

# Application Summary

## Competition Details

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**Competition Title:** 2019 Curriculum Innovation Award

**Category:** Institutional Awards - CTL

**Award Cycle:** 2019

**Submission Deadline:** 02/01/2019 at 5:00 PM

## Application Information

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**Submitted By:** Craig Forest

**Application ID:** 3054

**Application Title:** CREATE-X curriculum: courses that instill entrepreneurial confidence in students

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## Personal Details

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**Primary School or Department**

Mechanical Engineering

**Primary Appointment Title:** Associate Professor

## Application Details

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**Proposal Title**

CREATE-X curriculum: courses that instill entrepreneurial confidence in students

## CREATE-X curriculum: courses that instill entrepreneurial confidence in students

Nomination for 2019 Georgia Tech Curriculum Innovation Award

Applicants: CREATE-X faculty and staff team:

Prof. Raghupathy Sivakumar (ECE) – Director of CREATE-X

Prof. (Emeritus) Ray Vito (ME)

Prof. Karthik Ramachandran (Business)

Dr. Joyelle Harris (ECE) – Associate Director of CREATE-X

Prof. Keith McGregor (CS)

Prof. Craig Forest (ME) – Associate Director of CREATE-X

Dr. Olufisayo Omojokun (CS)

Mr. Timothy Lee (BioE)

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## CREATE-X curriculum: courses that instill entrepreneurial confidence in students

### 1. Description and objectives of the innovation

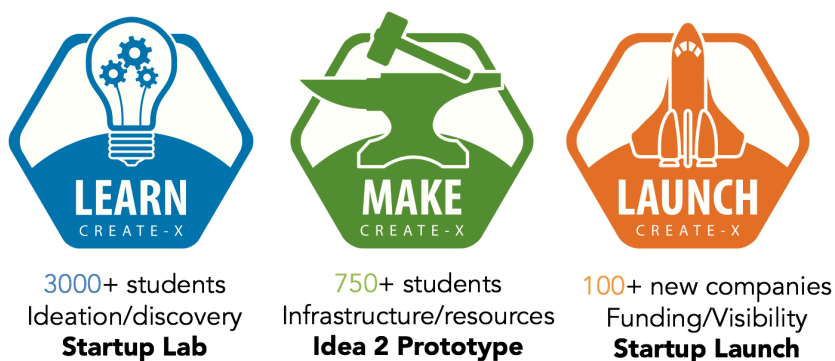
#### 1A. CREATE-X Overview

The characteristic inventiveness of the United States is critically dependent on leading technological institutions rising to the occasion to create the next generation of leaders who are entrepreneurial in their thinking. This is especially true given recent data showing the significant impact of independent entrepreneurs on the growth of free enterprise economies.

**Georgia Tech's Initiative to Enhance Undergraduate Entrepreneurial Confidence, called CREATE-X, is a visionary enterprise aimed at systematically nurturing *entrepreneurial confidence* as one of the signature attributes of Georgia Tech graduates.** The broader goal of this initiative is to provide the knowledge, skills, abilities, and experiences that will give Georgia Tech graduates the confidence to actively create their own future. During the past several years, existing competitions, classes, and programs (e.g., InVenture Prize, Invention Studio, VIP Program) have significantly changed the undergraduate culture at Georgia Tech as it pertains to entrepreneurial activities. However, the entrepreneurial confidence initiative is an opportunity to provide a *mentored pathway* to nurture this beginning and fully leverage and scale what we have learned to transform the undergraduate experience.

CREATE-X consists of three programmatic themes: (1) LEARN, (2) MAKE, and (3) LAUNCH, as shown in Fig. 1. These themes offer a pathway, consisting of undergraduate curricular and co-curricular learning opportunities that, in total, give all interested students, regardless of major, the skills to value and pursue entrepreneurial opportunities that are real, not theoretical; in short, our program enables students to be “entrepreneurially confident.”

The CREATE-X initiative is unique because of the following core philosophies:



**Figure 1.** CREATE-X Initiative. Three curricular themes provide a pathway that supports students from those who are curious about startups (LEARN), to those who can turn their invention ideas into prototypes (MAKE), to those who are ready to receive resources to start a company (LAUNCH).

- Students explore entrepreneurship through the ultimate experiential learning mode – launching their own startups with seed funding, legal assistance, and intensive coaching.
- All key elements of CREATE-X are curricular – students receive credit that counts toward graduation.
- The emphasis in CREATE-X programs is on “Deep Startups”, or in other words startups that are likely to have long-term impact as opposed to short-term gain.

## 1.B. CREATE-X Curriculum Overview

Underpinning the CREATE-X program is a series of courses, which are nominated for the 2019 Georgia Tech Curriculum Innovation Award. While these courses are complemented by co-curricular opportunities within CREATE-X, it is this curricular foundation that represents the majority of our efforts and impact. The series of undergraduate courses, organized according to the themes in Fig. 1., are as follows:

### LEARN

1. Startup Lab (COE 2701, CS 2701, MGT 4803) teaches evidence-based entrepreneurship. This semester-long three-credit class covers ideation, teaming, customer discovery, MVPs, and the business model canvas.
2. Invent (GT 2803) raises students’ awareness of how to “find” a problem, state it clearly and approach its solution in a creative way. Students are then prepared to pursue ideas by participating in follow-up on activities like the InVenture Prize or other curricular elements of the CREATE X initiative, including *Idea to Prototype* or *Startup Lab*.

### MAKE

3. Idea to Prototype, “I2P” (Major Designation 2699, 4699) provides students with resources and technical mentorship to refine their idea into a working prototype. Teams look more deeply into the technology underlying their ideas and then construct a prototype or working proof of concept.
4. Capstone Design (ME 4182, GT 4823, CS 4853). In this course, student teams will design and build prototypes of their invention ideas and explore whether there is a market demand and value proposition for them. This is done in a nurturing environment, with mentorship and financial support for these entrepreneurial teams, including relevant lectures catering to the needs of a startup.

## LAUNCH

5. Startup Launch provides students the funding, coaching and legal services to launch their startups and take their products to market in a 12-week intensive student and startup-focused summer-semester with specialized coaches that coach the student teams.

Over the past few years, CREATE-X has instilled thousands of students with entrepreneurial confidence. Given Georgia Tech's status as one of the top educational institutions in the country, it is anticipated that the initiative will be mirrored and adopted at other peer institutions across the country, and thus the proposed effort will truly have a profound impact on university education as a whole in the United States.

## 2. Approach and implementation of CREATE-X curriculum

### LEARN: Creating Student Entrepreneurs

The Learn component (See Fig. 2) fosters an entrepreneurial mindset and related skills for all Georgia Tech undergraduate students. LEARN involves promoting and developing a diverse set of activities that increase students' exposure to unmet market needs, providing students with opportunities to generate unique and valuable ideas as a team. Students have the opportunity in their first two years to learn startup vocabulary and processes; to identify market need; to develop an idea that addresses that need; and, to build an enthusiastic team interested in pursuing that idea. LEARN enables students to develop the language and practice of entrepreneurship, while simultaneously offering mentoring opportunities. This effort does not duplicate any current initiatives for undergraduates which already support LEARN activities across campus; LEARN nurtures, coordinates, scales, and adapts existing programming as needed while also creating several new initiatives to focus on previously unaddressed elements. There is a particular need to create a pathway for what happens after a student team has developed an idea that might have true value for impacting society positively.

Startup Lab: Introduction to technology ventures/startups. Different elements of technology venture creation are introduced including opportunity identification and validation, ideation, customer discovery, market analysis, minimum viable product development, business models, intellectual property, and capital raises are covered. The pilot Startup Lab in Spring



**Figure 2.** Students participate in team discussion about startup ideas in the Startup Lab, a LEARN course within CREATE-X.

2014 consisted of 30 students; subsequent offerings of the class during the fall semesters (2015-2018) each have had 100+ registrations with proportional representation from ECE, BME, ME, and COC. The class is currently cross-listed between COE, COC, and MGT and the intention is to cross-list the class in the College of Design and other colleges in the near future. The 90-100 students are split amongst 4 sections with a common curriculum, but with separate instructional team (lead instructor, co-instructor, and undergraduate TA. Web-based video content to introduce concepts is complemented by instructor and student meetings and presentations, as shown in Fig. 2. Students discover a compelling value proposition thesis by going out and interviewing hundreds of people. Students commit six hours a week of time outside of the class time to be successful.

Startup Lab is a unique course because it allows teams of undergraduates the opportunity to create a zero-risk startup. The students are curious about entrepreneurship, and many of them want to launch companies. By taking the course, the entrepreneurial process is demystified by giving them a framework to test their ideas in the market. The course is also unique because we both encourage and applaud failure. The vast majority of our students realize that their ideas would not make successful companies, and they are relieved to learn this fact in a class instead of in the market.

*Invent*: In this 3-credit hour lecture course with homework assignments, students build the skills needed through in-class exercises and assignments. They develop “habits of the mind” that will serve later as they identify real problems and seek to create and test creative solutions to those problems. *Invent* is often the first exposure students have to entrepreneurship, thus the focus of the course is twofold: to introduce and practice a problem-finding mindset and to introduce the culture of innovation at Georgia Tech.

As a part of the first course focus, students learn about the “Invention Canvas”—a simple tool that guides students in the invention process. The Invention Canvas divides the process of invention into four distinct steps (Discovery, Problem Identification, Solution Generation, and Build/Test). As the semester progresses, students walk through the Invention Canvas, practicing each step along the way in small teams. By the end of the course, students have walked through the Invention Canvas multiple times and are able to find real and important problems as well as start to attack and solve these problems.

For the second aim of *Invent*, student, faculty, and guest speakers introduce the culture of innovation at GT through guest lectures, campus tours, and in-class activities. Students learn about intellectual property, funding mechanisms, and start-up best-practices. *Invent* is traditionally offered to first-year students and not restricted by major, thus this course draws a wide variety of students who are eager to learn about entrepreneurship and

invention. As an example, the Spring 2018 Invent course had 42 students across two sections, representing 11 different majors. Thus, this course provides a veritable entrepreneurial foundation for Georgia Tech students.

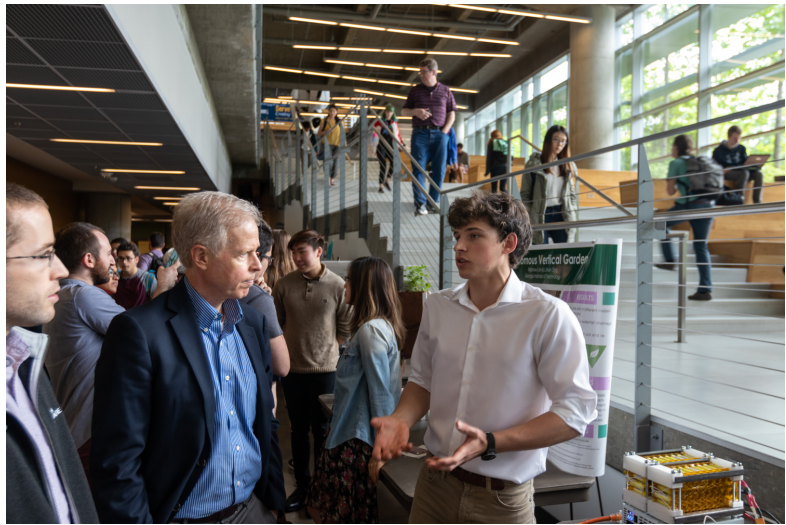
## **MAKE: Technology Innovation and Solution Building**

A subset of the LEARN student population (although not required as a prerequisite) advance to participate in the MAKE component (See Fig. 3), and develop concrete ideas for the creation of prototypes or other proof-of-concept activities that are designed to validate the ideas developed during the LEARN phase. In addition to invention, design, assessment, modification, and testing, MAKE also incorporates structured processes such as customer discovery and validation to objectively establish the potential value of any particular idea. The iterative process of ideation, customer discovery-driven hypothesis testing, product requirements learning, pivoting, and customer validation is a relatively new approach to entrepreneurship, and is an important new component of MAKE. Students who have ideas and want to move forward also need support—space, facilities, infrastructure, and access to mentors. MAKE provides students with the tools and resources necessary for the long process of moving from the conception of an idea to determining the merit of that idea and if the idea can serve its stated “customers” in a financially viable, sustainable fashion.

While Georgia Tech has some programs in place that serve parts of this purpose, these efforts have limited intersection or availability to undergraduate students, and most importantly, they do not fulfill the entire process outlined above. The Price Gilbert Library is clearly emerging as a center of design, innovation, and entrepreneurial thinking. We anticipate that as the Library is transitioned to its new purpose, it will house not only classes but also programs that support student teams with ideas. Student-run makerspaces, like the Invention Studio in the Woodruff School of Mechanical Engineering, serve as a model for additional hands-on maker’s spaces. The InVenture Prize School, held in conjunction with the competition, is a series of early evening events supporting creative thinking, mentoring, and team formation. The lessons learned from Startup Lab (LEARN) and the strengths developed in existing programs have been directly leveraged to inform future programming for MAKE.

*Idea to Prototype (I2P).* In I2P, student invention teams receive faculty mentors, guidance, seed funding (\$500 minimum per team), and additional university resources to build functional prototypes of their ideas. Student apply for the course with their team and clearly identified and validated startup problem. Students earn three undergraduate research credit hours for each semester they enroll in the course (up to six maximum). Faculty mentors meet with teams weekly, while the teams design and build their inventions independently using funding and space provided by CREATE-X. In Spring 2019, 57 teams are accepted into the course, comprising 115 students from 13 majors. Over the past 5 years, a total of 233 teams have participated.

The I2P Showcase, shown in Fig. 3, is the climactic event for I2P. At the end of the semester, student teams present their prototypes to the public with prizes in front of hundreds of attendees, as shown in Fig. 3. Beyond the awards, this event is an opportunity for students to receive feedback on products that might go on to become a successful startup venture.



**Figure 3.** Students demonstrate and explain prototypes of their inventions created in Idea to Prototype, a MAKE course within CREATE-X.

***CREATE-X Capstone Design:*** With students from three majors (ME, CS, and ECE) in Spring 2019, 13 teams (averaging 3 members each) receive coaching, funding, and mentorship support for designing and building prototypes that are targeted toward a validated startup hypothesis. This course aligns with the senior capstone design syllabus, ABET accreditation, and learning objectives. Successful students spend 10+ hours/week on the course. The course was offered initially in Fall 2018 to 7 teams, and has approximately doubled in size in one semester. We anticipate that this course eventually enroll as many as half of all capstone design students at Georgia Tech and serve as a major on-ramp to Startup Launch.

In the course, a series of weekly lectures introduce students to 3 major topics: evidence-based entrepreneurship; design and prototyping; and ethics, intellectual property, and agile/scrum management. A series of major reports and presentations complement weekly presentations to faculty mentors and peers. Teams exhibit their projects at the end-of-semester Capstone Expo, attended by approximately 5000 people at McCamish Pavilion.

## **LAUNCH: Creating Successful Startups**

The LAUNCH component (See Fig. 4) constitutes taking acquired skills from the LEARN and MAKE components to the next level, with the goal of Georgia Tech leading the nation in the number of funded student startup enterprises. This component encompasses seed funding, further customer discovery, and advanced prototyping. The LAUNCH approach leverages much of what is emerging organically among the student body in both entrepreneurship and interdisciplinary design. LAUNCH is a more ambitious and systematic effort that reaches more students and creates critical mass

around a life skill, enriching our students' futures and enabling them to create their own jobs.

**Startup Launch:** A 12-week intensive internship class, recorded on student transcripts (at zero credit hours), Startup Launch is a student-focused program for undergraduate teams to work on their startup ideas. Teams admitted into the program are eligible for \$20,000 of investment funding from a startup investment fund, established and managed outside of GT, for this specific purpose. A major portion of the seed investment fund is spent by the teams on product design, customer discovery, minimum viable product, infrastructure, prototyping, customer validation, market research, travel, customer meetings, online presence. Student teams leverage Georgia Tech infrastructure such as the Invention Studio and cost centers. Each team also receives pro-bono legal services and networking opportunities with other early stage startups. Teams are coached by specialized team of faculty with entrepreneurial experience, receive space in the newly renovated CREATE-X Woodruff Dining Hall on West Campus, and receive a crash-course in evidence-based entrepreneurship. An end-of-term Demo Day, as shown in Fig. 4, serves as a focal point for the startups to pitch to the Georgia Tech community and investors at the Fox Theatre.



**Figure 4.** Over 1500 attendees in person and 1000 streaming online watch the end-of-summer Startup Launch Demo-Day event, where 42 startups pitched as a part of this LAUNCH course within CREATE-X, in the Fox Theatre.

Through the startup Launch program a total of 115 companies have been created by students in the past 5 years. Ninety-two of these are still active today and valued collectively at \$150M.

### 3. Learning outcomes, metrics and evaluation

The following learning outcomes are woven into the five CREATE-X courses in varying degrees of emphasis and sophistication:

1. Students will learn and demonstrate evidence-based entrepreneurship as exemplified by customer discovery, business theses, and value proposition.
2. Students will define real-world, important, unsolved problems.
3. Students will design and build working prototypes of their invention ideas.
4. Students will pitch their ideas to multiple stakeholders.

Key outcomes and metrics used to evaluate impact of CREATE-X courses are as follows:

1. Student engagement as measured by number of students participating.
2. Number of student-led companies created and continuity of these companies.
3. Faculty engagement with students as mentors and coaches.
4. Percentage of students self-reporting increased entrepreneurial confidence at end-of-semester versus prior year.

In addition we have gathered qualitative evidence of course effectiveness in the form of CIOs comments (self-reported lessons learned and feedback) and Letters of Support from students who have participated.

### Evaluation Results

We used the following SMART goals to evaluate the success of the CREATE-X. SMART goals are defined as Specific, Measurable, Achievable, Relevant and Time-bound goals.

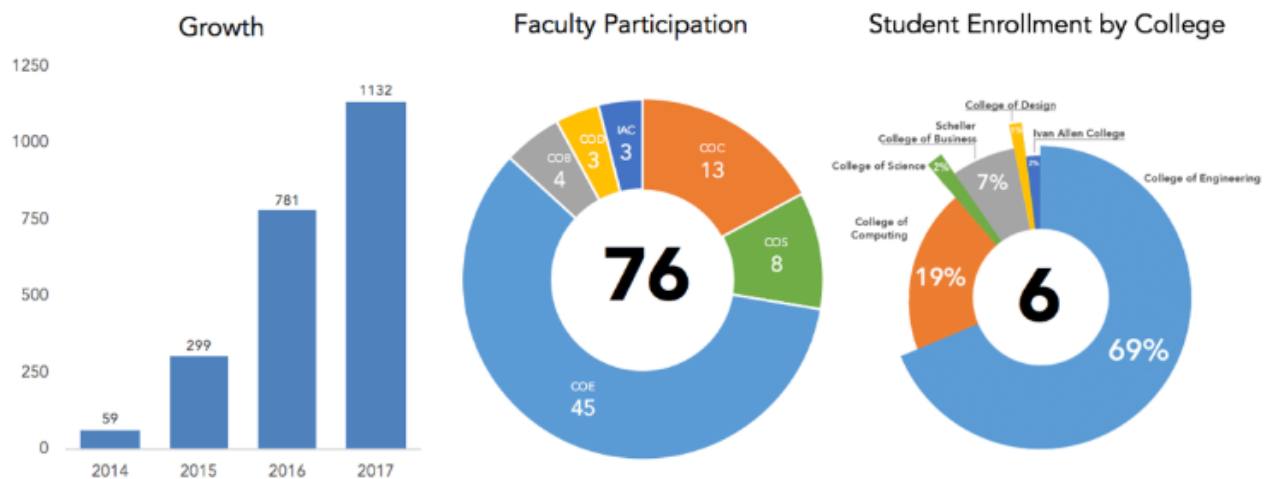
- **Number of Students Engaged in year 2018 [Goal: 1270, Achieved: 113]**  
CREATE-X engaged with 1132 students over the last year, representing a **1.5x increase** in the number of students compared to the previous year as shown in Fig. 5 (left) and represented all six colleges (Fig 5 (right)).
- **Number of Startups Launched in year 2018 [Goal: 42, Achieved: 42]**  
CREATE-X worked with 42 funded student startups (chosen out of 300 applications) over the most recent cohort representing a **1.4x increase** in the number of startups compared to the previous year, as shown in Fig. 6. Overall, 115+ funded startups have been launched with the help of CREATE-X. 92 of these are still active and have market valuation as of Jan 2019 of \$150M+, and the most successful company grossed more than \$35M in 2018.

- **Faculty engagement in year 2018 [Goal: 50, Achieved 76]**

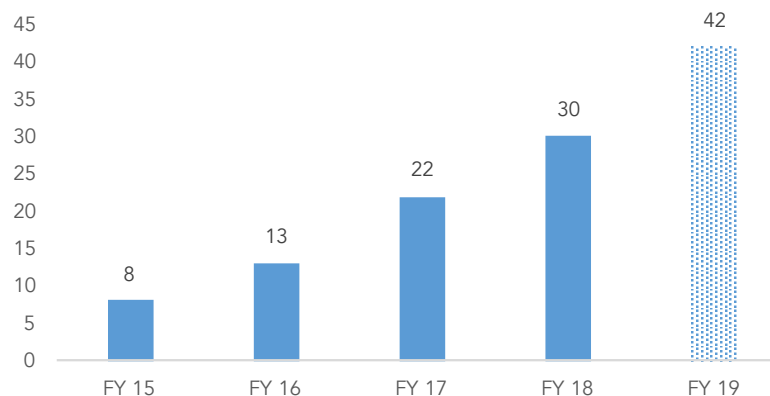
Since our initiative's primary objective is to engage with students, it is imperative that the program be as close to the students as possible. The involvement of interested faculty, consequently impacting curriculum, is a key requirement to establish a scalable program. Faculty mentors and coaches worked with students one-on-one, as well as in teams throughout the year. Some faculty members gave guest course lectures as well. Altogether, 76 faculty from all six colleges were engaged in CREATE-X courses, as shown in Fig. 5 (center).

- **Percent of students more entrepreneurially confident [Goal: 100%, Achieved: 97%]**

97% students who completed Startup Lab in Fall 2017 and Idea to Prototype in Spring 2018 expressed increased entrepreneurial confidence at the end of semester survey.



**Figure 5.** (left) Student participation in CREATE-X courses over the past four years. (center) Faculty participation in CREATE-X courses, representing all 6 colleges. (right) Student enrollment in CREATE-X courses, shown by college enrolled.



**Figure 6.** Number of startup companies launched by CREATE-X in each of the past 5 years. Of these 115 companies, 92 remain active and they are valued at a combined \$150M.

Qualitatively, we have gathered evidence of course effectiveness. Three students have written letters of support (See attached), one of which is from a student who participated in all three of CREATE-X's themes: LEARN, MAKE and LAUNCH.

We have also been encouraged by comments from students at end of semester surveys. For example, SmartEvals comments from anonymous students in Fall 2018 CREATE-X Capstone Design include the following:

*"This course has potential to really transform education. I often hear people saying how pointless university is becoming and how you never really use what you learn in school. This made going to university worth it because it was the only class to actually transform how I see problems in the world and how I can actually use the knowledge gained in school to make a difference."* -Anonymous student

*"I had an awesome time in this course and I'm really excited to see how it transpires in the future for other students and what comes out of it. I feel more motivated to become an entrepreneur and I see the world through a different lens. I'm really thankful for the effort put into this class by the creat e-x group and I hope to work with them again in the future years to come!"* -Anonymous student

*"The freedom and control each team had on their project was a nice change and also humbling. Not being micromanaged is eyeopening to how you actually operate. I was so use to planning according to a rubric and knowing exactly what I had to do but this class shook that up a bit and made me actually think critically."* -Anonymous student

*"This course allows you to decide where YOU want to focus your efforts on."* -Anonymous student

*"Taking this course was the best decision I have made."* -Anonymous student

In end-of-semester surveys administered in all five courses, students consistently report two outcomes: (1) Because they are required to discuss their business idea with many potential customers, they now have the ability to converse comfortably with people outside of their social circles, which may be useful as they advance their career searches and build professional networks. (2) Because of the process we teach them, they now have entrepreneurial confidence. Surveys have shown that more than 85% of our students appreciate the course model and would recommend this course to a friend. Almost all students (97%) who completed Startup Lab in Fall 2017 and Idea to Prototype in Spring 2018 expressed increased entrepreneurial confidence at the end of semester survey. Indeed, several teams from each course cohort go on to launch companies with CREATE-X Startup Launch.

Some of the 115 companies from the Startup Launch program have been remarkably successful. Selected “Graduate” highlights over the years include the following:

- [Gimme Vending](#) offers supply chain management software to vending machine operators for ensuring increased driver compliance and efficiency, and accessing cash, inventory, and service data in real-time. The company has generated over \$1M in revenue. Gimme has been deployed in over 30,000 vending machines.
- [FIXD](#) offers a hybrid hardware-software solution for automobile owners. The company has run a successful Kickstarter campaign. FIXD has generated over \$50M in revenue and is available for sale on Amazon.
- [Replantable](#) offers a produce-growing appliance for home kitchens. Replantable completed a successful Kickstarter campaign raising over \$60K. They are currently serving both consumers and restaurants.
- [Grubbly Farms](#) uses locally grown, sustainable, protein rich feed for chicken farms. The company is serving farms in the state of Georgia and is post-revenue. Grubbly was accepted into the TechStars NYC program. They recently closed a \$1.25M funding round.
- [TEQ Charging](#) is the powerstrip for electric vehicle charging stations. The company is deploying their system in multiple locations and participated in the TechStars Internet of Things (IOT) NYC program raising an additional \$120K in funding.
- [Stord](#) creates more efficient warehousing of goods by matching shipper demand with warehousing supply. The team has participated in Dynamo, a Chattanooga accelerator program and has raised over \$2.5M in funding to date.
- [Eddy Motorworks](#) builds ground-up specialty electric vehicles, like the world’s first all-electric consumer-available race car, [The Electrocet](#), as well as custom electric conversions on classic cars.

- [Crescendo](#) develops an interactive music trainer that boosts the confidence of a student learning to play music. Their apps are available on the Apple appstore and Google Play, one of their apps was recently featured as the “App of the Day”.
- [Toptime Coffee](#) manufactures a coffee roaster that allows customers to completely customize their roasts with their aromatic preferences in mind. They also sell bags of coffee and fresh brew at their pop-up stalls (one is located on the Georgia Tech campus in the MRDC building).

### **Future metrics and evaluation**

Over the next year, the initiative is anticipated to achieve the following goals:

- 97%+ of students seeking this path will be entrepreneurial in their thinking and will possess entrepreneurial confidence;
- 1600+ undergraduates at Georgia Tech will participate in some part of the LEARN-MAKE-LAUNCH funnel; and,
- 55 new student-led enterprises will be created.

When fully scaled (over a 5-year period), the initiative is anticipated to achieve the following goals:

- 100% of students seeking this path will be entrepreneurial in their thinking and will possess entrepreneurial confidence;
- 100% of undergraduates at Georgia Tech will participate in some part of the LEARN-MAKE-LAUNCH funnel; and,
- 100 new student-led enterprises will be created every year.

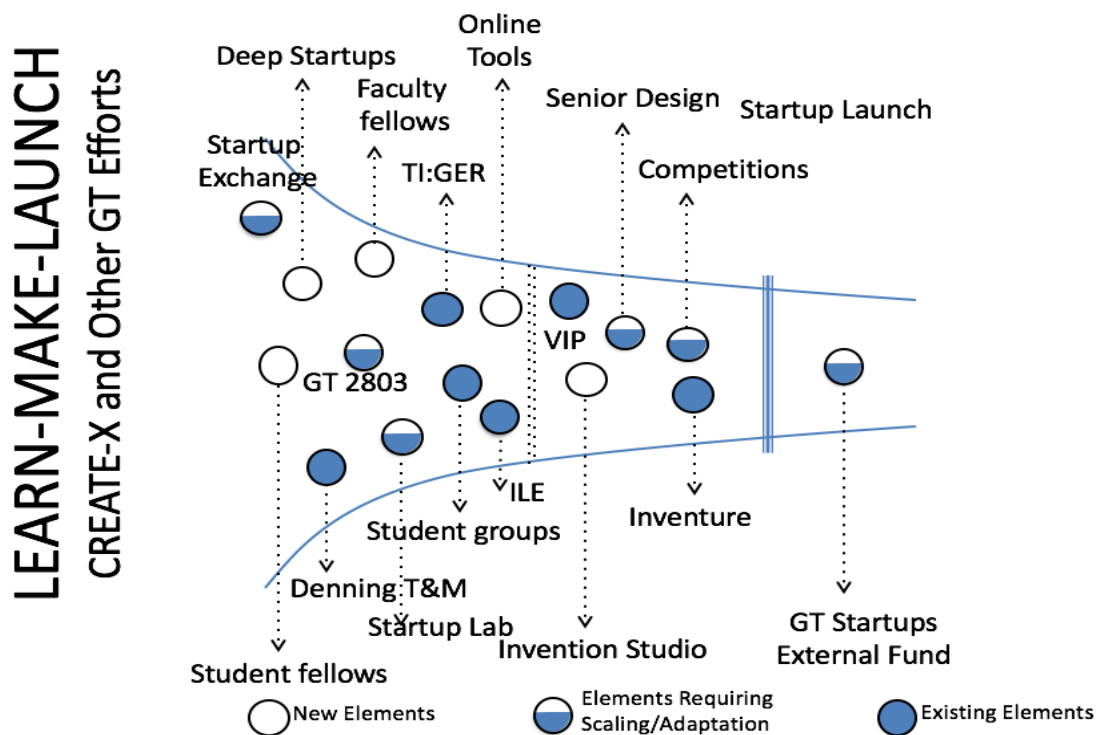
We will track the success in the upcoming years through the measurement of clear metrics as follows:

- Entrepreneurial thinking of students who complete stages of the initiative through exit surveys/interviews. Since the primary goal of the initiative is to create entrepreneurial confidence, this will be an important metric to track. Specific sub-metrics will be developed as we make progress with the initiative.
- Relative performance between LAUNCH phase startup teams that have completed the LEARN or MAKE phases or both, and those that have not. Specifically, such teams will be evaluated based on their startup maturity when they graduate from the initiative and whether they have been successful in gaining customer and investor traction. This will help us evaluate the value (or lack thereof) of the LEARN and MAKE phases. If data indicates that the LEARN and MAKE phases are not adding value to the LAUNCH phase, we anticipate scaling down and perhaps eliminating those phases. On the other hand, if those phases add significant value to the LAUNCH phase, we anticipate scaling up those phases.

- Number of startups that the initiative is creating on a yearly basis.
- Longer-term tracking of startup activities of students who graduate from the different stages of the initiative

#### 4. Adoption and adaptation of the innovation for others

CREATE-X will not exist in a vacuum amongst the myriad of entrepreneurial activities that are underway at GT. The initiative will truly be institute-wide and remain open to all students, regardless of major. It is also the intent to seek entrepreneurially inclined faculty from as many schools/colleges as possible to participate in the program elements and therein attract students from those schools/colleges. Specifically, we are closely collaborating with the College of Computing, the Scheller College of Business, and the College of Design to encourage more faculty to participate and expand courses that encourage students to pursue their own ideas at Georgia Tech. The funnel below represents the other activities within GT that will dovetail into CREATE-X. We will continually explore how the synergies can be improved.



**Figure 7.** Synergies between CREATE-X and other Georgia Tech Programs

Already we are seeing a growing role for CREATE-X Capstone Design (MAKE) amongst the larger Senior (Capstone) Design ecosystem. A healthy balance of industry, research, and entrepreneurial projects can be offered by these complementary Capstone courses.

In addition, the concepts taught in Startup Lab (LEARN) have been integrated into three other courses and are on track to influence many more. Specifically, the customer discovery process is taught as part of Senior Design. Business thesis development is taught in ECE Junior Design. Furthermore, a new graduate course, Tech Ventures, was developed by adapting the content from Startup Lab.

## **5. Leadership team**

Professor Raghupathy Sivakumar (“Siva”) from the School of Electrical and Computer Engineering is the Founding Director of CREATE-X. Siva is the Wayne J. Holman Chair in Electrical Engineering. He has considerable experience with developing other elements for supporting student entrepreneurship. Siva also is an experienced entrepreneur, having founded/participated in three different venture-funded technology startups. Associate Directors of the CREATE-X curricular themes include Prof. Craig Forest (MAKE) and Prof. Joyelle Harris (LEARN). The entire team applying for the award is comprised of the following:

Prof. Raghupathy Sivakumar (ECE) – Director of CREATE-X  
Prof. (Emeritus) Ray Vito (ME)  
Prof. Karthik Ramachandran (Business)  
Dr. Joyelle Harris (ECE) – Associate Director of CREATE-X  
Prof. Keith McGreggor (CS)  
Prof. Craig Forest (ME) – Associate Director of CREATE-X  
Dr. Olufisayo Omojokun (CS)  
Mr. Timothy Lee (BioE)

Many faculty members of the Georgia Tech administration are supportive of this initiative and are actively involved. Letters of Support from College of Engineering Dean Steve McLaughlin and George W. Woodruff School of Mechanical Engineering Prof. Samuel Graham are attached as supporting documentation.

## **6. Conclusion**

The Georgia Institute of Technology’s vision is to define the technological research university of the twenty-first century. Building upon current momentum and mounting student interest and enthusiasm, the Institute has the opportunity to prepare students to embrace entrepreneurial confidence; a mindset and skill set that will enable them to be the leaders of tomorrow. The Initiative to Enhance Undergraduate Entrepreneurial Confidence (CREATE-X) is enabling Georgia Tech to realize, in part, its vision, infuse an entrepreneurial mindset across all Colleges, and, once fully realized, will forever transform the undergraduate educational experience for generations of Georgia Tech students.



The George W. Woodruff School of Mechanical Engineering

Jan 24, 2019

Dear Institute Curriculum Innovation Award Committee,

It is my distinct pleasure to offer a letter of support for the CREATE-X faculty team, led in this award nomination by Dr. Craig Forest, Association Professor in the George W. Woodruff School of Mechanical Engineering at Georgia Tech, for the 2019 Georgia Tech Curriculum Innovation Award. This team has in just a few years, created a series of CREATE-X courses which have impacted thousands of students and fundamentally changed the culture of Georgia Tech to be more innovative and entrepreneurial.

Prof. Forest, with a team comprising Prof. Raghupathy Sivakumar (ECE), Prof. (Emeritus) Ray Vito (ME), Prof. Karthik Ramachandran (Business), Prof. Joyelle Harris (ECE), Prof. Keith McGreggor (CS), Dr. Olufisayo (CS), and Mr. Timothy Lee (BioE) have established a pathway for students who are seeking knowledge and agency about the invention and entrepreneurial process. This team of faculty from across the Institute have embraced open-ended, real-world problem finding and problem solving in these courses. These curricular experiences provide them the resources, infrastructure, and incentives to pursue their entrepreneurial passions. From faculty mentors, to financial resources of up to \$20,000 per team, to physical space for teams to work, to prizes and showcases—they have systematically supported students in moving their ideas to the next level.

I regularly hear about a student's startup success in the Georgia Tech news, or see an invention rolling around on the 2<sup>nd</sup> floor of the MRDC, or see a team at one of the end-of-semester celebrations, which has been successful in large part because of the CREATE-X curricular backbone that this team has led. Some of these students I have seen grow into creative engineers and inventors during my time at Georgia Tech like Ben Horst of Eddy Motorworks. I am proud to tell their stories to our alumni and other that visit our school. However, the inventions that they have created were really enabled by the CREATE-X curriculum developed by this team.

Over 1000 students enrolled in these courses in 2018, which is truly remarkable... They have resulted in the founding of 42 companies led by students—more than in any other year in Georgia Tech's history. In fact, it is the most remarkable curricular impact I have seen at Georgia Tech in the 15 years here. CREATE-X is truly providing a culture changing opportunity for our students, and this award will serve as a fitting acknowledgement of that impact.

Sincerely,

A handwritten signature in black ink that reads "Samuel Graham, Jr.".

Samuel Graham, Jr.

Eugene C. Gwaltney, Jr. School Chair and Professor  
George W. Woodruff School of Mechanical Engineering  
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Steven W. McLaughlin  
Dean and Southern Company Chair, College of Engineering  
Professor, School of Electrical and Computer Engineering

January 28, 2019

To whom it may concern,

I am very happy to send this letter of support for the CREATE-X faculty team for the 2019 Georgia Tech Curriculum Innovation Award. This award nomination is led by Dr. Craig Forest, in the George W. Woodruff School of Mechanical Engineering.

Building upon our momentum and mounting student interest and enthusiasm in innovation and entrepreneurship, CREATE-X is a series of courses and student engagements around entrepreneurial confidence; a mindset and skill set that will enable them to be the leaders of tomorrow. The Initiative to Enhance Undergraduate Entrepreneurial Confidence (CREATE-X) allows Georgia Tech to infuse an entrepreneurial mindset across all Colleges, and it is transforming the undergraduate educational experience for current and future generations of Georgia Tech students.

One of my goals has been to help the CREATE-X team in their efforts, which I believe is a true game- and culture-changing program for all of Georgia Tech. It goes beyond the funds that have been raised and the more than 100 companies that have been started, it's about the students' lives that have been changed. Tech students have gained the confidence to pursue their entrepreneurial ideas; they have learned how to find and solve real problems in the world. CREATE-X has tapped into the energy, ambitions and abilities of our students in ways that I have not seen before at Tech.

Specifically, a team comprising of Prof. Forest, Prof. Raghupathy Sivakumar (ECE), Prof. (Emeritus) Ray Vito (ME), Prof. Karthik Ramachandran (Business), Prof. Joyelle Harris (ECE), Prof. Keith McGreggor (CS), Dr. Olufisayo (CS), and Mr. Timothy Lee (BioE) have established a set of courses: from Invent and Startup Lab for Freshmen through to Capstone Design and Startup Launch for upperclassmen in order for them to explore these interests, learn the fundamentals of evidence-based entrepreneurship, and launch real businesses to commercialize their inventions. The students want to learn because they are passionate about pursuing their own ideas to change the world, and almost all of them, when surveyed report they have more confidence in doing so after the course.

It is my great pleasure to support them in recognition for the hard work and impact they've had with this high honor-the Institute Curriculum Innovation Award.

Sincerely,



Steven W. McLaughlin  
Dean and Southern Company Chair

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January 25, 2018

Dear Selection Committee,

It is my absolute honor to recommend the CREATE-X program for the Center for Teaching & Learning Curriculum Innovation award. I have had the opportunity to participate in the following courses and programs during my tenure at Georgia Tech between Fall 2014 and Fall 2018:

- GT 2803 “Invent” (Your Idea, Your Invention)
- CREATE-X “Learn” (Startup Lab)
- CREATE-X “Make” (Idea to Prototype) twice
- CREATE-X “Launch” twice

I came into Georgia Tech with a lot of uncertainty. The only thing I was certain of was my desire to become a physician, which led me to choose Biomedical Engineering as my major. On a whim, I signed up for GT 2803: Your Idea, Your Invention with Ray Vito, Wendy Newstetter, and Wayne Li; and what a life changing experience that was.

The first thing I noticed about GT 2803 was how different it was from any of the other courses I was enrolled in. There were no right answers. There wasn't anyone holding your hand or any resources guiding you through what you should be doing. The course emphasized the process of identifying problems that exist in the real world and identifying why current solutions were inadequate. We often used successful inventions as a platform for Socratic-style case studies. I remember everyone in the class taking turns expressing what grievances they encountered in their lives, and how relatable they were to the whole group. What was unique about this course was how engaged all of the students were, simply because the problems we were identifying were so relatable; everyone had a high level of interest in better understanding these problems because they were directly impacted by them.

One vivid example that comes to mind is the day we were asked to dive into a common problem we had identified in a previous session: having to replace toilet paper on the toilet paper dowel once a roll was used up. I'll spare you the details of the argument that ensued regarding which paper towel roll orientation is correct (everyone knows the leading edge of the roll should come towards you), but what I will say is how surreal it felt to be in a classroom with every student and teacher actively working towards a common goal. We searched patents that already existed, different methods of unspooling toilet paper, and even sparked tangential discussions regarding the meager market penetration of bidets. Looking back, I realized GT 2803 was the first time I had come to a class and loved it. I looked forward to the next session after leaving the makeshift classroom in the library every single time.

I enjoyed GT 2803 so much that I decided I wanted to continue to enroll in similar classes during my tenure at Georgia Tech, which led me to CREATE-X Startup Lab. In Startup Lab, we would go a step farther than problem identification. We were tasked with ideating solutions and then getting out of the room to get feedback from relevant users. More often than not, we

learned that our hypothesized solution would never have worked, and we needed to “pivot.” By the end of the course, most teams had pivoted enough times for their starting solution and final solution to be so wildly different, it was comical. I gained two incredible insights from this course. First, I learned that failure is only an opportunity to learn how to succeed. And second, I learned that every solution must have the end-user in mind.

I took these newfound insights with me into CREATE-X Idea to Prototype, which ultimately allowed me to win the 2017 Georgia Tech InVenture Prize and receive People’s Choice in the 2017 ACC InVenture Prize. The learning didn’t stop there. I then had a chance to start my own business and continue to learn about innovation and entrepreneurship firsthand. I think this element is what sets the CREATE-X program apart the most. You learn by doing, not just through theory or someone else’s experiences. My experience creating my own company was ultimately what caused me to shift my career plans from practicing medicine to being the one that created the devices that allowed healthcare providers to tend to patients in the first place. That first startup went well enough for me now be happily pursuing my second one with my former capstone team.

In short, CREATE-X creates a learning environment that students want to engage in. CREATE-X changes the way students learn and view the world. And finally, CREATE-X allows students to learn about entrepreneurship firsthand, by creating the next generation of Steve Jobs, Bill Gates, etc.

Without reservations, I believe the CREATE-X team deserves this award. Should you have any questions or the need to reach out for any reason at all, please do not hesitate to do so.

Kind regards,  
Dev Mandavia

To: Curriculum Innovation Award Selection Committee

From: Mugdha Apte

Re: Startup Lab

Dear Award Selection Committee:

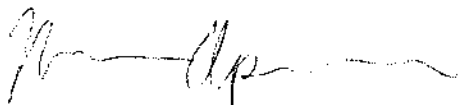
My name is Mugdha Apte, and I am a sophomore, biomedical engineering (BME) major. I took CoE 2701 Startup Lab during the fall 2018 semester. During this course, I was exposed to principles of evidence based entrepreneurship and how to build a startup.

As part of the class, I worked on an idea called Comfort Kit, which is a package of travel necessities for bus riders. In order to gain customer feedback for my idea, I took several multi-hour greyhound bus rides down the coast of California and down the East Coast. During these bus rides, I gave riders items like earbuds, snacks, magazines, and sunglasses, which I purchased with my own money. By giving these items to riders, I learned how different aspects of the bus ride, such as timing and destination, affect customer preferences for items in the Comfort Kit. Prior to Startup Lab, I would have never imagined undertaking such an endeavor and adventure. During these bus rides and throughout the course, I learned how to approach strangers who are drastically different from me.

I appreciate this class because I was able to apply Startup Lab course principles to my BME design classes. Specifically, the process of customer discovery and rapid prototyping were helpful in allowing me to learn quickly when designing a product in an unfamiliar field. Also, I frequently have to contact people outside my social network for product and design feedback, and the skills I gained in Startup Lab make me comfortable doing so.

I recommend the CREATE-X and Startup Lab team for the Curriculum Innovation Award because the instructors are wonderful, and the class is truly unique. This course provided me with real-world experience that I would not have gained in other aspects of my curriculum.

Sincerely,

A handwritten signature in black ink, appearing to read 'Mugdha Apte', with a long horizontal flourish extending to the right.

Mugdha Apte

[muapte9@gatech.edu](mailto:muapte9@gatech.edu)

January 16th, 2019  
Georgia Tech's Center for Teaching and Learning  
Curriculum Innovation Award Committee

Dear Selection Committee,

I am writing in reference to Dr. Craig Forest's Create-X Capstone course. My name is Erik Van Winkle and I graduated with a mechanical engineering degree in December of 2018. I took Dr. Forest's capstone class in the Fall of 2018. My capstone teammates Emilio Conde (ME Spring 2019), Colin Santoro (ME Spring 2019), and Chris Truong (CS Spring 2020) have all read this letter and fully endorse its content. Dr. Forest's innovative curriculum has deeply impacted each of us and we would like for his dedication to the undergraduate learning experience to be recognized.

I can't tell you how many of my fellow students have complained to me about their capstone projects. Students pour countless hours into solutions that often get little recognition or attention from the companies who requested them. My lab partner from ME4056 (ME Senior Level Lab) sent her company weekly emails detailing her team's progress. In every email, she asked for feedback from the company or a face to face meeting. They never responded to her emails. She heard from this company twice: once during the first week of the semester when they gave her the project and once during the last week of the semester when they evaluated the project. In this evaluation meeting, the company was upset that the team's results weren't what they expected. She ended her college career by getting a "B" in capstone (she had a 3.85 prior to this) and hated the class. My mother was a ChemE back in the 1980s. Her company notified her that they were abandoning her capstone project (then called senior design) halfway through the semester. While working two jobs to pay for college, she was forced to work countless hours on a product that she knew nobody would ever care about. She still complains about her capstone experience to this day. My roommate from freshman year designs cars for GT Motorsports in his spare time and was asked to design a paper towel dispenser for his capstone project. By the 12th iteration of his design, he got so frustrated that he just re-submitted his initial design. The company said it was simple and elegant, exactly what they'd been looking for the entire time! This capstone experience made my friend seriously question his decision to be a design engineer after college. Needless to say, after hearing these stories I was not excited about taking capstone. Thanks to Dr. Forest, this kind of experience didn't happen to me. I valued and enjoyed my time in capstone.

Dr. Forest's Create-X capstone gave my team the freedom to find our own project. That freedom motivated us in ways that I can't truly put into words. Thanks to Dr. Forest, I wasn't working for anyone else, I was working for myself. I looked forward to my team's daily meetings. I put time and careful effort into each one of Dr. Forest's deliverables because I saw capstone as more than just a stepping stone to a degree. To me, it was my chance at making a business. I made decisions in capstone based on what would help my company succeed instead of choosing what would get me a good grade. I was so passionate about my capstone project that I'm still working on it right now. I asked the company who offered me full-time employment to push back their offer for six months because I knew I would always regret letting this idea die off. In addition to that, all of my teammates are still working on this project with me. We've even added on three more employees and countless volunteers. The core seven (4 from capstone and 3 new employees) meet every Sunday to give progress reports and set deliverables for the next week. Even though the class is over and Dr. Forest's obligation to the team is fulfilled, he still takes time out of his

busy schedule to advise us as we continue to grow. Thanks to Dr. Forest, our startup has \$20,000 in funding, is competing in The Inventure Prize this Spring and is presenting our idea at the Georgia State Capitol in March. I have recommended this class to several friends and have 3 taking it this Spring.

While all of this sounds amazing, I don't want it to sound like this class was a breeze. It wasn't. It was challenging and forced me outside of my comfort zone in a way that Georgia Tech never has before. Normally, you start working on an engineering problem with the knowledge that a solution exists. Let's say that  $Y=mx+b$ . As a student, I might not have known what  $y$ ,  $m$ ,  $x$ , or  $b$  were, but at least I knew that  $y$ ,  $m$ ,  $x$ , and  $b$  existed. All I had to do was go through the class notes to find them. This class didn't ask for the solution to an equation though. It asked me to apply my knowledge of engineering in areas that we're totally unrelated to engineering. For the first time in college, I was dealing with people instead of numbers and applying my degree to real problems. It was my job to figure out if a solution existed and I could never be sure that one did. I had to learn about marketing, customer discovery, patent rights, legal processes, and so much more. Create-X Capstone forced me to expand past the engineering mindset that I had acquired in school and learn about a whole new side of life and industry. It was challenging, but it was challenging in the right ways.

Dr. Forest's capstone also forced my teammates and I to confront problems within ourselves that we had never faced before. One great example would be our tendency towards design fixation. I'd had brief encounters with it in my classes at Tech, but was never passionate to the point where it got in the way of class deliverables. Once my team had found an idea, it was our baby. This idea was the greatest thing to ever grace the planet Earth and there was no possible way it could fail. We loved it and would defend it at all costs. Dr. Forest had the difficult task of telling us the hard truths that we needed to hear. "There isn't a market for electric heelys". "Shoes that charge a battery with every step aren't technologically feasible". "Brighter bicycle lights already exist and aren't innovative". At the beginning of this class, we would convince ourselves that we were right. We had no interest in hearing these hard truths. Dr. Forest still told us and there were times we resented him for that. Looking back though, his advice was always right. By the time we found an idea worth pursuing, we understood our own flaws well enough to listen to his words as advice instead of as criticisms. This self actualization was all thanks to Dr. Forest and the rigorous curriculum that he created.

Dr. Forest and his work on Create-X Capstone has had a serious impact on my life, my career path, and me as a person. I appreciate him for that. This capstone class inspired my team and I in ways that we would never have thought possible. We all personally wish him nothing but the best of luck in future iterations of this class and hope to see his work get the recognition it deserves. My teammates and I strongly believe that Dr. Forest's work with undergraduates is incredibly innovative and deserves CTL's curriculum innovation award.

Sincerely,

Erik Van Winkle

With the approval of Emilio Conde, Colin Santoro, and Chris Truong

