Ludike, J. (2018). Digital Employee Experience Engagement Paradox: Futureproofing Retention Practice. In M. Coetzee, I. L. Potgieter, & N. Ferreira (Eds.), *Psychology of Retention: Theory, Research and Practice* (pp. 55-73). Springer International Publishing. https://doi.org/10.1007/978-3-319-98920-4_3
- Mahatanankoon, P., Watanapa, B., & Sathapornvajana, S. (2012). Gender gap in Information Technology (IT) majors: a preliminary study on cross-cultural perspective. *PACIS 2012 Proceedings*. 153. <https://aisel.aisnet.org/pacis2012/153>
- Mahatanankoon, P., & Wolf, J. (2025). Development of the Cognitive Programming Engagement (CPE) Scale: A Learning

- Strategy. *Journal of Information Systems Education*, 36(4), 400-416. <https://doi.org/10.62273/KJKC8408>
- Mahatanankoon, P., & Wolf, J. (2021). Cognitive Learning Strategies in an Introductory Computer Programming Course. *Information Systems Education Journal*, 19(3), 11-20. <http://isedj.org/2021-19/n3/ISEDJv19n3p11.html>
- Meske, C., & Junglas, I. (2021). Investigating the elicitation of employees' support towards digital workplace transformation. *Behaviour & Information Technology*, 40(11), 1120-1136. <https://doi.org/10.1080/0144929X.2020.1742382>
- Moore, J. E., & Love, M. S. (2011). An examination of prestigious stigma: The case of the technology geek. *International Journal of Social and Organizational Dynamics in IT (IJSODIT)*, 1(2), 1-25. <https://doi.org/10.4018/ijisodit.2011040101>
- Morgan, M., Butler, M., Thota, N., & Sinclair, J. (2018a). How CS academics view student engagement. *Proceedings of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education*, 284-289. <https://doi.org/10.1145/3197091.3197092>
- Morgan, M., Sinclair, J., Butler, M., Thota, N., Fraser, J., Cross, G., & Jackova, J. (2018b). Understanding International Benchmarks on Student Engagement: Awareness and Research Alignment from a Computer Science Perspective. *Proceedings of the 2017 ITiCSE Conference on Working Group Reports*, 1-24. <https://doi.org/10.1145/3174781.3174782>
- Muller, J. (2018). *The Tyranny of Metrics*. Princeton University Press. <https://doi.org/10.23943/9781400889433>
- National Survey of Student Engagement. (2023). *Annual results 2023*. <https://nsse.indiana.edu/research/annual-results/2023/index.html>
- Niederman, F., Ferratt, T. W., & Trauth, E. M. (2016). On the Co-Evolution of Information Technology and Information Systems Personnel. *ACM SIGMIS Database: The DATABASE for Advances in Information Systems*, 47(1), 29-50. <https://doi.org/10.1145/2894216.2894219>
- Perrmann-Graham, J., Peat, D. M., Christensen-Salem, A., & Walumbwa, F. O. (2025). The evolution of online learning and engagement in management education during disruption: A paradoxical view. *The International Journal of Management Education*, 23(2), 101190. <https://doi.org/10.1016/j.ijme.2025.101190>
- Pike, G. R. (2013). NSSE Benchmarks and Institutional Outcomes: A Note on the Importance of Considering the Intended Uses of a Measure in Validity Studies. *Research in Higher Education*, 54(2), 149-170. <https://doi.org/10.1007/s11162-012-9279-y>
- Porter, S. R., Rumann, C., & Pontius, J. (2011). The validity of student engagement survey questions: Can we accurately measure academic challenge? *New Directions for Institutional Research*, 2011(150), 87-98. <https://doi.org/10.1002/ir.391>
- Price, K., & Baker, S. N. (2012). Measuring Students' Engagement on College Campuses: Is the NSSE an Appropriate Measure of Adult Students' Engagement? *The Journal of Continuing Higher Education*, 60(1), 20-32. <https://doi.org/10.1080/07377363.2012.649127>
- Prommegger, B., Wiesche, M., & Krcmar, H. (2020). What Makes IT Professionals Special?: A Literature Review on Context-Specific Theorizing in IT Workforce Research. *Proceedings of the 2020 Computers and People Research Conference*, 81-90. <https://doi.org/10.1145/3378539.3393861>
- Rabiei, R., & Almasi, S. (2022). Requirements and challenges of hospital dashboards: A systematic literature review. *BMC Medical Informatics and Decision Making*, 22(1), 287. <https://doi.org/10.1186/s12911-022-02037-8>
- Rao, V. S., & Ramachandran, S. (2011). Occupational Cultures of Information Systems Personnel and Managerial Personnel: Potential Conflicts. *Communications of the Association for Information Systems*, 29. <https://doi.org/10.17705/1CAIS.02931>
- Rapaport, H., Clapham, H., Adams, J., Lawson, W., Porayska-Pomsta, K., & Pellicano, E. (2024). "In a State of Flow": A Qualitative Examination of Autistic Adults' Phenomenological Experiences of Task Immersion. *Autism in Adulthood*, 6(3), 362-373. <https://doi.org/10.1089/aut.2023.0032>
- Riemenschneider, C. K., & Armstrong, D. J. (2021). The Development of the Perceived Distinctiveness Antecedent of Information Systems Professional Identity. *MIS Quarterly*,

- 45(3), 1149–1186.
<https://doi.org/10.25300/misq/2021/14626>
- Rong, G., & Grover, V. (2009). Keeping up-to-date with information technology: Testing a model of technological knowledge renewal effectiveness for IT professionals. *Information & Management*, 46(7), 376–387. <https://doi.org/10.1016/j.im.2009.07.002>
- Rutner, P., Riemenschneider, C., O'Leary-Kelly, A., & Hardgrave, Bi. (2011). Work exhaustion in information technology professionals: The impact of emotion labor. *ACM SIGMIS Database: The DATABASE for Advances in Information Systems*, 42(1), 102–120. <https://doi.org/10.1145/1952712.1952718>
- Shernoff, D. J., & Schmidt, J. A. (2008). Further Evidence of an Engagement–Achievement Paradox Among U.S. High School Students. *Journal of Youth and Adolescence*, 37(5), 564–580. <https://doi.org/10.1007/s10964-007-9241-z>
- Sinclair, J., Butler, M., Morgan, M., & Kalvala, S. (2015). Measures of Student Engagement in Computer Science. *Proceedings of the 2015 ACM Conference on Innovation and Technology in Computer Science Education*, 242–247. <https://doi.org/10.1145/2729094.2742586>
- Treem, J. W., Barley, W. C., Weber, M. S., & Barbour, J. B. (2023). Signaling and meaning in organizational analytics: Coping with Goodhart's Law in an era of digitization and datafication. *Journal of Computer-Mediated Communication*, 28(4), zmad023. <https://doi.org/10.1093/jcmc/zmad023>
- Tuomivaara, S., Lindholm, H., & Käsälä, M. (2017). Short-Term Physiological Strain and Recovery among Employees Working with Agile and Lean Methods in Software and Embedded ICT Systems. *International Journal of Human–Computer Interaction*, 33(11), 857–867. <https://doi.org/10.1080/10447318.2017.1294336>
- Venkatesh, Morris, Davis, & Davis. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, 27(3), 425. <https://doi.org/10.2307/30036540>
- Whitney, T., Gammal, D., Gee, B., Mahoney, J., & Simard, C. (2013). Priming the Pipeline: Addressing Gender-Based Barriers in Computing. *Computer*, 46(3), 30–36. <https://doi.org/10.1109/MC.2013.40>
- Wolf-Wendel, L., Ward, K., & Kinzie, J. (2009). A Tangled Web of Terms: The Overlap and Unique Contribution of Involvement, Engagement, and Integration to Understanding College Student Success. *Journal of College Student Development*, 50(4), 407–428. <https://doi.org/10.1353/csd.0.0077>
- Wong, Z. Y., & Liem, G. A. D. (2022). Student engagement: Current state of the construct, conceptual refinement, and future research directions. *Educational Psychology Review*, 34(1), 107–138. <https://doi.org/10.1007/s10648-021-09628-3>
- Zaza, S., Joseph, D., & Armstrong, D. J. (2023). Are IT Professionals Unique? A Second-Order Meta-Analytic Comparison of Turnover Intentions Across Occupations. *MIS Quarterly*, 47(3), 1213–1238. <https://doi.org/10.25300/misq/2022/16951>
- Zhang, X., Ryan, S. D., Prybutok, V. R., & Kappelman, L. (2012). Perceived obsolescence, organizational embeddedness, and turnover of it workers: An empirical study. *ACM SIGMIS Database: The DATABASE for Advances in Information Systems*, 43(4), 12–32. <https://doi.org/10.1145/2398834.2398837>

9. APPENDIX

NSSE Measurements

Higher-Order Learning

- Applying facts, theories or methods to practical problems or new situations
- Analyzing an idea, experience, or line of reasoning in depth by examining its parts
- Evaluating a point of view, decision, or information source
- Forming a new idea or understanding from various pieces of information

Reflective & Integrative Learning

- Combining ideas from different courses when completing assignments
- Connecting your learning to societal problems or issues
- Including diverse perspectives (political, religious, racial/ethnic, gender, etc.) in course discussions or assignments
- Examining the strengths and weaknesses of your own views on a topic or issue
- Trying to better understand someone else's views by imagining how an issue looks from his or her perspective
- Learning something that changed the way you understand an issue or concept
- Connecting ideas from your courses to your prior experiences and knowledge

Learning Strategies

- Identifying key information from reading assignments
- Reviewing your notes after class

- Summarizing what you learned in class or from course materials

Collaborative Learning

- Asking other students to help you understand course material
- Explaining course material to one or more students
- Preparing for exams by discussing or working through course material with other students.
- Working with other students on projects or assignments

ABET's Computer Accreditation Commission (CAC) Student Outcomes Measures

- Analyzing complex computing problems to identify solutions
- Applying principles of computing to identify solutions
- Designing a computer-based solution to meet a given set of computing requirements
- Implementing a computer-based solution to meet a given set of computing requirements
- Evaluating a computer-based solution to meet a given set of computing requirements
- Communicating effectively in a variety of professional contexts
- Recognizing professional responsibilities and making informed judgments in computing practice based on legal and ethical principles
- Functioning effectively as a member or leader of a team engaged in activities