**Student Success through Digital Innovation: A Change Management Model**

Higher education institutions increasingly innovate with digital technologies to facilitate student learning and to help students maneuver their educational journey (Miller, 2017). However, to effectively improve the success rate of their students through digitalization (Parviainen, 2017), higher education institutions must negotiate rapidly changing landscapes of technologies, stakeholders and institutional arrangements (Miller, 2017). While higher education institutions generally innovate by introducing and applying better solutions to meet new requirements, unarticulated needs, and existing demands (Maranville, 1992), digital innovations transform "socio-technical structures that were previously mediated by non-digital artifacts or relationships" (Yoo et al., 2010, p. 6). As such, they render previous systems, processes, and roles inadequate and they require fundamental changes in how institutions teach their students and support their educational journey (Nambisan et al., 2017). Creating student success through digital innovations therefore raises important questions related to change management: How to prioritize different technological options? How to complement each technology with appropriate organizational arrangements? And, how to ensure student, faculty and staff participation to move digital innovation initiatives forward towards higher levels of student success?

Against that backdrop, we studied digital innovation initiatives across Georgia State University's (GSU) highly successful and widely reported student success program (Gumbel, 2020; Kurzweil & Wu, 2015; U.S. News & World Report, 2020) based on the following research question: *How does a higher education institution effectively manage change in digital innovations to support student success*? We conducted 26 semi-structured interviews with key staff and faculty. We also collected and analyzed archival data in the form of documents, presentations, and news articles related to the initiatives. To guide our investigation, we adapted Pettigrew's (1985, 1987, 1990) theory of organizational change focused on the interactions between the context, the process and the content of change.

Context of change refers to the environment in which organizations and stakeholders operate, including the outer context of social, economic, and technological factors, and the inner context of structural, managerial and cultural arrangements through which ideas for change proceed. In the case of GSU, the outer context includes the economic and socio-cultural context of Georgia, higher education in Georgia and the US, and the technological context of higher education around the world, whereas the inner context includes the structural, managerial and cultural arrangements inside GSU. The process of change refers to the continuous and interdependent sequence of events that shaped the origins, continuance, and outcome of a transformation, including the vertical dimension of interdependencies between higher and lower levels of change, and the horizontal dimension of how change unfolds over time. At GSU, the vertical dimension encompasses the organization of digital innovation initiatives within the overarching structure of the student success program, whereas the horizontal dimension includes two decades of digital innovation initiatives and how each of them was conceptualized, initiated, and continuously developed. Last but not least, the content of change are the areas of transformation, including business models, technologies, organizational structures and processes, and the people involved. At GSU, the content of change includes the value propositions, structures, processes, and systems that were transformed through digital innovations to improve the performance of students.

**Digital Innovation at Georgia State University**

Drawing on the insights from GSU and Pettigrew's change theory (1985, 1987, 1990), we have captured important lessons for how higher education institutions can successfully design and manage digital innovation initiatives to improve the success rate of their students. We start by presenting three areas of digital innovation that support a student's educational journey at GSU. The first is concerned with how students are taught and learn; the second is concerned with how students are monitored and advised; and, the third is concerned with how the institution engages its students. Subsequently, we turn to key lessons for managing the involved changes, and we conclude by summarizing these lessons into a change management model that other institutions can adapt to their context and needs.

*Support Student Learning*

Higher education institutions were early adopters of the first learning management systems in the late 1990s. These systems automate the documentation, administration, tracking, reporting, and delivery of educational courses, training programs, or learning and development programs (Ellis, 2009). Acting as platforms for quality teaching and learning (Gyurko & Snow, 2020), they changed the technological and competitive contexts of higher education and GSU quickly responded by adopting different versions.

GSU's most recent learning management system, iCollege, is a rebranding of the system Brightspace developed by Desire 2 Learn. Implemented at the turn of the century to share course contents with students, the system has developed to cover the pedagogical process with other functionalities, such as taking online quizzes, submitting assignments, grading of quizzes and assignments, monitoring progress of each student, and tailoring teacher communication through intelligent agents. At GSU, iCollege currently supports online learning delivery and acts as a platform for online content for both asynchronous and synchronous courses. Due to COVID-19, GSU recently used iCollege to move most of its courses online, illustrating well how changes in outer context is forcing accelerated digital innovation in teaching.

To improve student learning, GSU also faced unique challenges from its socio-economic context. Georgia's diverse demography implies that the majority of students are African-American, Hispanic, and immigrants from around the world. Moreover, most students are first-generation college students from low-income families. Nationally, first-generation, low-income students are historically far behind other student groups in baccalaureate degree attainment (Stewart, 2020). To improve the performance of this student body, GSU experimented with adaptive learning technologies that use computer algorithms to support learning by selecting and adapting the presentation of materials and activities based on each student's responses to previous questions, tasks and experiences.

GSU initiated its digital innovations based on adaptive learning technologies in 2006 through its Mathematics Interactive Learning Environment (MILE). The rationale for MILE was that mathematics historically has been challenging for underprivileged students, who consistently failed or underperformed in introductory gateway mathematics courses. To break this pedagogical barrier, GSU redesigned its introductory mathematics courses—pre-calculus, college algebra, and elementary statistics—using MILE. Before the redesign, drop, fail and withdrawal (DFW) rates regularly topped 40% in these courses. After failing once, students had to retake the course, often picking up another D or F. As a result, each semester hundreds of students lost their scholarships and dropped out because of this one requirement.

GSU no longer offers traditional lecture-focused sections of any of these mathematics courses. Instead, students attend MILE lab sessions in large groups with dedicated instructors. In each lab session, students sit at individual terminals working on the same chapter of material using adaptive learning systems and receiving support from teaching assistants orchestrated by a professor. All students are hence working in parallel and the teaching assistants are walking around engaging with students one-on-one. Using MILE, GSU was able to drop DFW rates across the three mandatory mathematics courses from an average of 31% in 2007 to 23% in 2014, helping hundreds of additional students pass the mathematics requirement in their first attempt each semester. Encouraged by this success, in 2017 GSU deployed adaptive courseware in five gateway courses in economics, political science, and psychology. The involved professors praised the adaptive learning technologies, emphasizing that they help students manage enormous amounts of information in a structured way that is tailored to their evolving knowledge and capabilities.

### Monitor and Advise Students

Since the majority of students are underprivileged, due to the socio-economic context in Georgia, GSU closely monitors and frequently advises each student. Starting in 2011, GSU has collaborated with Education Advisory Board (EAB) to continuously develop a graduation progression system (GPS) that monitors and detects problems students face and complementary advising technologies that help students avoid or overcome these problems. GPS uses predictive analytics and a system of more than 800 alerts to track all undergraduate students daily, identify at-risk behaviors, and have advisers respond to alerts by intervening in a timely manner to get students back on track. The high impact of such data-driven monitoring systems on improving student success is echoed in previous research (Devlin & Bushey, 2019).

GSU has created a centralized structure of trained academic advisers, the University Advisement Center (UAC), to monitor the alerts and respond with timely, proactive advice to students at scale with 60 advisers. The previous advising organization was fragmented and fraught with problems such as high student to adviser ratio, no common record keeping, little systematic tracking, and little coordination. The UAC has implemented a vertical governance structure for common advising systems and technologies that offers systematic tracking and record keeping, coordination among advisers, significantly reduced student-adviser ratio, and career paths and systematic training for academic advisers. As such, the goal of UAC is to give students the information that they need when they need it to make decisions that lead to increased retention, progression, and graduation. UAC is continually working towards this goal through individualized education planning, proactive risk targeting, and personalized interventions.

The GPS system went live in August 2012. Based on 10 years of 144,000 student records and 2.5 million grades, the system offers analytical models that predict potential problems for any student and refer them to an academic adviser at UAC for consultation. In the 2019-2020 academic year, the GPS system generated more than 55,000 individual meetings between students and advisers to discuss specific alerts and get students back on a path toward graduation. Before GPS went live, many students were confused on which major to choose and which courses to register for. Since GSU initiated GPS advising, the number of students in majors that fit their academic abilities increased by 13 percentage points, progression rates increased by 16 percentage points, and changes of major in the sophomore, junior and senior years decreased by 32%. Also, freshman fall-to-spring retention rates increased by 5 percentage points and graduating seniors are taking fewer excess courses in completing their degrees. As the SVP of student success commented "we are engaging with students and really changing their trajectory."

In 2016, GSU consolidated with Georgia Perimeter College, a two-year institution with multiple campuses around the metro Atlanta area. With grant funding, GSU has deployed its GPS system and adapted its advising strategy to increase graduation rates for these additional 20,000 students seeking associate degrees with 42,000 meetings between students and advisers in 2017-2018. The GPS platform was launched at Perimeter College in 2016-2017 and GSU hired an additional 30 academic advisers. Early data shows that the GPS is equally effective in improving outcomes for associate and baccalaureate degree students. In each case, 90% of the upfront costs were directed to personnel, not technology. In addition to providing much-needed support to students seeking associate degrees, this latest extension of the GPS system provides GSU with the opportunity to better understand and support transfer pathways between two- and four-year institutions. With data-driven predictive analytics and student-centric proactive advising, GSU continues to improve the performance of its students.

### *Engage and Inform Students*

The journey of college education is overwhelming even before it begins, especially for first-generation, low-income students. Many students fail to navigate the path towards college education after high school graduation, becoming victims of "summer melt" by accepting offers of admission during summer but not showing up for fall classes. In 2015, 19% of GSU's incoming freshman class were victims of summer melt. Although they were accepted and had confirmed their plans to attend, these students never showed up for classes. GSU tracked these students using National Student Clearinghouse data and found that, one year later, 274 of them (74% of whom were low-income) never attended a single day of class at any institution.

To successfully begin their college education, accepted students need answers to questions about financial aid, FAFSA, registration, immunization, housing, admissions, and academic advising. Although student advisers may have answers to these questions, they cannot reach all students. Moreover, students also feel vulnerable and hesitant to share personal information with a stranger. Hence, GSU realized that it needed to be far more proactive and personal in interacting with students between high-school graduation and the first day of college classes and was one of the first institutions nationally to deploy an artificial intelligent chatbot to reduce summer melt. Later on, the chatbot became a platform for communicating with all students, incoming or continuing alike, on myriad of issues.

In summer 2016, GSU collaborated with Admit Hub to deploy its first chatbot—a texting system named after the school mascot 'Pounce'—that allowed students to text any questions 24/7 from their smart phones. GSU built a knowledge base of 2,000 answers to commonly asked questions and in the three months leading up to the Fall 2016 classes, Pounce replied to 201,000 student questions, with an average response time of 7 seconds. Similar usage was tracked in 2017 and 2018. With the help of Pounce, GSU has lowered summer melt by 22% in 2016, which translates into 324 more students, mostly first-generation and low income, showing up for freshman fall classes. One year earlier, these students were sitting out the college experience. In 2017 and 2018, summer melt declined by an additional 4 percentage points.

Students asked Pounce questions on a broad range of topics. "How do I complete the FAFSA?" "What is the difference between a grant and a loan?" "What do I do if I can't find or don't have immunization records?" After receiving a question from a student, the artificial intelligence capability integrated in Pounce determines if there is an appropriate answer in the knowledge base or, alternately, whether the applicant's question needs to be directed to a staff member to write an answer and add that to the knowledge base. As

such, the knowledge base continues to grow and the artificial intelligence capability learns to derive the meaning of more questions over time.

Students communicated with Pounce in surprising ways. They used the system more heavily at 1:00 am than at 9:00 am—a clear indictment of GSU's traditional business hour practices. They also confided problems to the chatbot they would never have shared with a human being, knowing that the chatbot would not judge them. With Pounce, the playing field of access to information has been leveled. In most cases, students do not need access to someone with personal knowledge of college bureaucracies to get help, they just need access to the chatbot. As the project director of the chatbot stated, "this technology lets us touch students faster and more effectively."

After Pounce's success in admission, GSU expanded its knowledge base to help students in retention. Today the chatbot sends reminders, conducts guided tutorials, takes surveys, and provides targeted human support on topics including academics, financing education, student life, student organizations, housing, meal plans, sports, and more. Critical to Pounce's success was building an adequate knowledge base of answers that students can rely on. Currently, the knowledge base includes 3,000 answers and the chatbot continues to learn daily. During the difficult times of COVID-19, Pounce has been heavily used to disseminate information regarding the virus, its prevention, and changes in policies, rules, and courses.

## Managing Change at Georgia State University

At a campus visit event at GSU, where representatives from higher education institutions from around the world convened to learn about GSU's student success program, the dominant question among the attendees was "how do we replicate GSU's success at my institution?" Since higher education institutions are situated in very different contexts, challenged by unique problems, and aspire to bring changes across its stakeholders with unique and divergent interests, a direct replication of GSU experiences may not be fruitful for other institutions. Hence, as we consider how GSU drove digital innovations towards improved student success, we present key lessons on how they managed this complex change process through interactions between the context of change, the process of change, and the content of change. This theoretical lens allows us to offer a comprehensive account of change management in digital innovation for student success. In addition, we have articulated each lesson in general terms that can apply to any institution, while at the same time providing specific experiences from GSU. In this way, other institutions can find inspiration in how GSU has managed change and adapt the general lessons to their context and needs.

### *Context of Change*

**Strong and visionary leadership:** At the heart of GSU's transformation is the visionary leadership of President Mark Becker and Senior Vice President for student success, Timothy Renick. Under their leadership, in 2011 GSU accelerated its activities to improve student success through a five-year strategic plan with five goals: become a national model for undergraduate education by demonstrating that students from all backgrounds can achieve academic and career success at high rates; significantly strengthen and grow the base of distinctive graduate and professional programs by developing the next generation of researchers and societal leaders; become a leading public research university by addressing the most challenging issues of the 21st century; be a leader in understanding the complex challenges of cities and

developing effective solutions; and, achieve distinction in globalizing the university. Through this bold and timely strategic plan, GSU made a conscious decision to build on ten years of various student success initiatives to transform itself enabled by digital innovations. Although the new Office of Student Success led the way from the top by initiating and implementing each digital innovation, their success depended on leaders at every level of the organizational structure. As such, a vertical structure of organic leadership fueled the ongoing horizontal transformation process and the realization of change through digital innovations, from inception to fruition.

**Commitment to student success:** Inspired by the strong, visionary leadership, the faculty and staff at GSU demonstrated an unrelenting commitment to student success. In terms of digital innovations to support learning, the respective faculty and staff played an instrumental role in creating the systems and the contents, always putting student needs first. They selected textbooks that would be affordable and useful for students, created contents for the new systems that would best serve student aspirations, and organized and conducted adaptive learning sessions to provide students help and support. When COVID-19 forced GSU to move courses online, the staff worked round the clock to prepare iCollege for the mass transition and to provide online tutorials for how students and faculty could effectively use iCollege. In terms of digital innovations to monitor and advice students, the staff at GSU tirelessly collected, cleaned, and processed student records from previous years to train the predictive models of GPS. Moreover, when GPS predicted problems for students, the advisers at UAC conducted individually-tailored one-on-one consultations to get them back on track. Finally, in terms of digital innovations to engage and inform students, the staff at GSU has been working relentlessly to develop the knowledge base of Pounce by adding new answers to potential questions and by expanding its use from student admission to include student retention. It is this high level of commitment to student success of people at every level at GSU that maintained focus in digital innovation on one common goal with clearly measurable outcomes.

**Sourcing technological expertise:** GSU's decision and commitment to support student learning, to monitor and advise students, and to engage and inform students led to a series of strategic digital innovation decisions, including how to source requisite professional expertise, how to select technology vendors, how to specify system features, how to communicate requirements to potential vendors, and how to customize and rebrand systems according to GSU requirements. Rather than developing technological solutions purely in-house, GSU outsourced most of them, creating close collaborations between technology suppliers and internal experts at GSU. Outside technological expertise provided GSU with a wider range of options for digital innovation and an unrestricted focus on its principal function of delivering value based on these innovations to improve student success. This combination of external and internal technological expertise has helped GSU continually create and share knowledge and resources with EAB, Desire 2 Learn, Admit Hub, and other technology vendors, while at the same time growing its own dedicated expertise in digital innovation for improved student success.

*Process of Change*

**Participatory innovation and learning:** Under the central leadership of the student success program, GSU fosters a culture of collaborative and participatory innovation and learning. Although the student success program holds the authority to evaluate, decide on, initiate, and orchestrate innovation options, ideas emerge from different levels of diverse functional units across GSU. To facilitate such an organic incubation of innovation, the student success program holds a manger meeting every week to discuss the

current status, future trends, and potential innovation opportunities. Representatives from different functional units attend the meetings to learn about the ongoing development of the student success program and contribute their expert opinions on future innovation initiatives. As such, even though the authority is centralized at GSU, the genesis of innovation is decentralized, emergent, and organic. The commitment of people at these meetings to student success motivates them to proactively participate in innovation and learning. GSU's culture of participatory innovation and learning generates a wider range of innovation options, reduces the time to realize innovation opportunities, and eliminates potential bureaucratic obstacles.

**Evidence-based problem solving:** GSU's innovations are rational—based on evidence of underlying problems—rather than speculative adoption of sophisticated technologies. The economic and socio-cultural outer context of Georgia posed unique challenges for GSU. The majority of students are African-Americans, Hispanics, or immigrants—demographics that are nationally and historically far behind other demographics in associate and baccalaureate degree attainment. Most students come from low-income families and are first-generation college students. They lacked in pedagogical background, understanding of academic progression and pitfalls, and knowledge of the bureaucratic governance of college education. GSU sensed these unique problems in its outer context and interpreted them as an opportunity to innovate its value propositions, structures, processes, and systems. Moreover, GSU had to appreciate its existing structural, managerial and cultural arrangements in its inner context to ascertain and realize possible solutions. Thus, GSU's innovations are a consequence of continuously analyzing existing problems and measuring the impact of solutions as an impetus for change.

**From experiments to scale:** Finally, GSU's process of change entailed experimenting with different solutions in small scale and implementing appropriate ones at scale. In this change process, GSU experimented with solutions by testing configurations of technologies and organizational arrangements in small scale and implementing the best solutions to scale. For example, GSU experimented with adaptive learning technologies in small scale with one MILE lab and one introductory mathematics course. After learning from this experiment, GSU gradually increased the number of labs and expanded the adaptive learning technologies to other courses in mathematics, economics, political science, and psychology. Similar actions were taken regarding the graduation progression and advising systems and the artificial intelligence chatbots. For example, GSU initially launched its chatbot 'Pounce' to support students in admission, and after successful implementation, GSU expanded the knowledge base and question repertoire to support students in retention as well.

### *Content of Change*

**Supporting the student journey:** Realizing that GSU students required additional nonconventional help to be taught, advised, and engaged, GSU identified digital options to support the student journey. The feasibility of these options was evaluated based on existing needs, the context, potential impact, and available resources. After careful consideration, GSU zoomed in on digital options in teaching, advising, and engaging students. This selection process required evaluation of digital options for nonconventional teaching, early detection of adverse student outcomes, individually-tailored advising to avoid or overcome adverse outcomes, and personalized guidance through the labyrinth of the university bureaucracy. This led GSU to innovate the way students were taught with learning management systems and adaptive learning technologies, the way students were monitored and advised with graduation progression and advising

systems, and the way students were engaged and informed with artificial intelligence chatbots and other social networking technologies. To realize these digital options, GSU identified and implemented necessary changes in organizational structures and systems, including a centralized Student Success Center to lead all initiatives, the UAC to timely advise students, and the MILE labs to effectively improve student performance in select courses. As such, supporting the student journey and making the journey easier for students was the ultimate goal of all of GSU's change initiatives.

**Predictive analytics and networking:** To support the student journey, the underprivileged students at GSU had to be monitored closely and guided individually. GSU opted for a data-driven strategy to make the student journey easier and, hence, implemented predictive analytics and social networking technologies. GSU innovated a graduation progression system (GPS), that uses predictive analytics to monitor and detect problems that students might face. In terms of networking, GSU innovated complementary advising systems and technologies to guide students to avoid or overcome such problems. Using these systems, advisers can respond to alerts by intervening in a timely manner to get students back on track. GPS and complementary advising systems and technologies together act as a navigation system that guides students through their educational journey. Analytics is also integrated in adaptive learning technologies to predict the proficiency level of a student in a subject and adjust teaching contents accordingly. Professors and teaching assistants working in an adaptive learning session provide further guidance in terms of networking. As such, GSU is a perpetual laboratory of new ideas for using big data analytics, social networking technologies and data-driven experimentation to improve higher education and to keep disadvantaged students on track towards a degree.

**Socio-technical solutions:** Finally, the technologies innovated at GSU are only as effective as the people who utilize them. As such, GSU's success story is a socio-technical one in which people with unrelenting commitment to student success interact with technologies with potential to make the journey easier for students. GSU's innovations are socio-technical solutions to its unique challenges. For example, the learning management system provides the platform for teachers to disseminate knowledge. However, it is the teacher who decides the specific contents that the students should learn and the organization of those contents that benefits the students most. Although adaptive learning technologies can help students learn at their own proficiency level and speed, whenever students are in doubt professors and teaching assistants are there to guide them. Similar patterns emerge in advising and engaging students. GPS can predict potential problems that a student might face, but without the guidance of an adviser a student might not be able to avoid or overcome such problems. Similarly, the artificial intelligence chatbots are useful only because they have a knowledge base of answers, regularly updated by people.

## A Change Management Model

Combining our analyses of digital innovations at GSU with Pettigrew's change theory (1985, 1987, 1990), we offer a model for managing change in digital innovations for student success. According to the model, change management revolves around three dimensions—the context, the content, and the process of change. In each of these dimensions, GSU took important steps to rationalize, initiate, and administer requisite organizational transformations. As illustrated in Figure 1 and summarized below, we draw on these experiences to offer general lessons along each of the three dimensions that other institutions can adapt to manage change in their digital innovation initiatives toward increased student success.
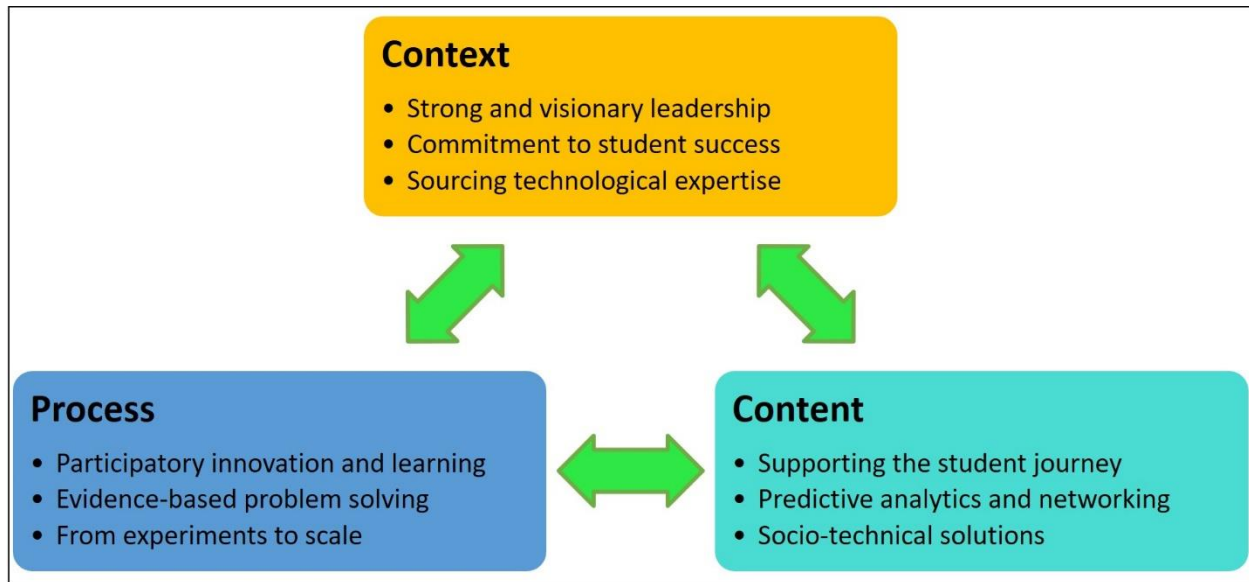
*Figure 1: A Change Management Model*

Considering the context of change, the most significant principle guiding GSU's student-success efforts has been a pledge to improve student performance through inclusion rather than exclusion. GSU's outer context posed formidable challenges in attaining this ambitious goal. Yet in 2011, through its strategic plan, GSU pledged to increase the number of enrolled low-income, first-generation, and minority students and to significantly improve their graduation rate. The realization of this vision was supported by the unrelenting commitment of staff and faculty at every level of the institution to student success. To cope with the challenges in its outer context, GSU had to change its inner context by transforming its structural, managerial and cultural arrangements. Examples include establishing the Student Success Center to lead all innovation initiatives; developing the GPS system to track every student daily with the use of predictive analytics and to proactively intervene with students who are at risk; overhauling the advising systems and technologies and establishing the UAC to better advise the students; and setting up MILE labs to effectively improve student performance in difficult gateway courses. To facilitate such rapid, disruptive transformations, GSU trained and developed its own workforce and sourced expertise from outside.

As a second principle, GSU's change process, horizontally spanning over two decades, was facilitated by a vertical structure with the Student Success Center at the top and participation from people at every level of the organization. Even though the Student Success Center initiated change processes, evaluated available innovation options, and authorized innovation initiatives, a culture of participatory innovation and learning across the organization was the driving force in realizing GSU's vision. Routines such as the weekly manager meeting is an example of this collaborative culture. Moreover, decision-making at every step of the innovation process was justified and substantiated by evidence based on data, rather than unjustified speculations over sophisticated technology. Along the horizontal dimension of the change process, GSU first experimented with digital innovation options in small scale, and only after evaluating and ensuring the positive impact of such options, did GSU develop solutions to scale. At all time, ensuring and improving student success was at the core of evaluating innovation options.

Finally, as a principle for managing the content of change, GSU used data aggressively in order to identify and understand the most pervasive obstacles to its students' admission, progression, retention, and completion. GSU realized that it will not be able to solve decades-old problems by the same old means. As such, GSU proactively initiated change to support and improve all dimensions of the student journey—teaching and learning, monitoring and advising, and engaging and informing. Data analytics was heavily used to identify and evaluate problems and GSU was willing to address problems by piloting new strategies and experimenting with new technologies. Data analytics was also used to track the impact of innovation options and to make adjustments as necessary to improve results. Most importantly, GSU's success can be attributed to intensive networking between people with unrelenting commitment to student success and technologies with potential to improve student success. As such, GSU invested more in people than in technologies. GSU trained faculty and staff in using the learning management system, trained instructors and teaching assistants on the adaptive learning technologies, trained staff on how to collect and clean data necessary for developing the predictive analytics models of GPS, hired and trained academic advisers on how to advise students timely and effectively, and trained chatbot staff on how to update the knowledge base and respond to questions that are not currently in the knowledge base. As such, GSU's success is a story of socio-technical innovations to overcome its unique challenges.

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