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Assessing Technological Self-Conception: Are Business Students Ready to be Citizen Developers?

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Abstract

Generation Z students have begun their college experiences in earnest. They are confident in their perceived ability to command technology and are often heralded as Digital Natives, emphasizing they came of age with computerization and ubiquitous personal devices during the internet era. However, the digital native narrative belies a narrow definition of technology that may not align with practical demands. A concern exists that those who are simply users of technology are at risk unless they can develop technological solutions themselves. This project attempts to understand the technological self-conception of business students with regards to being a technological developer versus simply being a technology user in preparation for incorporating low-code/no-code tools and workflow automation activities into the curriculum. These tools make incorporating developer activities into non-technical courses and programs feasible in a way that was not possible before, encouraging what is sometimes called "citizen developers." A survey, designed with consideration of the Theory of Planned Behavior, is used to understand student pre-disposition and self-conception. In the survey responses, students expressed confidence in their technological abilities, but few had even heard of workflow automation or low-code/no-code tools. Students initially indicated tepid interest, if not a disinterest, in development activities generally. By the survey's end, though, students reported that these tools and approaches could be valuable and that they were interested in learning more on how to use them, indicating an openness to becoming involved in development activities and beginning the journey of moving beyond just using technology towards becoming citizen developers.

Keywords: citizen developer, low-code no-code, Design Thinking, Theory of Planned Behavior, workflow automation, Digital Natives, Generation Z

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1. INTRODUCTION

Generation Z students are beginning to dominate the enrollment in college-level programs. These students are widely regarded as *Digital Natives*, emphasizing that they were born and raised with computerization and ubiquitous personal devices during the internet era. As educators, understanding our students' self-conception, aptitude, and interest in using technology—and in developing technological solutions to problems—is important for effectively incorporating technology into course pedagogy and across the academic curriculum more generally. This paper presents an effort to understand student perception of technology, especially regarding the use-of-technology versus the development-of-technology self-perception schema. While anecdotally it seems that students are comfortable with using smart phones and devices in their personal and work lives; less often, do students express interest in computer programming, producing apps and other development activities. Having insight into students' self-conception in this regard might provide actionable information that can be fashioned into academic interventions that spark their interest to learn and do more with technology.

A planned behavior inspired survey was developed to gather information on these items and others. After gaining preliminary insight into students via the survey, we will craft workflow automation (WFA) learning activities, implement them, and then query student participants post-activity to gauge any change in their perspective. In this effort, the concepts of Design Thinking and design education pedagogy are aligned nicely with our long-term endeavors and provide insights for our work. The pre- and post-activity surveys go beyond WFA and include forward-looking questions to gauge student interest in creating apps for others to use and even to create intelligent agents incorporated into cross-functional and cross-system solutions. The results presented in this manuscript include discussion and analysis of the pre-activity survey results with a range of possible future endeavors and research ideas identified and discussed.

2. TECHNOLOGICAL SELF-PERCEPTION

With students as Digital Natives, it would seem their comfort with computerized systems and devices might afford advantages in solving problems using technology. However, the digital native narrative belies a narrow definition of technology that may not fully align with practical demands. Using an app on a phone or other device can have value, of course. However, anecdotally it seems that student focus on technology is too concentrated on devices—like smartphones, watches, or tablets—and not enough on techniques, processes, and application software-based tools that proliferate in practice. In the book, The Culture of Technology, Pacey (1983) defines technology as "the application of scientific and other knowledge to practical tasks by … ordered systems that involve people and organizations, living things and machines" (p. 6). This definition points to the broad view of technology within society and emphasizes the interaction between humans and machines or processes. It is important to note that in consequential, and fundamental ways, the knowledge going into process design and the mechanics or techniques of task completion are important, though often under-appreciated aspects of technology.

Most Generation Z students have always possessed technology at their fingertips. They often seem, however, to lack a general conscientiousness or appreciation of innovation, problem solving, computer programming and technology development. Barak and Levenberg (2016), suggest that the issue is a resistance to change due to inflexible thinking. According to their studies, the individual learner has seemingly developed considerable fixed habits and patterns of thought, creating a resistance to change and reduced flexibility. In this case, they "don't know, what they don't know" and tend to be reluctant to search for alternative or better technology and solutions.

A concern exists that students have been lulled into a false sense of security and ease regarding technology. Because they are so comfortable with its use, students may be at risk of becoming replaced by such technology if they lack the ability to be a creator of technological processes and tools; developers that generate innovative solutions leading to efficient and positive outcomes for their organizations and society. This aligns with what might be called "citizen developers." Gartner defines a citizen developer as "a user who creates new business applications for consumption by others using development and runtime environments sanctioned by corporate IT" (Citizen Developer, n.d. para. 1). We seek to broaden student conception of themselves to consider becoming involved in creating the technological processes themselves, thereby, beginning the journey towards becoming citizen developers.

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In a pre-activity survey, students are asked to self-report their technology use in their personal and work lives. Figure 1 (see Appendix 1) presents the top-ten-word frequency responses regarding technology usage in students' personal (left panel) and work lives (right panel). Overall, from the personal perspective, students volunteered 324 responses, with another 206 from a professional view.

Both lists are dominated by devices. From a personal perspective, cellphones (including iPhone) laptops (including MacBooks), iPads, gaming systems, and TV represent more than half the responses. The remainder of the top-ten personal uses include office applications and cumulatively represents two-thirds of all responses. The professional use perspective differs some, with Point-of-Sale (POS) systems and accounting software (e.g. QuickBooks) appearing on the list. Neither list contains any programming languages or other technology development tools or platforms.

From Figure 1, it might be inferred that students are comfortable with their own aptitude and usage of technology; however, this could be providing false comfort. The word frequency results also hint at a lack of curiosity in students regarding harnessing or developing said technology, which is concerning to us as educators but also signals a meaningful learning opportunity.

Given that environmental and societal definitions of technology are very broad, whereas student conception of technology appears less so, we seek to encourage a more holistic conception of technology to be internalized by students. We hope to have students who see developing new processes, techniques, and ways of doing things—especially with computerized tools or approaches—as a technology mastery worth investigating. Considering the self-reported student views related to technology development in Figure 1, the indication and opportunity to have a meaningful educational intervention does seem promising. Not only do students need the tools, interest, and confidence to accomplish the role of the developer, in addition, they need the encouragement and freedom to explore solutions and possibilities on their own, which is at the heart of design thinking.

3. DESIGN THINKING

Design thinking is an approach that promotes innovative development as a means of combining technology with the human element to create viable, effective solutions. Design Thinking in Education (n.d.), is described as "a mindset and approach to learning, collaboration, and problem solving," (para. 1), that in practice, "is a structured framework for identifying challenges, gathering information, generating potential solutions, refining ideas, and testing solutions," (para. 1), that "can be flexibly implemented; serving equally well as a framework for a course design or a roadmap for an activity or group project" (para. 1).

The design thinking approach can be leveraged for our purposes, by employing trigger-oriented processes of low-code/no-code programming tools, such as Microsoft Power Automate, Zapier, and IFTTT. Harnessing the power of design thinking enables individuals to foster the ability to produce innovative procedures and then iterate and expand them easily. A sense of empowerment provides the student with the ability to become a citizen developer and an innovative contributor to their organization.

Gartner Inc. notes that end users are creating "new, more powerful applications" (Yanckello and Calhoun Williams, 2019 p. 45), destined to forever change who is considered a "programmer." And this reality is closer than many may realize. The Gartner Priority Matrix for Education (Yanckello and Calhoun Williams, 2019), projects that citizen developers are within two years of meaningful impact on the marketplace, and further predicts design thinking will become ingrained at all levels of organizational activities and problem-solving efforts. The intended outcome of our project is to initiate the creation of citizen developers, within existing curriculum and course requirements we are bound to honor; to serve as a bridge towards a more holistic design thinking in students, sparking a creative process of solution and problem-solving generation and development.

Design thinking and pedagogy has a long and rich foundation. Oxman (2006), claims as "conceptual changes become the content of new pedagogical methods of design education, [the] awareness of change and conflicts can stimulate the necessary theorization and conceptualization for new approaches to design didactics" (p. 45). The author reminds us that "[d]esign thinking precedes design learning," and although recent evolutions in this method have generated new paradigms, they are filled with "conceptual conflicts between the prevailing and the new values of two design ontologies" (p. 45). Oxman concludes that these new "pedagogies can operate within this condition of the evolution and instability of ontologies [but] can do so only by directly articulating and working with conceptual structures as pedagogical material" (p. 45). In summary, Oxman (2006) emphasizes the need to properly craft the intervention and its implementation—and to communicate what is being asked of students and why—so students can not only see the value in the activity itself but may appreciate the logic, motivation and exhortations behind it, then to make it their own to solve problems of interest to them.

Luka (2014), reminds us "[i]nnovation drives improvement, either incrementally idolizing existing processes or more radically by introducing new practices" (p. 72), and reiterates what other authors have claimed that to increase student innovation is through developing design thinking skills. Luka (2014), concludes claiming "[s]tudents practice during their studies learn to make their own mistakes and realize that there are no right or wrong solutions to various problems [and] learn to explain their options and listen to others opinions, accept untraditional ideas thus welcoming innovation" (p. 73). Wrigley & Straker (2015) are adamant that new pedagogical approaches must be introduced into higher education to adequately equip students with both the hard and soft skills that organizations prize in order to stay pace with changes in local and global trading environments. In addition, their Educational Design Ladder "provides a scaffold for organising and structuring Design Thinking units or courses in multidisciplinary contexts" (p. 11). The emergence of the low-code/no-code platforms provides an important scaffold for integrating these activities into a non-technical program such as business management and marketing, that simply did not exist a few years ago.

Vander Ark (2017) describes this methodology in its application to the world of work, as "a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success" (para. 1), and concludes with interpreting the needs of all stakeholders while exercising continuous problem solving, and employing inquiry-based learning that builds "character strengths, mindsets and dispositions [where] deeper learning activities including design thinking investigations are a great way to develop these new priority outcomes" (Design Thinking For EdLeaders, para. 3). So, design thinking and pedagogy have great promise of collective impact, although they both also have drawbacks or issues of concern, in that students must be properly prepared to learn in a design thinking paradigm and cannot just be thrown in and expected to thrive. This emphasizes Oxman's (2006) exhortation that students must understand what they are being asked to do and why. In short, students, the technology, and the environment, both academic and business, all must be appropriately "ready" for success to be possible.

Schell (n.d.) considers this pedagogy problem as "wicked," reminding educators that both teaching and learning this methodology, such that they result in lasting impacts "requires slowing down the learning, taking time to unfold the layers of what it means to be human-centered and to pay attention to the innate dignity of human beings" (Design Thinking's Pedagogy Problem, para. 2), and "spending focused energy practicing and receiving feedback from experts" (Design Thinking's Pedagogy Problem, para. 2).

Nonetheless, Schell (n.d.) offers a solution: first, cultivate self-regulated students of the methodology, and second, build a pedagogy to enhance their self-efficacy. Schell (n.d.), concludes to overcome the wicked problem, i.e. "the demand and authentic human need for accelerated design thinking pedagogy when the efficacious teaching of design thinking demands a decelerated model" (Conclusion, para. 1), is to avoid "accelerated design thinking education outside of academia" (Conclusion, para. 1) in favor of employing and advancing best practices with embedded options for students to self-regulate their learning and build their self-efficacy. In our efforts, we seek not to overwhelm students with unstructured and complex problems to solve to start with, but to ease students into this proposition, with articulated experiences within the curriculum we are bound to honor.

4. CURRICULAR CONSIDERATIONS

Our business program has 500 students taking classes where the plurality of majors is business management (50%) and marketing (20%), with accounting, economics, finance, CIS, and entrepreneurship making up the rest. The curriculum at our institution is in no means devoid of technology as faculty members have made purposeful choices to incorporate technology into their courses, even though it is not required, so that developing student

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technology proficiencies are not just a "one-and-done" mentality but, rather, reinforced throughout the program, particularly with office applications like Excel, but also Qualtrics and SPSS, amongst others.

It must be emphasized, that we have a duty to maintain fidelity to each Course Data Sheet, which is what defines the course coverage requirements and options at our institution. Through faculty choices, and within curriculum limits, though, we strive to ensure that students have a true appreciation and understanding of a plethora of technology options, thereby encouraging students to develop their own robust problem-solving developer's toolbox. So, at least in this regard, faculty choices to integrate technology even when not required, provides some of the foundation that Schell (n.d.) and Oxman (2006) emphasize is needed before design thinking can be a beneficial pedagogical tool. Low-code/no-code tools that are now becoming available, represent an important scaffold that simply was not available to us before and which provides new opportunity for non-technical academic programs to encourage such development in their students.

Pope-Ruark (2020) outlines that the new role of higher education is for institutions "to offer more options to achieve the master credential of a degree" (para. 7), and faculty "to help students chart a meaningful course through an intentionally selected variety of learning experiences, traditional and nontraditional, while helping them make meaningful connections that inform their choices about future experiences, careers, and roles as citizens" (para. 7). Our effort in this project is attempting to do just what Pope-Ruark (2020), exhorts. While we cannot change our program unilaterally, through academic freedom, we can certainly change what we do and how we do it to honor the spirit of Pope-Ruark's call to action.

Through these WFA activities, we seek to expose student self-perception to where they first recognize that low-code/no-code tools exist and then that these can be valuable tools in their current and future personal and professional lives. If this can be achieved, then we can seek to help students develop a new schema where they see in themselves—and have a measure of confidence in themselves—as actual developers who can indeed leverage low-code tools for personal and professional benefit.

5. PROJECT DESCRIPTION

This stage of the research project is focused on developing an understanding of student technology comprehension and their prior experience in not just utilizing technology but in leveraging it to develop solutions to solve meaningful problems. Considering that we are looking to students as potential citizen developers, it is important to identify the technological skill and experience levels of students, along with their extant perceptions. We are interested in understanding student participants' existing ability and interest in computer programming and developing automated processes utilizing computerized technologies. Beyond measurement of current applications, future intentions towards using additional technological applications and their confidence in doing so are also of interest.

Survey Instrument

A survey was created as an instrument to collect data and then to evaluate the comprehension, technological abilities, and perceived value of WFA within student's personal and professional lives. The student pre-activity survey consisted of 20 questions: 6 – Belief Scales, 3 – Attitude Scales, 8 – Behavior Scales and 3 – Behavioral /Intention Scales. Subsets of questions can be divided as technological competency, usage, experience, process development, and solution application of technology (See Appendix 2). One concern in developing the survey was that most of our students might not have any truly significant knowledge or understanding of WFA and/or low-code/no-code tools, so the survey itself would have to convey some foundational information while attempting to favorably influence perceptions and future behaviors.

Therefore, the survey was designed with consideration of the Theory of Planned Behavior (Ajzen, 2019). Behind human behavior are pre-dispositions and attitudes about what is believed. To change the behavior and on-going beliefs, one must build a beginning understanding, and then through progressions, change the beliefs that would support the desired on-going behavior. The survey questions represented a planned progression beginning with definition, self-report, and underlying beliefs. Through progressions like this, the theory posits that attitudes and beliefs can be softened or prepared for desired modification. Questions were arranged to expose student normative beliefs as well as behavioral beliefs towards technology and application development. Once existing beliefs were

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revealed, attitudes towards changing these existing beliefs were then queried. Finally, introduction of perceived behavior and reflection outcomes and intention to change the belief towards citizen development was measured. The underlying motivation was to induce participants to self-report their background knowledge on WFA, along with their comfort, confidence, and willingness to utilize technology as a practical and useful means.

The survey proffered low-code/no-code tools as a possible means to accomplish routine tasks through the creation and application of automated workflow processes in both the professional capacity and for their personal concerns. While a no-code/low-code approach and tools lowers the technical skill and cognitive load for users, there are also barriers related to critical thinking and problem-solving awareness more generally that we felt were important to understand when crafting effective activities. In other words, we needed to understand where students were in these regards so we could craft activities to effectively reach our audience.

Implementation Approach

The pre-activity survey evaluation began with voluntary participation sought from students enrolled in several courses that already had significant applied computer components. These courses included a basic computer applications course, an intermediate computer class focused on using information systems to solve business problems, an operations management course, and a project management course.

The introduction of the survey was performed early in the semester, with a preliminary review performed as a guide to creating the WFA activities. At the conclusion of the semester and activities, a thorough evaluation of the pre-activity survey results was performed, which is the focus of the remainder of this manuscript. Separate, forthcoming works will examine the efficacy the intervention and lessons learned from the endeavor overall.

6. RESULTS AND DISCUSSION

The pre-activity survey was distributed students in the classes noted above, generating 105 complete survey responses (n=105). All participants were undergraduate students of an AACSB business program at a regional campus of a major university. This represents approximately 20% of the total business student population for this regional campus with roughly 60% of students are upper division with the remainder being freshman or sophomores.

Before delving into the detailed results, note that differences between upper and lower division students was considered to determine if they differ significantly and should be treated as different populations or not. Appendix 3, below, has a graphical and statistical summary of eleven survey questions. These questions include aspects of student knowledge of and interest in WFA and low-code/no-code tools, their current use of such tools, their technological competency and confidence, and the value they ascribe to such tools. Using a graphical analysis, the upper and lower division students look very similar while from a statistical significance perspective, at a significance level of 0.10, none of the questions appear to differ significantly between upper- and lower-division students. Given these findings, the remainder of the results are analyzed from a single population perspective.

A key outcome of the pre-activity survey indicated that at the outset, most student participants had little knowledge or appreciation of WFA and limited knowledge of related technologies. In the left panel of Figure 2 (See Appendix 1), it is seen that a clear majority of students (62.7%) had never heard of the term WFA before taking the pre-survey with a minority (37.3%) affirming to have heard of it. However, once introduced and informed about workflow automated processes, through the completion of the survey itself—which later in the survey included describing specific WFA applications—students are in near total agreement (91.2%) that WFA holds promise and could be of at least somewhat value. Indeed, the right panel of Figure 2 shows that more than two-thirds of students, 70.6 percent, thought WFA could be extremely valuable or valuable. It is encouraging to see that upon learning something about WFA, students recognize WFA as valuable, which suggests that they could be interested and willing to explore automation in their personal lifestyles, business interests, and academic endeavors too. In the WFA activities themselves, then, emphasis will be placed on creating cogent, relevant examples for students to complete.

Not surprisingly, students expressed a general sense of comfort and competency in using technology. As seen in Figure 3 of Appendix 1, about 85 percent of students expressed favorable perceptions of their technology competency (extremely or somewhat

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competent) in both the personal and organizational settings; however, remember from Figure 1 that the forms of technology used by students were predominantly general hardware and software applications. There is a definite skewedness towards *utilization* of packaged and subscription software/applications by students.

In contrast to being comfortable with using technology, there is a seemingly lack of interest, if not a trepidation, by students towards being a creator or developer of technological processes and tools. As seen in Figure 4 of Appendix 1, at this pre-activity point in time, there appears to be little student interest in creating automations for use by others through the development of apps or intelligent agents. Only one-in-five (19.8%) responses expressed interest or prior consideration of creating intelligent agents with two-thirds (65.1%) not interested. Students seem more interested in creating apps, as 37.4 percent have considered or are interested, while roughly half (46.1%) are simply not interested. In addition, no students reported having already created an app or intelligent agent. It should be noted that in the survey only eight students indicated any programming experience, with Java and Java Script the most common, followed by C#/Visual Basic/VBA, with one mention each for Python and PHP.

From these results, it seems there is little indication of a conscientious, individual technology development conception by students beyond that of being a user. In general, the survey results seem to signal a sense of confidence, if not overconfidence, by students that might result from their genuine comfort in using technology. But there seems to be a much more limited conception of the technology itself and how to harness technology rather than just being a user of it.

Digging deeper, Figure 5 in Appendix 1 shows that students do have some technological familiarity with a variety of technology tools. Results indicate that the main types of technological tools harnessed by students were Google Forms, WFA (including trigger automation, Zapier and IFTTT) and Smartsheets. It should be noted that tools, such as office applications that are already taught in our program, were not included as a response choice in this survey question and no students indicated other tools than those listed.

Of the minority of students that reported having used WFA in the past, Figure 6 (See Appendix 1) shows the tasks they automated (left panel) and the areas they employed them in (right panel), be it personal, business, entrepreneurial, academic, etc. It is seen that for the students who have used WFA, they span the gamut of tasks and application areas.

Gaging the future intentions of students toward automated workflow development was an important aspect of our preparations, especially given that most students had never created or used WFAs or even heard of it. An aim of our planned WFA activities is to bring awareness to areas of WFA, and development of automated processes more generally, and these pre-activity survey responses indicated that a more fundamental, articulated approach to doing this, rather than an advanced one, is reasonable. At the same time, emphasizing the applicability of these tools to many tasks and areas to educate and inspire them, will be important.

Figure 7 in Appendix 1, meanwhile, shows that by the end of the survey, nearly nine-of-ten students (89.2%) agree (completely, strongly, or somewhat) that they would like to learn more about creating WFAs. In some small way, then, it seems some student conceptual evolution—or a schema shift—is being initiated through completing the survey itself: very few students even knew of WFA to start, but upon learning something about it, the vast majority believe it could be valuable and want to learn more about how to do so.

In addition to questions about WFA, the survey separated out and defined what cross-functional and cross-system developments, applications and intelligent agents were. This aspect to the survey intended to alert, if not inform, students that the WFA development being discussed was not just referring to isolated, individual-only development. Indeed, we wanted students to realize that such developments had potential impact across organizational functions and in tying together disparate computer systems. Furthermore, we wanted students to realize that automations are often incorporated into apps for others to use or are components of intelligent agents, even if they did not fully understand or appreciate what that meant to begin with.

In Figure 8 of Appendix 1, less than one-fourth (22.5%) of students strongly or completely believe they can create useful cross-functional or cross-system automations with 77.5 percent of students less sure or even not believing they currently can do so. In Figure 9 (See Appendix 1), students signal a willingness to learn more about creating apps and intelligent agents (left panel) along with cross-system and cross-functional development (right panel). Nearly three-fourths of respondents (71.6%) are at least somewhat interested in creating apps or intelligent agents while 86.3 percent are interested in learning about cross-functional and cross-system development more generally. This is indeed encouraging.

7. CONCLUSIONS

In summary, the most definitive discovery of the survey stems from the recognition that students initially do have a self-perception of themselves as users of technology rather than developers of technology.

At the start of the survey, students do not see themselves as developers or programmers in any meaningful sense and might even be characterized as initially having a general disinterest in becoming one. It is unclear whether this has resulted from a lack of knowledge, a fear of technological development, a lack of motivation, or something else. By survey's end, during which they are informed about WFA, cross-functional and cross-system development, intelligent agents and app development, students show interest in learning more about all these items. At the same time, though, students are not confident in their ability in these areas.

Overall, we find this student feedback enlightening and promising. The results not only suggest students would value learning how to become developers of technology but also demonstrates to us a tremendous opportunity to develop pedagogical approaches towards these ends. Given student hesitancy and lack of prior interest or experience in development, the activities will include learning support scaffolds and designed to be highly relatable to their personal and professional experiences.

Generation Z students have always had consumer electronics at their fingertips, and it is easy to mistake this familiarity of use with having an actual command over technology. Utilizing the Theory of Planned Behavior, as well as a design thinking approach, we have an opportunity to positively affect student development and skill building. Low-code/no-code tools provide a framework for truly harnessing this technology so our students can ride the wave of technology rather than being overwhelmed by it. The survey reported within this manuscript was a way to test our ideas and to use that learning as we consider pedagogical interventions and activities for driving students towards becoming citizen developers.

8. FUTURE ENDEAVORS

After a preliminary analysis of the survey results, classroom activities were developed relating to common business scenarios using the WFA tool, Zapier. We chose to limit these activities to two scenarios: a personal use example, and a business application, while also highlighting many other applications for students. Each step in the process will be supported through not just written instructions and screenshots of the Zapier system but with step-by-step video support and implemented via a learning management system page that is self-explanatory in how to proceed, including a checklist to track progress.

As the citizen development mindset is being achieved, or really integrated into the program, design thinking can be reinforced via numerous small, frequent, and meaningful activities and assignments. Our plan is to incorporate these introductory WFA activities into our computer applications course going forward, so all our students have this foundation. Next, an upper-division course focusing on using information systems to solve business problems will implement more advanced WFAs including conditionality and multi-step processes. Applications for courses in operations management, supply chain management, marketing, and human resources are also being conceived. Then, we seek to leverage such WFA and low-code/no-code capabilities in promoting our students to businesses for internships, service-learning projects, and permanent positions.

The key is to create adaptive learning approaches to generate a new awareness and an integration of design thinking and citizen development into everyday practice, so our graduates can be successful solution architects in whatever direction the future takes them. This should help address the concerns of Schell (n.d.) and Oxman (2006), who advocated against just throwing students into a design or development pedagogy and overwhelming or frustrating them as a result. In doing so, we seek to meet the goal articulated by Pope-Ruark (2020) in providing students with "an intentionally selected variety of learning experiences, traditional and nontraditional" (para. 7) that helps them as they consider future careers and experiences.

9. REFERENCES

Ajzen, I. (2019). Constructing a theory of planned behavior questionnaire. Retrieved from https //people.umass.edu/aizen/pdf/tpb.measurement.pdf

Barak, M., & Levenberg, A. (2016b). Flexible thinking in learning: An individual differences measure for learning in technology-enhanced environments. *Computers & Education, 99*, 39–52. http://dx.doi.org/10.1016/j.compedu.2016.04.003

Citizen Developer (n.d.). In *Gartner Glossary*. Retrieved from https://www.gartner.com/en/information-technology/glossary/citizen-developer

Design Thinking in Education (n.d.). Retrieved from https://tll.gse.harvard.edu/design-thinking

Luka, I. (2014). Design Thinking in Pedagogy. Journal of Education Culture and Society*, 2*, 63-74. DOI: 10.15503/jecs20142.63.74

Oxman, R. (2006). 'Digital Design Thinking': In The New Design Is The New Pedagogy. in A. Kaga and R. Naka (editors), Proceedings of the 11th Conference on Computer-Aided Architectural Design Research in Asia (CAADRIA), Faculty of Engineering, Kumamoto University, Kumamoto, Japan, 37-46.

Pacey, A. (1983). *The Culture of Technology*. Cambridge, MA; MIT Press.

Pope-Ruark, R. (2020). Liberal Education Needs Integration, Not Unbundling. *Academe.* Retrieved from https://www.aaup.org/article/liberal-education-needs-integration-not-unbundling

Rymer, J. (2018, August 8). Why You Need To Know About Low-Code, Even If You're Not Responsible For Software Delivery. *Forrester.* Retrieved from https://go.forrester.com/blogs/why-you-need-to-know-about-low-code-even-if-youre-not-responsible-for-software-delivery/

Schell, J. (n.d.). Design Thinking Has a Pedagogy Problem … And a Way Forward. Retrieved from https://designcreativetech.utexas.edu/design-thinking-has-pedagogy-problem-way-forward

Shepard, L. (2000). The Role of Assessment in a Learning Culture. *Educational Researcher, 29*(7), 4-14.

Vander Ark, T. (2017, February 15). Design Thinking as Pedagogy – For Students and Educators. *Education Week.* Retrieved from https://blogs.edweek.org/edweek/on_innovation/2017/02/design_thinking_is_a_human-centered.html

Vincent, P. Iijima, K., Driver, M., Wong, J. & Natis, Y. (2019). Gartner 2019 Magic Quadrant for Enterprise Low-Code Application Platform. Retrieved from https://www.gartner.com/doc/reprints?id=1-1FKNU1TK&ct=190711&st=sb

Wrigley, C. & Straker, K. (2015). Design Thinking pedagogy: the Educational Design Ladder. *Innovations in Education and Teaching International,* DOI: 10.1080/14703297.2015.1108214

Yanckello, R. & Calhoun Williams, K. (2019, July 29). Hype Cycle for Education, 2019. Gartner, Inc.

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Appendices

Appendix 1: Planned Behavior Inspired Survey Results

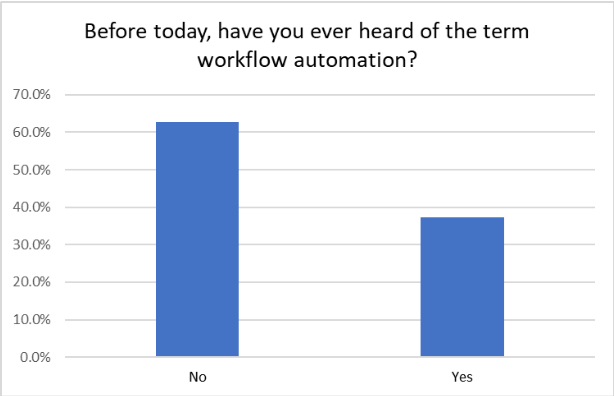
Personal Technology Use

Rank	Term	Count	Percent	Cumulative
1	cellphone	97	29.9%	29.9%
2	laptop	32	9.9%	39.8%
3	Excel	18	5.6%	45.4%
4	Word	14	4.3%	49.7%
5	iPhone	12	3.7%	53.4%
6	TV	9	2.8%	56.2%
7	MacBook	8	2.5%	58.6%
8	gaming systems	7	2.2%	60.8%
9	iPad	7	2.2%	63.0%
10	PowerPoint	7	2.2%	65.1%

Professional Technology Use

Rank	Term	Count	Percent	Cumulative
1	computer	36	17.5%	17.5%
2	Excel	17	8.3%	25.7%
3	cellphone	14	6.8%	32.5%
4	Word	10	4.9%	37.4%
5	POS system	7	3.4%	40.8%
6	none	6	2.9%	43.7%
7	desktop	5	2.4%	46.1%
8	iPad	5	2.4%	48.5%
9	laptop	4	1.9%	50.5%
10	QuickBooks	4	1.9%	52.4%

Figure 1. Word frequency analysis of self-reported technology used in personal (top) and organizational (bottom) settings.



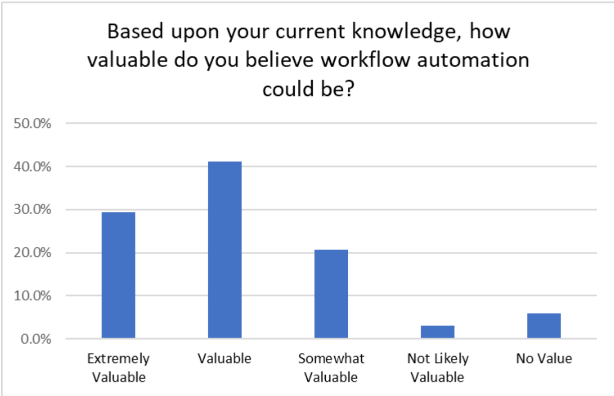


Figure 2. Student knowledge of WFA before the pre-activity survey (left) and their perception of WFA value following completion of pre-activity survey (right).

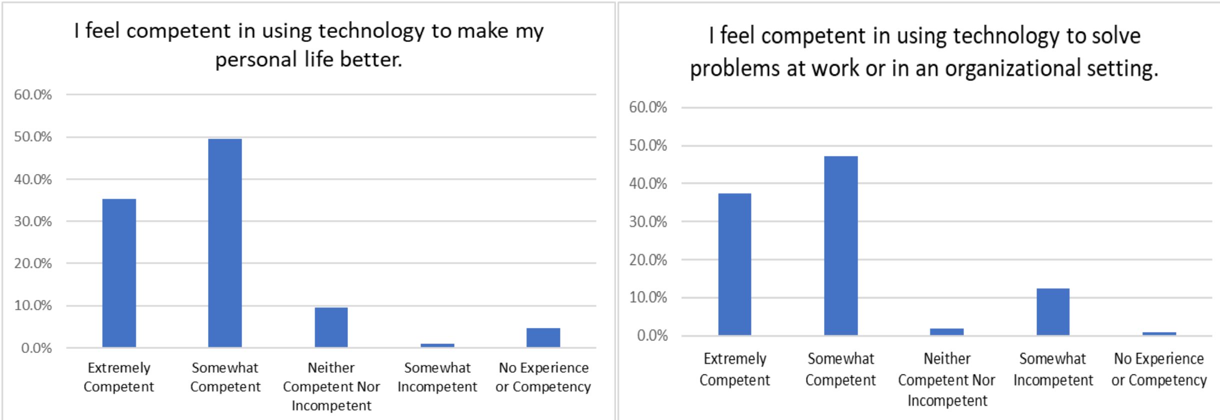


Figure 3. Student self-reported competency in using technology in personal (left) and work settings (right).

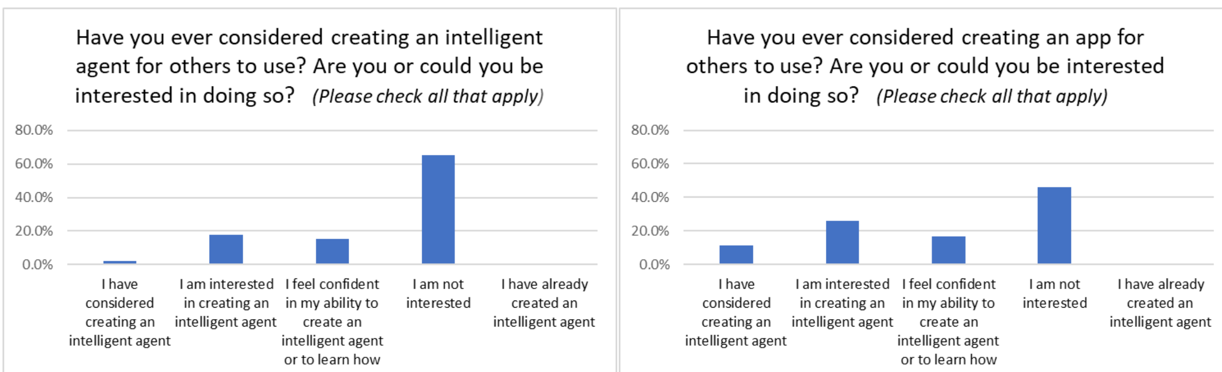


Figure 4. Student self-reported pre-activity interest in creating apps (left) or intelligent agents (right).

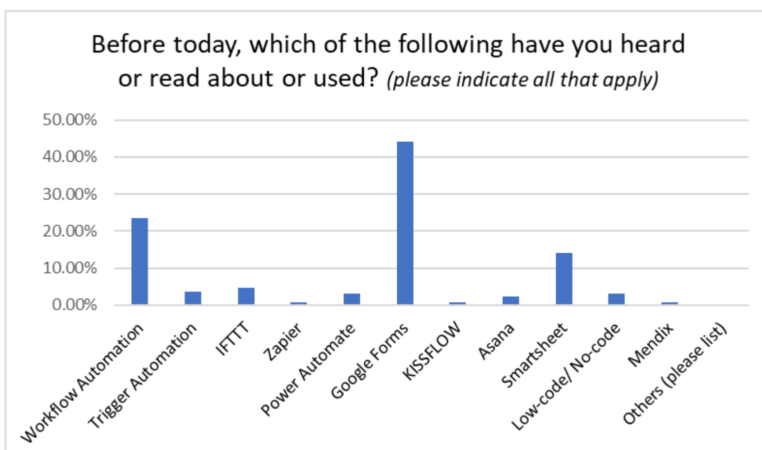


Figure 5. Self-reported use or knowledge of technology applications.

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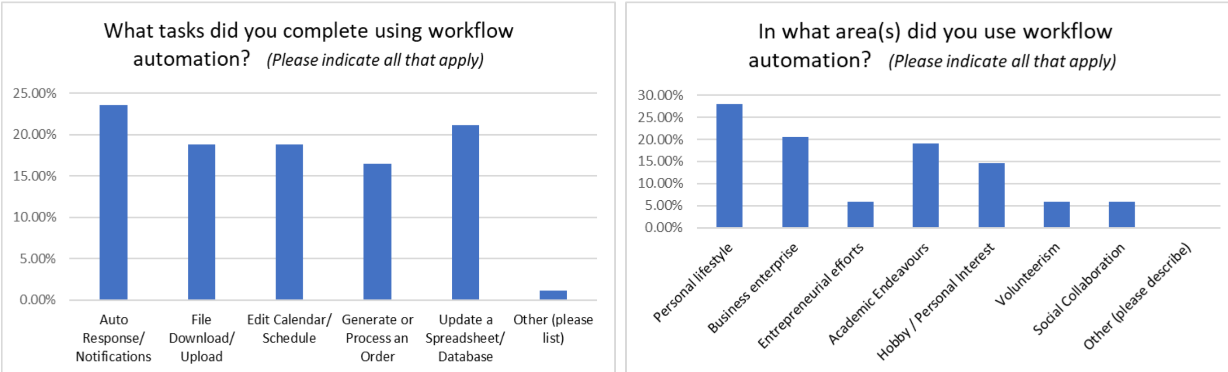

Figure 6. Student experience in creating WFAs: tasks completed (left) and areas where WFA was used (right).

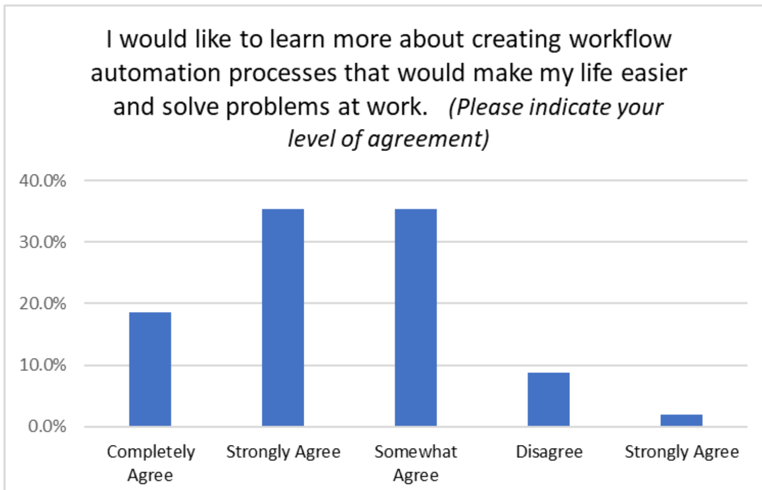

Figure 7. Self-reported interest in learning more about creating WFA processes.

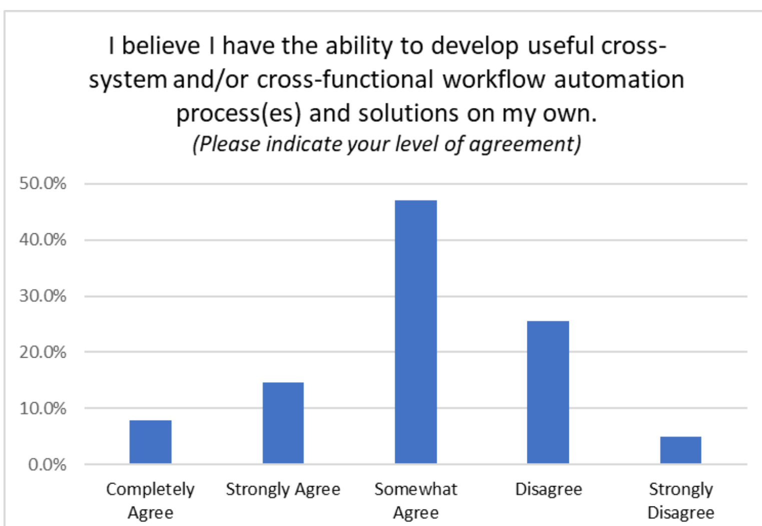

Figure 8. Student self-reported ability to develop cross-system or cross-functional WFAs.

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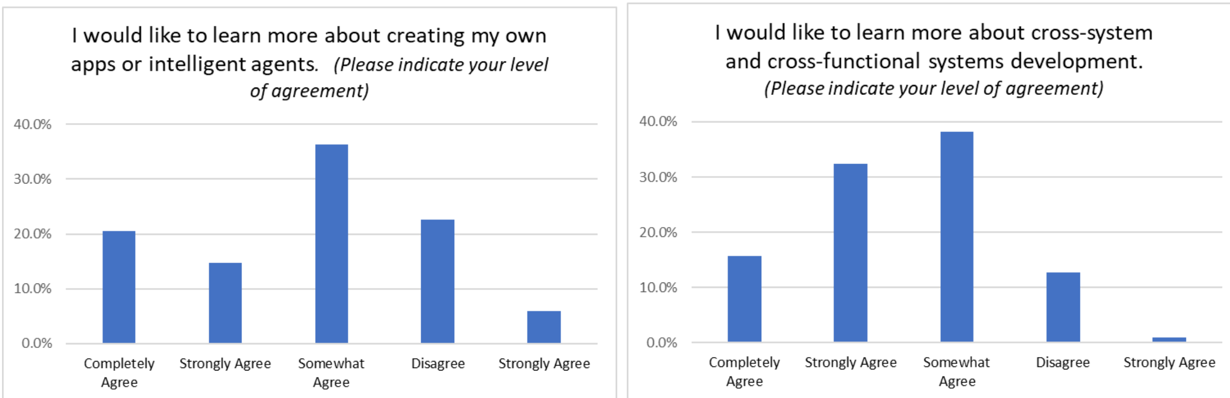

Figure 9. Self-reported interest in learning more about how to create apps or intelligent agents (left) and cross-system and cross-functional design (right).

Appendix 2: Survey Instrument

The following questionnaire was administered to students for gathering information about technological self-conception and to evaluate their readiness to become Citizen Developers. The instrument includes 20 questions with five subsets measuring constructs like technological competency, usage, experience, process development, and solution application of technology.

Q01: Please indicate your agreement with the following statement: I feel competent in using technology to make my personal life better.

- Extremely competent
- Somewhat competent
- Neither competent nor incompetent
- Somewhat incompetent
- No experience or competency

Q02: For the previous question, please explain the technology you have used (or currently use) in your personal life, if any.

- Text Response

Q03: Please indicate your agreement with the following statement: I feel competent in using technology to solve problems at work or in an organizational setting.

- Extremely competent
- Somewhat competent
- Neither competent nor incompetent
- Somewhat incompetent
- No experience or competency

Q04: Please explain the technology you have used (or currently use) in your professional or work life, if any.

- Text Response

Q05: Have you ever considered creating an app for others to use? Are you or could you be interested in doing so? (Please check all that apply)

- I have considered creating an app
- I am interested in creating an app
- I feel confidence in my ability to create an app or to learn how
- I am not interested
- I have already created an app. (please explain)

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Q06: Have you ever considered creating an intelligent agent for others to use? Are you or could you be interested in doing so? (Please check all that apply)

- I have considered creating an intelligent agent
- I am interested in creating an intelligent agent
- I feel confidence in my ability to create an intelligent agent or to learn how
- I am not interested
- I have already created an intelligent agent. (please explain)

Q07: I have some experience in or I have interest in learning the following. (Please check all that apply)

- Computer Programming (Experience)
- Cross System Development (Experience)
- Cross Functional Development (Experience)
- Computer Programming (Interest)
- Cross System Development (Interest)
- Cross Functional Development (Interest)

Q08: My knowledge of computer programming or coding is best described as:

- Extremely Knowledgeable
- Very Knowledgeable
- Moderately Knowledgeable
- Slightly Knowledgeable
- Not knowledgeable at all

Q09: Please check which computer programming languages, if any, you have used.

- Java / Java Script
- C / C+ / C++
- C# / Visual Basic / VBA
- Python
- PHP
- TypeScript
- Shell
- Ruby
- Other (please describe)

Q10: Please describe your programming or coding experiences. Is your primary experience at work, academic, and/ or personal?

- Text Response

Q11: Before today, have you ever heard of the term workflow automation?

- No
- Yes

Q12: Before today, which of the following have you heard or read about or used? (please indicate all that apply)

- Workflow Automation
- Trigger Automation
- IFTTT (If-This-Then-That)
- Zapier
- Power Automate
- Google Forms
- KISSFLOW
- Asana
- Smartsheet
- Low-code/ No-code
- Mendix
- Others (please list)

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Q13: Have you ever used workflow automation to make processes or situations better in your personal life, professional life, or hobby...even if you didn't know it was called workflow automation?

- No
- Yes

Q14: In what area(s) did you use workflow automation? (Please indicate all that apply)

- Personal lifestyle
- Business enterprise
- Entrepreneurial efforts
- Academic Endeavors
- Hobby / Personal Interest
- Volunteerism
- Social Collaboration
- Other (please describe)

Q15: What tasks did you complete using workflow automation? (Please indicate all that apply)

- Automatic Response or Notifications (email, text, etc.)
- File Download / Upload
- Edit Calendar / Schedule Automatically,
- Generate or Process an Order
- Update a Spreadsheet/ Database
- Other (please list out)

Q16: Based upon your current knowledge, how valuable do you believe workflow automation could be?

- Extremely Valuable
- Valuable
- Somewhat Valuable
- Not Likely Valuable
- No Value

Q17: I believe I have the ability to develop useful cross-system and/or cross-functional workflow automation process(es) and solutions on my own. (Please indicate your level of agreement)

- Completely agree
- Strongly Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

Q18: I would like to learn more about creating workflow automation processes that would make my life easier and solve problems at work. (Please indicate your level of agreement)

- Completely agree
- Strongly Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

Q19: I would like to learn more about cross-system and cross-functional systems development. (Please indicate your level of agreement)

- Completely agree
- Strongly Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

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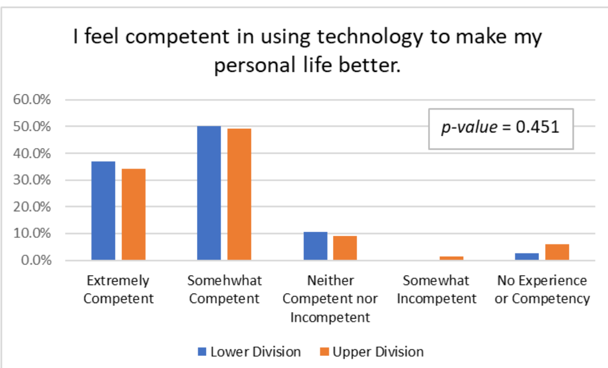
Q20: I would like to learn more about creating my own apps or intelligent agents. (Please indicate your level of agreement)

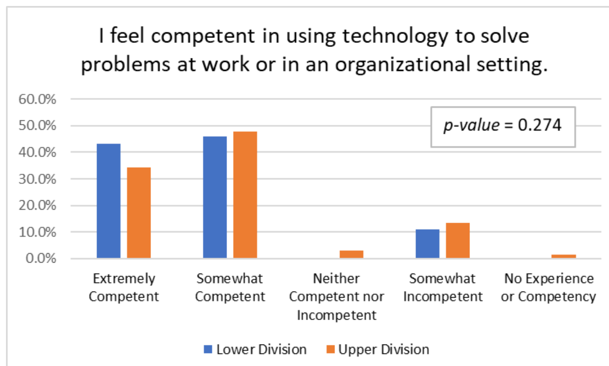
- Completely agree
- Strongly Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

Appendix 3: Graphical Representation and Statistical Significance of Responses to Select Questions from the Survey as denoted in [Appendix 2] of upper-division students versus lower-division ones.

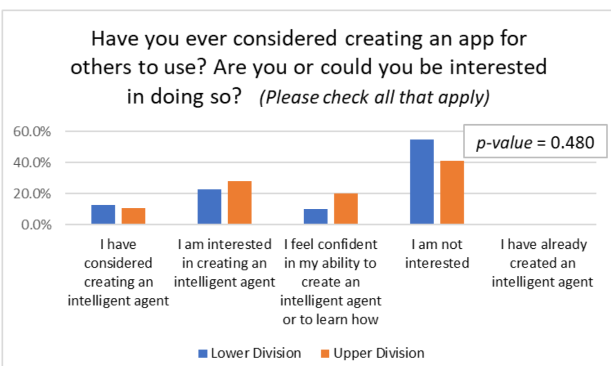
This is for testing/comparison of lower division versus upper division students to determine if they appear to be distinct populations or not for results analysis. None of the items below show statistical significance at the 0.10 level.



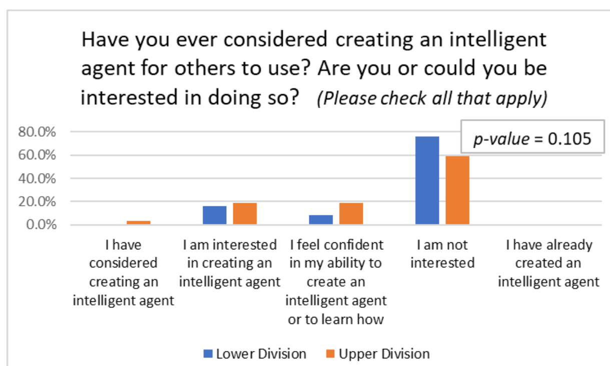
Responses to Q01



Responses to Q03



Responses to Q05



Responses to Q06

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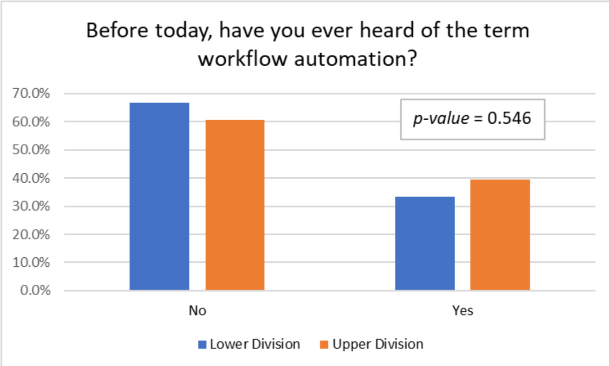
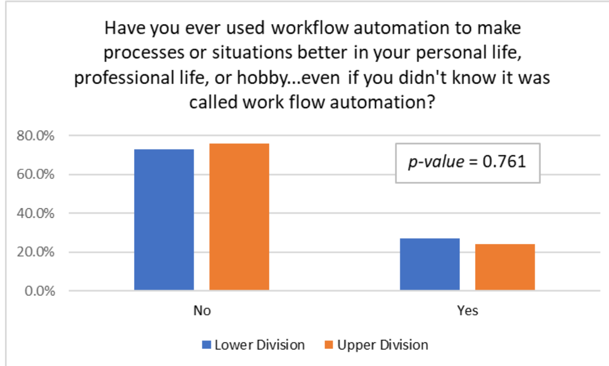
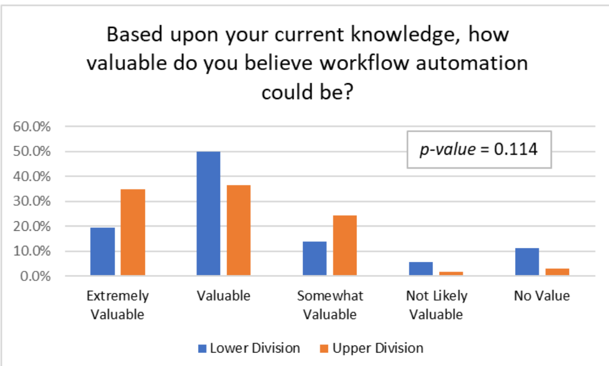


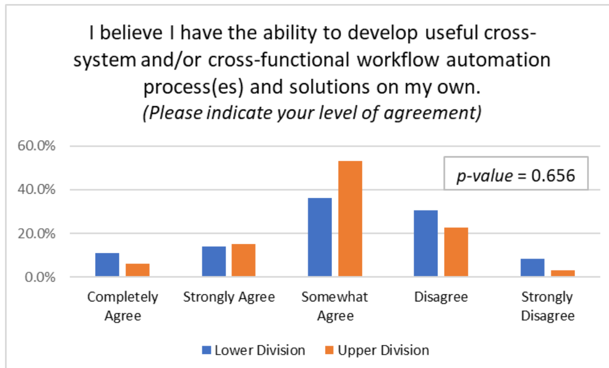
Responses to Q11



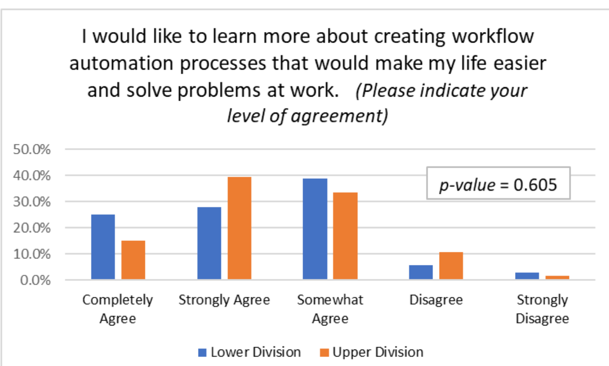
Responses to Q13



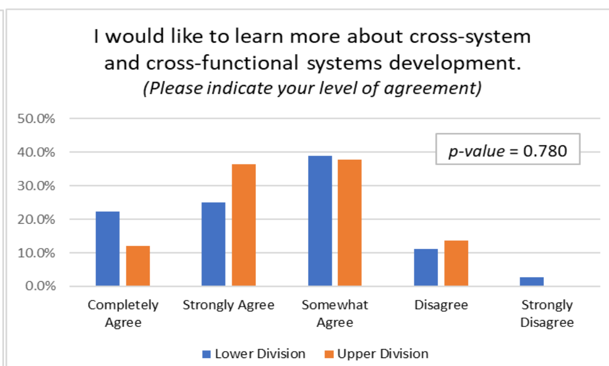
Responses to Q16



Responses to Q17



Responses to Q18



Responses to Q19

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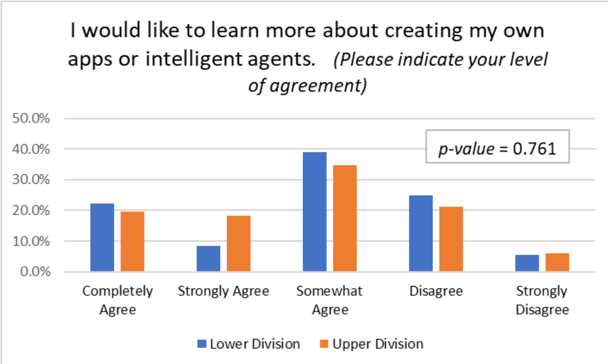

Responses to Q20