Since at least the early twentieth century, educational theorists and practitioners have agreed that active learning—also known as constructive learning, experiential learning, or learning by doing—is superior to didactic learning, or instruction (Dewey 1938). Experiential learning offers particularly attractive opportunities to engage learners in independent critical thinking, which, in addition to being a desirable end in itself, increases learners’ motivation and engagement.

In today’s employment context, graduates with little or no practical experience are at a disadvantage in the job market. Employers believe that practical experience equips learners with valuable and transferable “soft” skills better than passive instruction. For example, employers of business graduates demand “business awareness” and practical problem-solving and analytical skills (Kavanagh and Drennan 2008) and information literacy competencies (Sokoloff 2012) in addition to disciplinary (e.g., accounting) knowledge. A comparison of job advertisements for information professionals over a thirty-year period showed a marked shift from technical requirements toward interpersonal skills and behavioral characteristics (Kennan, Willard, and Wilson 2006). In general, employers increasingly expect graduates to be “employment ready” (Andrews and Higson 2008).

Experiential learning strives to develop such interpersonal skills and behaviors by embedding learning in authentic and relevant contexts. For example, many standard business practices are mimicked in experiential learning settings so that learners already are familiar with such practices when they begin working. For example, business reliance on cross-functional teams is reflected in interdisciplinary educational projects. Problem-based learning inverts the standard pedagogical model by placing problem-solving activities in the center of the learning experience and makes knowledge acquisition a means to an end. Knowlton (2003) argues that failing to so undermines the purpose of learning.

Experiential learning also introduces learners to the challenge of problem seeking, not merely problem solving. The world does not contain problems: it contains situations. The sign of the truly educated person, the true professional, is not merely that he or she can solve problems. That should be taken for granted. It is that he or she can regard a situation and say, “This is the problem worth working on.” Reasonable people can disagree about the identification of problems, as Rittel and Webber (1973) appreciated in the concept of “wicked problems”—a concept that has driven educational practice in the design and planning disciplines. A concern for problem formulation is why experiential learning is so essential. Instructional pedagogies do not prepare learners for wicked, sociotechnical, or contestable problems.

If this is so, why isn’t all learning structured in such a way at the best research universities? The answer is economic and cultural. Research universities cater to large numbers of students who are traditionally taught in large classes, especially in STEM and preprofessional disciplines, and especially at the introductory levels. Experiential learning is difficult to scale. This is in stark contrast to the traditional, lecture, which, because it involves little or no interaction between lecturer and student audience, can grow in class size without limit.

Not all teaching practices that take place during the events we call “lectures” are didactic. There has been widespread experimentation with active learning practices in lectures, such as the minilectures punctuated by small-group discussions and problem-solving exercises and the “flipped” classes, where the instruction is done between classes and the “lecture” session is devoted to interactive problem solving. Nevertheless, perhaps as much for cultural reasons and professional inertia as for scalability constraints, the instructional model is still the default mode of teaching in large STEM courses.

In contrast to STEM courses, many humanities courses have avoided the lecture model for decades, and although not all the teaching methods used in such courses are experiential, they do increase engagement and an appreciation for interdisciplinary and transdisciplinary connections. In addition, the case method is endemic in the teaching of business. Architecture and design are organized around intense and rigorous studio practices.

Getting beyond the instructional model, especially at research universities, has been the focus of several efforts sponsored by coalitions of universities, such as the Association of American Universities STEM initiative (Miller and Fairweather 2015), the Reinvention Collaborative (Katkin 2003), and the Association of American Colleges and Universities LEAP model (Peden, Reed, and Wolfe 2017). One approach that is receiving local attention at Georgia Tech is computer-aided individualized learning.
See the Creating the Next in Education (CNE) Report Supplement Exploiting Artificial Intelligence (AI) for Personalized Learning at Scale (Georgia Tech 2018).

These efforts are undoubtedly part of the solution, perhaps in conjunction with an evolved concept of “flipping” or “blending” the classroom experience. However, in-person education is a necessary, desirable, and ineradicable aspect of education at the best residential universities, especially at the undergraduate level.

Existing Experiential Learning Programs

Georgia Tech has a long-standing commitment to experiential learning. The Institute began as a technical school with unapologetically vocational goals. Students, who were initially all studying engineering, divided their days between lectures and shop classes. The A. French Building, now an administrative building, was originally the home of the School of Textile Engineering and was in fact a working textile mill. To this day, the sounding of “The Whistle,” an authentic factory whistle from the early years of the Institute, signals classes.

The co-op program, in which students spend alternating terms in classes and gaining work experience, is over 100 years old and is the largest voluntary co-op program in the United States. More recently, Georgia Tech has introduced non-co-op academic internships.

Over the last twenty years, international experiences have become an important part of the Georgia Tech culture. Over 50 percent of undergraduates have a meaningful, academic international experience. Many of Georgia Tech’s study abroad programs seize experiential learning as their raison d’être, incorporating academic and company visits, project work on site, or intentional cultural engagement into class content. Students in Greece and Italy have the opportunity to study site context and scale as they learn about art and architecture within their historical contexts and as part of a lived experience. Another example is students within the Civil Engineering program who work on an environmental quality project in Bolivia with colleagues from community-based organizations.

As a large public research university, it is inevitable that many of Georgia Tech’s courses are large and lecture based. Along with other universities in the same category, Georgia Tech is experimenting with flipping the classroom, and as a pioneer in the development of massive open online courses (MOOCs), the Institute has extensive course material available online that students can consult on their own time so that class periods can be devoted to active problem solving.

The School of Biomedical Engineering has pioneered team-based problem-based learning (PBL) since its inception as a program. PBL was developed as a radical way to teach diagnostic skills to medical students. Its defining feature is the unfolding and interactive presentation of an open-ended situation. Students are required to “solve” the open-ended situation using fundamental knowledge that they have acquired through self-directed reading and research. Contrary to fears that such students lack a full background in the fundamentals needed to solve an authentic problem, PBL learners typically outperform medical students on standardized tests (Imanieh 2014.)

Experiential learning opportunities in the context of open-ended projects are widely available for all Georgia Tech students; in fact, some exposure is required of nearly all graduate and undergraduate students. All of the colleges at Georgia Tech have courses that incorporate project work. For example, many humanities students create media (written and visual) individually and in teams. Engineering and computer science students have open-ended team-based capstone design projects or design courses that are required by the Accreditation Board for Engineering and Technology. Students in public policy and industrial design now join STEM students in doing capstone design projects that they showcase at the campus-wide Capstone Design Expo each year. Research, the ultimate open-ended project work, is required by Ph.D. students and many master’s-level students.

The Vertically Integrated Projects (VIP) program involves teams of students who work on research or projects over a long period of time, typically several semesters. The older students on a team mentor the newer students, providing the vertical integration of knowledge and mentoring. In the process, students acquire many interpersonal and intrapersonal skills. There are currently more than 50 VIP teams at Georgia Tech, consisting of between 8 and 30 students each. While the Georgia Tech VIP Program first grew out of Purdue’s EPIC program (engineering.purdue.edu/EPICS), it has since expanded to 24 other universities. VIPS more closely model the environment of Big Science or industrial research and development (R&D) contexts than traditional one-semester undergraduate research projects.

Major societal challenges, such as those included in the National Academy of Engineering’s Grand Challenges (www.nae.edu/Activities/Projects/grand-challenges-
Transcending the Carnegie Unit: Credit for Accomplishment

The Carnegie Unit, which is a unit of learning effort and accomplishment and is used for computing the total time necessary to complete a degree, the price of tuition, and the qualification of a student as full time, is cashed out in periods of time. Each unit corresponds to one hour of face-to-face student and faculty interaction. Each hour of contact, it is assumed, is supplemented by two hours outside of class for which the student receives no credit but which are required for a prepared and motivated student to succeed. In the case of online learning, standard procedures have been created to convert online experiences to face-to-face time. Thus, a 12- or 15-unit load translates to 36 or 45 hours per week of actual effort, which is why a 12-hour load is the minimum required for a student to be considered full time.

Other modes of learning are valued at a different rate. Three hours of laboratory work are worth only one credit. Sometimes this equation of three laboratory hours to one lecture hour is justified by saying that, unlike a lecture, a student needs no preparation before class and has no out-of-class work afterward. However, this does not allow for lab report assignments. The three-to-one ratio is really little more than a rule of thumb.

It is conceivable that another form of credential, one that accounts for experiential learning, could be developed. If a Carnegie Unit represents the equivalent of a single hour of direct student-faculty interaction, educators might use a parallel concept of a Dewey Unit, which represents the equivalent of a single hour of experiential learning activity. Georgia Tech has already begun to collect data on such student activities in the extracurricular setting with tools like OrgSync.

Georgia Tech participated in a National Science Foundation-sponsored cross-institutional survey, “Assessing the Spectrum of International Undergraduate Engineering Educational Experiences,” which used the nationally normed Global Perspectives Inventory to assess the global-mindedness (grounded in cognitive, intrapersonal, and interpersonal domains) of undergraduates. The study considered a variety of pre-college and in-college experiences, such as living in university housing with an international focus, study abroad, and service learning abroad.

This and other research shows that many of the experiences students have outside the traditional classroom—e.g., when they engage directly in research, discovery, and design—help them to develop so-called “twenty-first century skills” (National Research Council 2010), which better prepare them for the world outside campus. Such skills include adaptability, complex communication and social skills, nonroutine problem solving, self-management or self-development, systems thinking, innovation and entrepreneurship, and leadership.

Georgia Tech should explore opportunities to gain a better understanding of how cocurricular and extracurricular activities provide benefits to students,
including benefits that may occur as a result of Georgia Tech activities before, during, and after their formal enrollment.

**Expanding to Additional Populations**

Georgia Tech’s successful experiential learning initiatives could be expanded beyond the age boundaries of traditional enrollment. The Institute already engages in many ways with learners who are younger than traditional college-age students.

In some cases the engagement is indirect, such as via the successful Georgia Intern Fellowship for Teachers (GIFT) program that provides research experiences to K-12 STEM teachers. In other cases it is more direct, such as via camps or the Distance Calculus program. The Institute should explore opportunities to engage K-12 students and teachers with existing successful experiential learning programs, such as expanding the VIP Program to include these students and their teachers.

Additionally, many Georgia Tech alumni remain in the state of Georgia and have interest in continuing their learning in informal ways. They are frequently found engaging with their communities as members of maker spaces, coaching robotics teams, or participating in Girl Scouts STEM events. Georgia Tech could develop relationships with and support such STEM communities across the state to build up a “STEM Extension Service” similar to existing efforts in agriculture and manufacturing. This would provide a platform for on-campus students to interact with alumni and the broader community by volunteering or taking employment in STEM Extension Services. Students would have additional learning experiences more broadly across the state of Georgia and the services would give the Institute a local foothold in rural areas where Georgia Tech could be of service.

**Rejuvenate the Cooperative Education Program as an Educational Program**

The cooperative education program (co-op) can be rejuvenated in many ways. One change which has already occurred is that the co-op program at Georgia Tech is no longer just for engineering students. Also, co-op involves three alternating semesters of work and study, not seven alternating quarters, and “rotations” are with companies mutually agreed upon by both the university and the students, not companies that the Institute found and required. One thing that has never changed, however, is that co-op programs are an experience in which students are embedded in a large corporate organization and the three rotations of experience are housed within a single company. These features have some justification, but in order to rejuvenate the program, they should be reevaluated. Another way to improve the co-op program is to help the students integrate what they have learned on the job into their academic programs.

The Georgia Tech Center for Career Discovery and Development (C2D2) and colleges across campus should initiate a task force to examine and recommend changes to the co-op structure that clarify the similarities to and differences from (if any) the local internship program, the Global Internship Program, CREATE-X, and government service programs. Post-co-op debriefings should become a serious component of the student’s educational record.

**Students Thinking Big**

Georgia Tech students are encouraged to think big and to embrace societal challenges. The Serve-Learn-Sustain Program, the presence of the Grand Challenges scholars program, the emphasis of the InVenture Prize on products that directly benefit humanity, and the success of academic programs such as the Global Leadership minor all speak to Georgia Tech students’ awareness of sociotechnical challenges and their willingness to address these issues. The next step is for students to be placed into situations that are problematic and to be challenged to identify the problems that need to be solved.

As Georgia Tech students become more innovative and better global citizens, it is appropriate that the Institute form new curricula accordingly. Georgia Tech should explore ways for students to become partners in their education, by having them, where appropriate, develop the syllabus and content of some courses.

When Georgia Tech faculty enter into meaningful collaborations with their students on the topic of what should or should not be part of their education, there are benefits for both parties. Faculty will discover what the students are seeking to learn and, using their deeper expertise, will be able to guide educational material in meaningful directions. This also has the potential to inspire teaching innovations. Moreover, faculty will be called upon to demonstrate the same high level of risk taking that the Institute encourages in students.

Students will necessarily have to take on more responsibility for their own learning, but they will also be driven by their own agency. This is one approach for Georgia Tech to explore curricular changes in the age of the internet, where the average learner has access to a well-indexed, searchable repository of human knowledge.
Naturally, attention must still be paid to appropriate levels of rigor, but the result may end up being more authentic and meaningful. There are places where such educational experiments have been tried (e.g., Olin College), so administrators have already begun to learn what may or may not work at Georgia Tech.

**Urban Community as a Platform for Education**

Georgia Tech has a long history of working in local and regional communities, via student organizations such as Mobilizing Opportunities for Volunteer Experience (MOVE), K-12 outreach with CEISMC, courses such as the Honors Program’s Semester in the City, and research efforts in academic units and the Georgia Tech Research Institute (GTRI). Georgia Tech’s urban and regional setting offers tremendous potential for mutually beneficial efforts that allow students to learn by doing while engaging with communities to further local goals.

The recent Serve-Learn-Sustain initiative is creating curricular and cocurricular opportunities for community engagement around sustainability themes. Other campus efforts such as the Smart Cities and Inclusive Innovation Initiative and the Center for Urban Innovation demonstrate Georgia Tech interest and commitment to community service.

Urban Community as a Platform for Education is a sample pilot project that addresses two key elements currently missing from Georgia Tech and many other technological institutions that strive to take community engagement seriously. First, the project utilizes the campus as a living laboratory. Second, it creates a framework that offers students from multiple disciplines, including engineering, computing, architecture, and more, the opportunity to use design to improve existing conditions within a community. One key aspect of this effort is that the pilot will be available for projects that span several semesters, allowing for growth of student skills over a longer time span and providing a more in-depth group of problems to address.

The Georgia Tech Commission on Creating the Next in Education (CNE) proposes a two-tiered approach for this pilot program, intended to build on work already being done by Serve-Learn-Sustain and faculty across campus, through the VIP Program and other initiatives.

First, Georgia Tech educators must fully engage with the campus itself as a living laboratory for practice and experimentation. Opportunities to be explored in this effort include smart campus buildings, augmented and virtual reality for design visioning, data mining and integrated infrastructure, digital life and built-environment integration, and the campus as a digital platform. Georgia Tech’s campus provides an intellectually safe environment for student work, where educators understand and control relationship inputs/outputs and can more easily structure learning opportunities.

Second, Georgia Tech must create collaborative design labs in which students, faculty, staff, community organizations, city and regional officials, and professionals can come together to work. Design labs offer permanence of place and expertise, which can serve as training grounds for faculty and students who want to learn how to engage with communities. Design labs offer powerful demonstrations of collaborative work. They may be appealing for professionals doing pro bono work and contributing to the development of communities and the next generation.

Opportunities to explore in this effort include deeply interdisciplinary learning; innovative public government/private community collaborations; real-world, participatory design development; and sustainability in artifact production. A burgeoning, near-term opportunity to experiment with this idea is the Rockefeller Foundation’s 100 Resilient Cities Initiative and a planned community resource center “that uses design, art, data, media, and technology to help residents address local issues and improve resilience” (100 Resilient Cities Initiative 2017).

**Toward Proficiency-Based Education and Apprenticeship Learning**

Competency-based education (CBE) (preferably called proficiency-based education, as recommended by the Lumina Foundation), replaces credit-hour-based instruction with the demonstrated accomplishment of specific proficiencies. In its early incarnations, proficiency-based education has been applied exclusively to technical education through the use of prior learning credit (e.g., from military or work experience). The idea is much more general, however, and could potentially even be applied in STEM or liberal arts education.

Apprenticeship learning is more common at the doctoral level than in undergraduate education. In such learning, the learner works one on one or with a small committee of faculty on a chosen project, in the process growing from a student into a junior colleague through experiential learning.
Both models would be new to Georgia Tech but align perfectly with the Institute’s tradition of experiential learning. Transforming the entire learning culture of Georgia Tech is unfeasible, but there exist significant pockets of interest in which such approaches could be introduced into the curriculum as pilot projects.

The Commission recommends a pilot project to design and implement one or more academic programs around an apprenticeship or proficiency-based model. A perfect candidate for apprenticeship-based learning is the psychology major, because the faculty-to-student ratios at the undergraduate and graduate levels are remarkably similar. The School of Psychology is already in the early stages of considering this option. Another opportunity is a joint degree in economics and mathematics (because there is no existing legacy to replace). In addition, one or more of the concentrations in the business administration program might lend itself to a proficiency-based model (because the content is self-contained and the number of students is not large).

Administrative Issues

The Commission has been charged to investigate innovative approaches to education and not small-scale, incremental, administrative reforms. Experiential education, however, is one area where ideas and organizational implementation may clash. Fresh thinking about the very concepts that underpin administrative categories and practices would be welcome, because innovations cannot take root unless the organizational structure allows them to flourish. Following are a few such issues that will need to be addressed:

- Experiential education is difficult to deliver consistently and to assess. Although fundamentals do not have to be learned before their discovery when solving authentic problems, unless these problems are carefully designed, learners may never be exposed to subject matter that they need to learn. This has been a perennial objection to problem-based learning wherever it has been introduced.

- Experiences designed around competitions with intellectual property (IP) claims raise the specter of possible conflicts of interest among students and between students and faculty. Georgia Tech could introduce a model of teaching that favors “winning” over “learning” unless such competitions are carefully designed to provide scaffolding for all participating students. One troubling possibility is that this format may have an effect on the gender ratio of students who participate in the same way and for the same reasons that female participation in computer science programs is so low.

- Tenure-track faculty at Georgia Tech may lack the capacity to provide the individual guidance that some of these ideas require for successful implementation.

- The Georgia Tech course-scheduling template is an impediment to experiential learning events. Fifty-minute blocks do not facilitate learning by doing, except as short interludes between minilectures. Off-campus experiences, for example, require travel and therefore absence of overlap with adjacent classes of participating students. Georgia Tech’s Friday “flexible block,” utilizing the new class-scheduling template, alleviates this problem somewhat, but Friday rush hours are not conducive to off-campus travel.

- The creation of nonstandard modes of teaching may accommodate majors in one discipline at the expense of students pursuing other majors for whom the flexible schedules may be an impediment.
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