Table of Contents

Application Summary

Competition Details

Competition Title:	2020 Teaching Excellence Award for Online Teaching
Category:	Institutional Awards - CTL
Award Cycle:	2020
Submission Deadline:	03/02/2020 at 11:59 PM

Application Information

Submitted By:	Edwin Greco
Appplication ID:	4372
Application Title:	Mike Schatz Nomination
Date Submitted:	03/02/2020 at 2:17 PM

Personal Details

Applicant First Name:	Michael
Applicant Last Name:	Schatz
Email Address:	michael.schatz@physics.gatech.edu
Phone Number:	

Primary School or Department
School of Physics

Primary Appointment Title:	Professor

Application Details

Proposal Title
Mike Schatz Nomination

Teaching Excellence Award for Online Teaching

Nomination Packet for Prof. Michael Schatz

Table of Contents

Pablo Laguna
Professor and Chair, School of Physics
837 State Street, Georgia Institute of Technology
Atlanta, Georgia 30332-0430, U.S.A.

March 1st 2020

To CTL Faculty Awards Selection Committee:

I am writing to nominate **Professor Michael Schatz** for the ***Teaching Excellence Award for Online Teaching.*** Mike has systematically made an innovative and ambitious effort to improve education in physics for students and teachers at all levels around the world. By the end of this nomination letter, I hope to convince you that Mike is truly one of a kind, and that he has gone far above and beyond the normal expectations of a professor at a research institution. Indeed, in many ways, the work done by Mike is not only serving our local community but is making a global impact on the way educators think about teaching physics.

Mike is a full professor and Associate Chair for Undergraduate Education in the School of Physics at the Georgia Institute of Technology where he heads the Pattern Formation and Control Lab. Mike's research focuses primarily on the interdisciplinary field of pattern formation, a major branch of nonlinear science. Mike also heads the Georgia Tech Physics Education Research Group, where he works on curriculum reform with an emphasis on integrating modeling and scientific computation into all aspects (lecture, lab and homework) of introductory Physics courses. The scope of Mike's education efforts as related to online learning are summarized below.

Massive Open Online Course (MOOC) with Lab Component: During Summer 2013, Mike has taught *one of the very first* massive open online courses (MOOC) that *includes a laboratory requirement.* A barrier for MOOC courses in science and engineering has been how to include the necessary laboratory experience with the class. In response to this need, Mike developed a visionary introductory physics MOOC demonstrating how constraints involving complex equipment can be overcome. As quoted in a news article in the prestigious journal Nature, Mike explained that many conventional labs can be disconnected from reality and that "students get the idea that it's all about some specialized room with specialized equipment, and then they walk back out into the real world, where none of what they learned there applies." That is why, in part, Mike created Introductory Physics I with Laboratory, which is devoted to the elementary science of motion.

This is one of the first MOOCs to thoroughly integrate hands-on learning. The MOOC relies on the fact that these days, virtually every student is walking around with a camera-equipped smartphone. "We start by asking them to go out and capture a video of an object in their environment moving in a constant direction at a constant speed," says Schatz. (Later labs involve more complex motions, such as a basketball arching toward a hoop.) Next, the students analyze their videos using open-source software that extracts the object's position over time. Then they formulate a theory to explain their data and build models to implement it. Finally, they explain their results and their model in a 5-minute video lab report, which is uploaded to YouTube for the other students to discuss and critique online.

It is clear that Mike has been a thought leader and pioneer in an exciting area of online education. It is also noteworthy that the MOOC course also provides an opportunity to reach out to high school teachers/students outside of Georgia. Several students in the MOOC identified themselves as high school teachers, and some of them have reported using these computational models in their own classes.

Teacher Training Workshop: Since 2010, Mike has been involved in programs with Atlanta Public Schools and Fulton County Schools. In the past, he has been deeply involved with the development of science students for the K-12 for the state of Georgia. More recently, he has been focused on teacher training workshops with two main goals: 1) To develop new online materials for high school physics curriculum to provide students more opportunities to engage in authentic scientific practices such as computational modeling, which is an important scientific practice in the 21st century, yet is typically not covered in high school physics. 2) To create a community of teachers building and supporting this high school mechanics curriculum that uses observation and computational modeling as its primary investigation into the world around students.

In addition to offering the yearly teacher workshop, Mike provides these curricular materials freely online through the computational modeling website (http://computationalmodels.wordpress.com/) and through the original MOOC course. These materials include not only the activity packages for students to work on but also supporting instructional videos that the teachers can freely use to support their teaching. The high school students have pointed out that they loved these videos during our classroom visits. The course discussion forum also provides a platform for high school teachers to interact with each other (as well as Georgia Tech researchers).

Teaching: Innovative Physics Curriculum and Online Introductory Physics for Georgia Tech: Since 2007, Mike has been the driving force behind curricular reform in the introductory physics sequence in the School of Physics, which is now a flourishing component of the physics courses offered at Georgia Tech. Most semesters, half of the introductory physics courses taught follow the modernized curriculum championed by Mike, which includes teaching students how to use computer simulations to solve physics problems and a much stronger focus on conceptual understanding of physics. The courses are quite popular with undergraduate students, who traditionally dread taking required physics I and II. Average review scores for the physics professors teaching the courses, and the grade point averages in the class have raised significantly – despite the equivalence in the value of the material delivered to the students.

During the 2013-2014 academic year, Mike experimented for the first time in Georgia Tech history with teaching introductory physics in a ‘flipped’ or ‘blended’ classroom style, which provides more time for active learning. The flipped classroom model allows Georgia Tech students to watch lectures and complete homework assignments online, freeing up class time to hone problem-solving skills and do other activities together with constant guidance and discussion with the professor. This more active in class learning style helps students to better digest the material and develop critical skills. Mike frequently spent ***three to five hours a day in the classroom most days of the week*** to execute his educational experiment. This is far above and beyond the standard face time averaged by a professor at Georgia Tech in the classroom, which is closer to three to five hours a week (compared to 15-25 hrs/week).

By combining online course content from the MOOC offering and lessons learned from the ‘flipped’ on-campus courses Mike and his team were able to create a fully online SOUP course for PHYS 2211 and PHYS 2212 with laboratory. These courses have now been offered multiple times through GTPE over the summer with typical enrollment near 120 students in each course. They have also been used during the Fall and Spring term as online offerings for the GT Lorraine study abroad program. In both cases, students watch interactive online lectures, complete coursework online, and meet virtually (i.e. video conferencing) in small groups with instructors and TAs twice a week. Leveraging the online nature of the course, students present their lab results as mock scientific talks and are peer evaluated using a rubric designed by Mike and his team in collaboration with CTL. These courses have been well received by students with CIOS scores and course grades comparable to our best on campus offerings of introductory physics. The summer courses in particular have been popular with students with enrollment limited by the number of supporting TAs available to the school.

I hope the summary of Mike’s extensive efforts just from the past year convince you that Mike is performing a great service to the School of Physics at Georgia Tech, to physics education in general, and to researchers and educators around the world. I am convinced that Mike is a passionate thought leader guiding the rest of us with a unique and comprehensive vision regarding how to teach physics online.

Sincerely,

Laguna

Pablo Laguna,
Chair and Professor

26 February 2020

Dear Selection Committee,

I am writing to nominate **Professor Michael F. Schatz** for the Teaching Excellence Award for Online Teaching offered by Georgia Tech's Center for Teaching and Learning.

Professor Schatz has been teaching online introductory physics classes since 2013. It started with a Massive Open Online Course (MOOC) called "The World is Your Lab." This was an introductory mechanics course (equivalent to the on-campus PHYS 2211, Intro Physics I) hosted on Coursera and available to anyone worldwide. Over ten thousand people registered for the MOOC, and about one hundred and fifty completed it. A key element of this MOOC that differentiated it from other introductory physics MOOCs is that Professor Schatz created not just video lectures and assignments, but also lab activities that can be done with a smartphone and open-source software. This allows the online students to experience the experimental nature of physics and reinforce the concepts learned in the lectures.

In following summers, Professor Schatz taught introductory physics as part of the Summer Online Undergraduate Program (SOUP). The SOUP class was based on the MOOC, but with the additional component of having twice-weekly video conference meetings between the students and their instructors (Professor Schatz, Dr. Ed Greco, and several graduate teaching assistants (GTAs), myself included). These meetings consisted of group problem-solving sessions and individual student presentations. In the summers of 2015 through 2017, around 80 Georgia Tech students took their Physics I class online in this format. Along the way, Professor Schatz also developed an online version of PHYS 2212 (Intro Physics II, covering electricity and magnetism), which debuted in 2018 and also included smartphone-based lab activities and video conference meetings. In the summers of 2018 and 2019, a total of over 400 undergrads participated in the two online intro physics courses, with roughly equal numbers of students in Physics I and Physics II. Additionally, every Fall and Spring semester since Fall 2018, Professor Schatz has been teaching the online version of both intro physics courses to students who are spending the semester at the GT Lorraine campus in Metz, France. The curriculum and format are identical to the SOUP versions of the courses, but spread out over sixteen weeks instead of the typical eleven weeks of summer. Approximately 20 students have taken the online Physics I and 60 students have taken the online Physics II from GT Lorraine over four Fall and Spring semesters in the last two years.

The idea of being able to take a physics class online *that included lab activities* is something that I had never encountered before. Professor Schatz is undoubtedly a trailblazer and innovator when it comes to this aspect of the online courses. In the mechanics course, the majority of the lab activities consist of video recording an object exhibiting a specific type of motion (e.g., something falling from a certain height), analyzing the motion using the open-source video analysis tool Tracker, and then modeling the motion computationally using the VPython programming language. In the electricity and magnetism course, the labs span different kinds of activities, from experiments in electrostatics that later get modeled computationally, to using a smartphone's magnetometer sensor (the sensor that allows compass apps to indicate the direction of magnetic North) to measure the magnetic dipole moment of a bar magnet. By designing these activities, Professor Schatz has ensured that students get the hands-on experience of a lab even though there is no lab room for the students to gather in and do experiments. Additionally, since the students need to create a five-minute video lab report (which gets peer-graded according to a specially-crafted five-item rubric), with these activities Professor Schatz has also ensured that students get the opportunity to practice scientific/technical communication, which is an essential skill for students to have regardless of their major.

The group problem-solving sessions are another fantastic aspect of these online classes. Initially done using Google Hangouts, we now do these with the Conferences tool on Canvas. The problems that Professor Schatz wrote for these sessions are at a difficulty level where a student working alone would need to spend a significant amount of time solving them, whereas a small group of three to five students working collaboratively could solve them in a fraction of the time. The problem-solving sessions run two hours, and are run with two parallel sessions facilitated by an instructor. The instructor spends approximately 10 minutes at a time helping one group or the other, and when the instructor is not there, students are supposed to work together to continue solving the problems. Professor Schatz encouraged the GTAs to teach socratically, asking probing and guiding questions to help the students arrive at the correct solutions without actually giving away the answers. In the SOUP courses, Professor Schatz, Dr. Greco, and myself would watch video recordings of the conferences to then provide the GTAs with feedback on how to improve their teaching. In the GT Lorraine courses, Professor Schatz and I (and another GTA if needed) facilitate the problem-solving sessions by alternating between groups.

The student presentation sessions are of two kinds: individual problem presentations, and lab draft presentations. In the individual problem presentations, one single student logs into the video conference at a time, and they have 10 minutes to present a solution to their specifically assigned problem. These effectively act as oral quizzes, and the problems are of a difficulty similar to exam problems. The lab draft presentations are done in small groups, with each student presenting a draft of their video lab report (approximately ten days before the lab reports are due), and the instructors and other students providing constructive feedback for improvement.

With the twice-weekly video conference meetings, Professor Schatz has ensured that the online courses include an engagement component, where students interact not only with the instructors but also with each other, even though physically they may be hundreds or thousands of miles apart. Students help each other solve problems, give each other feedback on their presentations, and also get feedback and guidance from their instructors.

Professor Schatz also lets students know he is available for online office hours any day of the week, also done via video conferencing. He does not set specific day/time office hours because when he did try that, no students ever made use of it. But by explicitly stating that he's always available, the students have indeed received help from him on one-on-one video conferences. I have followed his lead on this, and during the current semester I have had several individual online office hours with the students at GT Lorraine.

In the early years of the SOUP course, Professor Schatz made sure to survey the students with the use of midterm evaluations. In the evaluations, he asked students to elaborate on what aspects of the course they liked and how did they think the course could be improved. Additional questions asked about the GTAs' strengths and areas for improvement. Professor Schatz always read through the students' feedback (in the midterm evals and in the CIOS at the end of summer) and adjusted the course accordingly to improve the learning environment for the students. By now, the online courses are well-established, both SOUP and GT Lorraine, but he still asks students for feedback and takes their comments into consideration. And he's always creating new problems and looking for ways to improve the lab activities. For example, one of the Physics II labs underwent a rewrite after two terms (one summer and one fall), because students reported that part of the activity was confusing and difficult to work through.

I have spoken extensively about the methods and logistics of the online courses because I have been assisting Professor Schatz in almost every step of the way. I was not involved in the creation of the video lectures – Professor Schatz worked with his then-student Scott Douglas to create those (Douglas et.al. (2017), The Physics Teacher, 55, 22) – but I have been a GTA in the SOUP and GT Lorraine courses, and helped Professor Schatz in rewriting starter codes and lab instructions for students to use. I can certainly say that he is very committed to providing his students with high-quality education in the online setting. Through his course design he has made sure that students are not simply passively watching videos and submitting homework assignments, but rather they are interacting with each other and with their instructors, engaging in scientific experimentation, and practicing communication and presentation skills. Professor Schatz is extremely enthusiastic about physics and about teaching, which is clearly apparent when you hear him explain concepts and guide students in their reasoning to achieve a correct answer in a physics problem. I can think of no one more deserving than him for being honored with an award for excellence in online teaching.

In summary, I enthusiastically nominate Professor Schatz for the Teaching Excellence Award for Online Teaching. Please do not hesitate to contact me if you have any questions.

Sincerely,

Emily Alicea-Muñoz

Emily Alicea-Muñoz, Ph.D.
Research Technician II
School of Physics, Georgia Institute of Technology

DEPARTMENT OF PHYSICS AND ASTRONOMY

25 Park Place, Suite 605
Atlanta, GA 30303-3083
Phone: 404 / 413-6033
FAX: 404 / 413-6025

Dr. Brian D. Thoms
Associate Professor & Associate Chair
Phone: 404 / 413-6045
e-mail: bthoms@gsu.edu

Georgia State University

February 28, 2020

Dear Awards Committee,

As associate chair and undergraduate director for the Department of Physics & Astronomy I am pleased to support the nomination of Dr. Michael Schatz for the Georgia Tech Teaching Excellence Award for Online Teaching.

I have known Dr. Schatz for over ten years in a number of capacities. We have collaborated in several physics education research projects including work on online and blended classes. We have also served together on the USG Regents Advisory Committee for Physics & Astronomy.

Dr. Schatz has worked for many years on the development of innovative and highly effective pedagogies for physics courses at both high school and college level, especially those pedagogies involving use of modern technologies. Mike was involved with introduction of the Matter & Interactions approach to introductory physics courses at Georgia Tech which uses computation as an integral part of the course. This approach is designed to better prepare students for the modern workplace by developing computational skills and computational thinking. By these methods students develop a more complete understanding of when and how computational approaches are useful and how to connect their physics knowledge to computational solutions.

Dr. Schatz took on a momentous challenge to develop an effective massive open online course (MOOC) in introductory physics that included a laboratory component. His knowledge and experience in physics education research allowed him to bring a deep understanding of best practices and previous work in the field. Along with his team (including one of my graduate students) they developed short, high quality and effective video lectures. These lectures were combined with discussion and help in the form of online discussion forums. The forums were guided by trained teaching assistants. The really novel contribution was the development of "laboratory" activities that could be completed anywhere through the use of cell-phone video cameras and free video analysis software. A key feature is the match between computational approaches which are step-wise and analysis of real motion video which is frame-wise. This results in a synergy which can enhance computational thinking for the students. To make these video laboratories effective, students needed assessment and feedback not easy to accomplish in a MOOC. Mike and his team developed a system of peer grading which used training videos to develop students' assessment skills. The peer assessment benefits both students and Mike and his team demonstrated that with their research.

Dr. Schatz has continued to investigate new technology and online pedagogical approaches through the conversion of the MOOC to a blended class where video lectures and combined with in-class problem solving and group work. His work is helping to define the most effective uses of both online and in-person education in physics.

Dr. Michael Schatz has brought innovative ideas to online physics innovation and implemented them thoughtfully with thorough and rigorous evaluation. I believe he is very deserving of the Georgia Tech Teaching Excellence Award for Online Teaching.

Sincerely, Brian D. Thoms

Tamara Bogdanović, Associate Professor
Center for Relativistic Astrophysics
School of Physics, Georgia Tech
837 State Street, Atlanta, GA 30332

Telephone : (404) 385-0113
Email : tamarab@gatech.edu
http://www.tbogdanovic.gatech.edu

February 28, 2020

Teaching Excellence Award for Online Teaching

Dear Selection Committee,

It gives me great pleasure to write this letter on behalf of **Professor Michael Schatz**, whose nomination for the Teaching Excellence Award for Online Teaching has my strongest support. Mike is a professor and Associate Chair for the Introductory Physics Program in the School of Physics at the Georgia Institute of Technology. He is internationally recognized for his research in experimental nonlinear dynamics and physics education. For his outstanding achievements, he received a Cottrell Scholar award, that recognizes that special combination of a teacher and scholar. I think that he is an exceptional candidate for this award, let me explain why.

Mike's research in nonlinear dynamics focuses on the physics of chaos that governs systems exhibiting complex behavior (turbulence being one example). The main aim of this research area is to characterize the properties of such systems and predict their behavior in deterministic way. The Schatz lab has specialized in carefully-controlled experiments that test new methods of characterizing complex dynamics in a variety of fluid flows, including turbulence. I will highlight one recent, particularly novel and important contribution made by the Schatz lab: a discovery that essential dynamics of chaotic/turbulent flows may be captured by coherent structures. The coherent structures are characteristic flow patterns that occur repeatedly, frequently, but fleetingly. Mike and his team have found numerous coherent structures and have shown that when the turbulent flow passes close to the neighborhood of a coherent structure, certain aspects of the behavior of the turbulent flow can be predicted. This work was published in the Physical Review Letters in 2017 and has because of its novelty been highlighted as "Editor's Suggestion" on the homepage of the journal. Because of his professional achievements in the area of nonlinear dynamics Mike has in 2013 been elected a Fellow of the American Physical Society. He also serves as Director of the Hands-on Research in Complex Systems Schools at the International Centre for Theoretical Physics (ICTP) in Trieste, Italy.

What is truly impressive about Mike is that he maintains not one, but two independent research programs along with two research teams. His other big passion is physics education research, an effort that he has developed since he became a faculty at Georgia Tech, and is presently as successful and well funded as his nonlinear dynamics program. Mike's contributions in this area have been visionary and paradigm shifting and it is no exaggeration to say that he has been the beating hearth behind many reforms and improvements made in our introductory physics courses. I should mention that impact of the introductory physics courses (Physics I and II) at Georgia Tech is huge: they have the highest enrollment in our institution (currently about 3700 students per course annually) and about 80% of Georgia Tech students take it as a part of their degree. As a part of his physics education research program Mike has (a) implemented the first use of clickers on-campus, (b) integrated computation into the introductory physics curriculum, (c) implemented a reform in introductory physics curriculum, and (d) introduced "flipped classroom" in our courses at Georgia Tech. Since 2016 he has developed fully online for-credit version of Physics I and has recently worked to expand the offering by adding the new online edition of Physics II. The main aim of this online platform is to benefit Georgia Tech students by improving affordability (by lowering out-of-pocket educational expenses) and increasing accessibility (e.g., enabling students to complete required physics courses while participating in off-campus co-ops or internships).

Because of his expertise in education research, Mike is often called on by the Dean and Provost to contribute recommendations for long-term, high-impact improvements to the teaching and learning environment at Georgia Tech, and is therefore making broad impact across the campus. A recent example is his engagement in the Commission on Creating the Next in Education, which aim is to define a vision for Georgia Tech as an education center in 2040. The list of on-campus educational initiatives that he is involved in goes on and on, and reviewing them all would make for a very long letter. I hope however that I managed to convey at least in part how important and far-reaching his contributions are.

In summary, Mike is a fellow researcher and educator whom I and others keep in very high regard, a colleague with whom I enjoy working on educational initiatives, and an educator I aspire to be. I strongly encourage you to consider him for this award.

Sincerely,
Tamara Bogdanović
Associate Professor of Physics

Michael F. Schatz, Ph.D.

Professor and Associate Chair

School of Physics

Georgia Institute of Technology

I. Earned Degrees
   A. B.S. (summa cum laude) Physics, 1983 - University of Notre Dame
   B. Ph.D. Physics, 1991 University of Texas, Austin
II. Employment History (partial)
   A. Georgia Institute of Technology
      1. Assistant Professor of Physics, 1996-2002
      2. Associate Professor of Physics, 2002-2012
      3. Professor of Physics, 2012-Present
III. Honors and Awards (Partial)
   A. 2014 USG Chancellor's Silver Service Excellence Award
   B. 2013 Fellow, American Physical Society
   C. 2005 Hesburgh Teaching Fellowship
   D. 1999 Cottrell Scholar
IV. Education and Mentorship
   A. Publications (selected)
      1. Shih-Yin Lin, **John M. Aiken**, Daniel T. Seaton, **Scott S. Douglas**, Edwin F. Greco, Brian D. Thoms, and Michael F. Schatz, Exploring physics students' engagement with online instructional videos in an introductory mechanics course, Physical Review Physics Education Research 13,020138 (2017)
      2. **Scott S. Douglas**, Shih-Yin Lin, **John M. Aiken**, Edwin F. Greco, **Emily Alicea-Munoz**, and Michael F. Schatz, Peer assessment of student-produced mechanics lab report videos, Physical Review Physics Education Research 13,020126 (2017)
      3. **Scott Samuel Douglas, John Mark Aiken**, Edwin F. Greco, Michael Schatz, Shih-Yin Lin, Do-It-Yourself Whiteboard-Style Physics Video Lectures, The Physics Teacher 55, 22 (2017)
      4. **John M. Aiken**, Shih-Yin Lin, **Scott S. Douglas**, Edwin F. Greco, Brian D. Thoms, Michael F. Schatz, Marcos D. Caballero, The Initial State of Students Taking an Introductory Physics MOOC, Physics Education Research Conference (2013)
   B. Presentations (invited selected)
      1. "Fully on-line introductory physics with a bona fide lab," APS March Meeting, Baltimore, MD, March 2016.

2. “Implementing and sustaining curricular reform in a large introductory physics course at Georgia Tech,” University of Utah Dept. of Physics and Astronomy Colloquium, Salt Lake City, UT, January 2016.
3. “Fully on-line introductory physics with a bona fide lab,” Hugo Rossi Memorial Lecture, Univer- sity of Utah, Salt Lake City, UT, January 2016.
4. “Student engagement with video course content in introductory mechanics,” Summer Meeting 2015 of the American Association of Physics Teachers, College Park, MD, July 2015.
5. “A MOOC and a blended course in introductory physics,” Conference on Open-Source Tools for Enhancing Teaching, Learning and Research in STEM, Universidad Nacional Autonoma de Honduras, Tegucigalpa, Honduras, April 2014.

C. Grants and Contracts (selected)
1. “Computational thinking: 21st Century problem-solving practices for Georgia students,” Georgia Innovation Fund, Sept.2012-June 2015, $431,198. PI Schatz’s Share: $431,198
2. “Transforming homework into cyberlearning in an introductory STEM course,” National Science Foundation, Dec. 2009-Nov. 2014, $200,000. PI Schatz’s Share: $200,000
3. “Institutionalizing a reform curriculum in large universities,” National Science Foundation, Oct. 2006-Sept. 2010, $400,000 (with Co-PIs Jack Marr and Richard Catrambone in GT’s School of Psychology; part of larger (2 million dollar) collaboration with NC State and Purdue University). PI Schatz’s Share: $250,000 (approx.)
4. “A MOOC for introductory physics,” Bill and Melinda Gates Foundation, Oct 2012-Sept 2013, $150,000 (with PI: Paul Baker, co-PIs Richard Catrambone, Rebecca Burnett and Karen Head).

V. Service

A. Professional Contributions (selected)
1. (Co-Organizer and Co-Chair), National Graduate Teaching Assistant Workshop, Georgia Tech, June 2017.
2. (Workshop Organizer), 2017 Winter Meeting of the American Association of Physics Teach- ers, Atlanta, GA, Feb 2017
3. Organizer), Computation and the Modeling Instruction Curriculum, High School Teacher Workshop, 2012 American Association of Physics Teachers Summer Meeting, Philadelphia, PA, July 2012.

B. Institute Contributions (partial)
1. 2016-Present Provost’s Creating the Next in Education Committee
2. 2015-Present School of Physics Graduate Committee
3. 2012-Present Associate Chair for Introductory Physics Program
4. 2014-Present USG Regents Advisory Committee on Physics
5. 2012-2016 Provost’s Council on Educational Technology

Teaching and learning philosophy, strategies, and objectives

My desire to improve the teaching and learning of physics at Georgia Tech was ignited 20 years ago when I first set foot on campus. Over the course of my career here at Georgia Tech, I have worked with numerous GT faculty and staff to improve the Institute's introductory physics courses. My early efforts included the first use of clickers on-campus (in collaboration with David Collard and Kent Barefield) and the institution of common exam periods (including final exams) in large service courses (a practice that continues today for Georgia Tech courses in Physics, ECE and CS).

Twelve years ago, my efforts expanded into a physics education research-based program, which explored the integration of computation into the introductory physics curriculum and tested/implemented a reform physics curriculum (Matter & Interactions–M&I). At present, M&I PHYS 2211 and 2212 enrollments at Georgia Tech total approximately 2000 students annually (approximately half of the total annual PHYS 2211/2212 enrollment)..

More recently, my work on teaching and research in teaching and learning have focused on the following two distinct areas:

(1) MOOCs, Blended Learning and Online Courses; Open Access Physics Resources

In 2012, I led an effort to develop a calculus-based physics (mechanics) Massive Open Online Course (MOOC) that included an authentic, hands-on lab that even online students could perform in their own surroundings. The MOOC course was offered on the Coursera platform in Summer 2013, Fall 2013, Spring 2014, and Fall 2014. The MOOC materials were used in on-campus courses to test the feasibility of "flipping" PHYS 2211; the flipped course was tested Fall 2013, Spring 2014, and Fall 2014. The experiences with both the MOOC and blended learning led, in turn, to the development of a fully online, for-credit version of PHYS 2211, which was successfully implemented in Summer 2015 as part of the Georgia Tech Summer Online Program (SOUP). The course was run successfully a second time as a SOUP offering in Summer 2016. Further testing of online physics will continue with additional offerings of PHYS2211 planned for Summer 2017 (as part of SOUP).

As a consequence of involvement with MOOC, blended and online courses, my recent teaching and learning efforts have focused on novel capabilities enabled by the platforms used to host curricular content in these settings. For example, the MOOC-inspired platforms now make possible the capture "clickstream" data (time-stamped data of individual student interactions with hosted content). Suitable analysis of this data promises to provide new insights into improving student learning. My research group has carried out studies of clickstream data on student interactions with video lectures. Additionally, beginning in 2013, I started a VIP program called "Physics MOOCs" to support development of predictive analytics for clickstream data; this VIP group has now transformed into the current VIP effort entitled "Data-Driven Education" and is now co-led together with Dr. Yaku Gazi (Georgia Tech Professional Education) and Drs. Rob

Kadel, Steve Harmon and Amanda Madden (Georgia Tech Center for 21st Century Universities)). Closely related to this, within the past year, I have been co-leading an effort (with Ed Greco (GT Physics)) to develop an introductory physics content platform, hosted on edX, that will offer an array of open access introductory physics curricular materials. The platform will support courses with instructor-customized curricula (i.e., in a traditional, M&I reform, or IPLS (Intro. Physics for Living Systems) format)) for students either on-campus or fully online. Moreover, the platform aims to benefit Georgia Tech students by improving affordability (via use of open source curricular materials to lower out-of-pocket educational expenses) and increasing accessibility (e.g., enabling students to complete required physics courses while participating in off-campus coops or internships.)

(2) Graduate Teaching Assistant Professional Development

Beginning in 2013, I helped lead the School's participation in a campus-wide initiative (spearheaded by Georgia Tech's Center for Teaching and Learning (CTL)) for increased and more in depth support for graduate student teaching. The need for this stemmed from our online offerings which demonstrated the increased demand on Graduate Teaching Assistants to facilitate small online group learning. The School worked with CTL to prepare and to offer a course tailored for (and required of) first year graduate students in their first semester of teaching. First offered in Fall 2013, the Physics version of this course continues to undergo revisions to improve it.

In parallel, I have co-led efforts to foster and to propagate best practices in GTA career development through co-sponsorship of National Teaching Assistant Workshops. (The workshops are currently funded by the National Science Foundation and the Research Corporation for Scientific Advancement, co-sponsored by the University of Utah, and supported by the American Physical Society, the American Association of Physics Teachers, and the American Chemical Society.)

During the workshop, participant teams from R1 physics and chemistry departments devise viable action plans to enhance the professional development of GTAs at their home institutions. Plan formation is nurtured by interactions both with other teams and with recognized leaders in GTA professional development. Two workshops were held May 2014 and May 2015 on the Georgia Tech campus and was attended by thirty-six participant teams sent by physics and chemistry departments at thirty universities from across the nation. A third workshop is planned for June 2017.

Innovative teaching artifacts used in the online environment

1. **Interactive video lectures**
    a. One of the distinguishing features of the online physics courses developed by Prof. Schatz is the use of whiteboard animations and not talking head lectures. Whiteboard animations are made by taking a picture of a whiteboard once per second as physics is animated. Prof. Schatz hired undergraduate students to animate his lecture notes and scripts and then provided the voice over. The final project is highly engaging to watch and resulted in several publications on their teaching effectiveness (see CV)

2. **Online Labs**
    a. The guiding principle for designing the online labs was that they model authentic practices of professional physicists. For each lab, students should: (1) observe the world around them, (2) make measurements, (3) develop and test a mathematical and/or computational model, and (4) report their findings in a concise oral video report. These labs are inquiry based, context rich, and employ a cell phone as a data acquisition device. Each student may end up deciding to study a slightly different phenomenon centered on the same underlying fundamental principle. An example lab is provided at the end of this nomination packet.
3. **Peer evaluation**
    a. A good deal of the scholarship, research, and even a PhD thesis associated with these online physics courses was centered on the study of peer evaluation (see CV). After submitting a final video lab presentation, students watch and evaluate three model presentations using a grading rubric (attached). Students then receive the instructor evaluations for these videos and a score that measures how close their grading was to expert grading. Finally, students are assigned three random peer videos to evaluate. This process has been shown to produce better science communicators with successively better online oral presentations.
4. **Recitation through video conferencing**
    a. One of the lessons learned from Prof. Schatz's "flipped" class experiment was the need for expert guided small group discussions. For all of his online courses, students meet virtually twice a week in groups of 5 with an instructor or graduate TA. During these meetings, students - working in groups or individually - solve complex recitation problems and give practice talks of their lab reports. The instructor uses a rubric (see attached) to evaluate the work of each student and provides immediate feedback.

Current and past student support and testimonials

I had Professor Schatz in Fall 2019 at GTL and loved how he structured the course. He was always willing to explain information when there was confusion and really pushed us to use reasoning when he asked us questions. He would never really use the term, " You're wrong," but he used, "You're not quite there yet or almost correct." Despite it being an online class I felt our class made a strong connection with Professor Schatz and our TAs (who were also amazing)! We also had a GroupMe made for the course and all the TA's and Professor Schatz were very quick at responding despite the time difference.
Jennifer Do - Georgia Institute of Technology | Biomedical Engineering Class of 2021

I am a second-year Industrial Engineering major. I took Professor Schatz's Physics II class last semester when I was studying abroad at GT Lorraine. Schatz structured the course very well. Certain things would be due on the same days of the week, so it was very easy for my peers and I to stay organized. Moreover, he gave us ample to time to learn/attempt things on our own before we had to join video calls with him or the TAs. These calls were extremely useful as they reinforced our learning, corrected any misunderstandings, and filled any holes. In addition, Schatz had a vibrant personality and brought a sense of humor to the course. I could tell he was very enthusiastic about teaching and physics.
Venky Erninti

I think it's a great idea you're nominating him! I'm actually working on a team with him in a research project currently, and he definitely deserves some recognition. Being able to take physics 2 online was extremely helpful and convenient for me, as I was able to solely focus on that class last summer while living and working in my hometown (Nashville, TN). I took it so I could stay home, but also so I could get ahead in my coursework. I believe the format of it boosted my understanding of each concept taught, and I had multiple resources to ensure my success in the course. Professor Schatz cares about his students and his work, and he wants physics to be a course we understand and learn to love, and I can personally attest to this.
Anna Lummus - Mechanical Engineering '22

I am a second year Industrial Engineering major and I decided to take Physics 1 online so I could save money and travel over the summer. By taking the class online, I could live at home and save on rent. Since I was able to have online meetings in the evening, I could work a job during the day and travel to different time zones while still completing

my homework, labs, and be present in the virtual classroom. Also, by taking just one online course over the summer, I could really focus on the coursework and save money on fees. All the instructors were very supportive on the online forum and email, so I didn't feel isolated or lost. This course made me a lot more interested in taking more SOUP courses, namely Physics 2.
Emma Jones

I am very grateful that they offered the course online through SOUP because it allowed me to focus only on a course as hard as Physics 2 instead of having to take this class while focusing on my major-related courses and being a TA. I am an industrial engineering student, and by offering this class online I was able to take the course while I was staying in Singapore, as well as finishing it in Argentina when I went back home to visit my family. This made me be able to graduate in time too!
Maria Agustina Boffi - Industrial Engineering Class of 2020

Hi, I am a 3rd year Industrial Engineering major. I took physics 1 SOUP last summer and it really was amazing that I was able to take that class and get credit and also travel with my family. It made my schedule a lot more manageable and I was able to learn the material just as well. I really thought the videos and the organization of the course was very well done and the professors and TA's were very responsive and willing to help. I plan on taking Physics 2 SOUP this summer again as it is a lot more flexible with internships and such plans that students have at Tech.
Raneem Rizvi

I am currently a 3rd year BME. I took this class Summer of 2019. I decided to take this class online because I was doing research that summer and the online class provided me with more flexibility in choosing my hours while still learning physics and getting the credit I needed to graduate. I think Professor Schatz is a fantastic nominee for the *Teaching Excellence in Online Teaching* award for the following reasons. First, Professor Schatz made many very helpful and interesting videos for the topics we had to learn. His videos were easy to follow, provided plenty of helpful examples, and were often funny and artistic. Second, Professor Schatz made himself available so we could ask him questions and get feedback frequently. I remember before the final that he hosted one-on-one office hours with each group for an indefinite amount of time, so we had the opportunity to ask him lots of questions in a small group settings so we didn’t have to wait too long to have our questions answered. Lastly, Professor Schatz is very thorough and straight-forward when explaining concepts. He always starts from square one and checks for understanding from students before continuing onto more complex topics. He makes sure that students have a good foundational understanding since this

will help them more in the long run as opposed to just giving them the answer immediately.
Ana Cristian

I was one of the students who came into this school with zero credits under my belt. As a freshman, I was told it would be difficult for me to graduate in four years. Online SOUP courses, specifically 2211 (and 2212 in the future), have allowed me to take classes while I am off campus for the summer and have helped me in more ways than I can imagine. Being able to take these courses online has helped me stay on track with my class schedule and has helped me save money since I am an out of state student. Thanks to Professor Mike Schatz and his commitment to getting physics online for students like me, I will be graduating in four and a half years with my B.S in Chemical and Biomolecular Engineering, a complete co-op, and an added minor. I can say with complete certainty that without the addition of physics to the SOUP program, I would not be able to graduate in a realistic timeframe and participate in the opportunities available to me as a Tech student.
Sara Wheat - chemical engineer

I'm a biology major and decided to take the class online because I was living at home this past summer and did not think it was logical to commute for the 9am in person lecture being offered. I put a lot of time into the class and as a result I came out with a lot of knowledge about physics. Being a biology major, I will likely never use a lot of this again but I found the lectures easy to follow and I really liked how structured the course was. I always knew what was expected of me and I was able to balance the class with my part time job over the summer. Overall great experience and I feel that I have a strong base in physics because of it.
Hannah Day

I decided to take physics one online because I actually took it the in-person version and got a D and needed a C to pass for my major. I hadn’t taken physics in high school so it made the biggest difference in the world to be able to pause a lecture and rewind when I got confused. It’s easy to get lost in a fast paced lecture and keep snowballing so the online lectures were very helpful. It also allowed me to not get behind in my classes because I wouldn’t have been able to take it in person so it let me make up that class before the fall semester began.
Addison Reynolds - Mechanical Engineering

Evidence of online teaching excellence

A. Lab Peer Evaluation Rubric

	Criterion	Poor	Fair	Good	Very Good	Excellent
1	**Organization/ Structure** *Organization, Logical structure, introduciton and conclusion, problem statement, preview of major sections in introduction, transitions & signposts, audience can follow structure*	The introduction is missing or lacking several important elements. The viewer is lost right from the outset while watching the video.	The introduction is present but its elements need more detail. Major sections are listed by name with no description or preview. Transitions between sections are sometimes abrupt.	The introduction contains all its elements, and all the elements are briefly described. Video is divided verbally or by title slides into major sections, but a few topics might have been better placed in different sections. Viewer always knows where they are in the video.	The introduction is more than just a general description; it includes relevant information about the author's particular lab experience. Viewer always knows where they are, and also knows what's coming up next.	The introduction not only describes the problem very well, but also indicates why we're interested in the answer. Transitions are accomplished without removing the viewer from the flow of narration. The structure of the video as a whole is always apparent to the viewer, from beginning to end.
2	**Content: Models** *Identification of models relevant to physical system, main physics ideas discussion, application of ideas to problem, connection between fundamental principles and model*	It is unclear to the viewer what the fundamental physics principles are, or what models are relevant to the physical system. Profound physics errors.	The models and fundamental physics principles are named but not described. The system is not described as separate from its surroundings. Physics errors are significant.	The system, models, and fundamental physics principles are named and described, but some improvement could be made in explaining the connections between them. A clear distinction is made between the system and its surroundings. Any physics errors are minor, or might just be poor phrasing.	The connections between the fundamental principles and the model are clear.	The connections between the fundamental principles and the model are clear, and the author aptly explains why this model in particular was chosen to examine this system. Main physics ideas are presented with more than one relevant representation (e.g., both an equation and a drawn figure)
3	**Content: Prediction Discussion** *Identification of data used to initialize model, discussion of adjusting parameters to fit data, discussion of data/model fit, discussion of computational model's predictive ability*	Observational data is not compared with model prediction. No mention of initial conditions, or initial conditions are listed but no mention is made of how they were calculated from the data.	Observational data is compared with model prediction, but the comparison misses some important difference between them. Data used to calculate identification is identified hastily or vaguely.	Observational data is compared with model prediction, and all relevant differences and similarities are identified and described. Possible sources of discrepancy are named. Data used to calculate initial conditions is identified clearly.	Observational data is compared with model prediction, and all relevant differences and similarities are explained explicitly in terms of fundamental physics principles. Possible sources of error are also explained in terms of fundamental physics principles.	Similarities and differences between model prediction and observational data are discussed in terms of fundamental physics principles, and the author identifies and explains how to improve prediction/data agreement in future experiments or with alternate models.
4	**Content: Overall** *Absence of physics errors, Discussion of "What if…" question, discussion of "What does it mean?" question*	Physics discussion suffers from serious flaws, e.g. attempting to apply an irrelevant physics principle. "What if…" and "What does it mean?" questions are absent or perfunctory.	Physics discussion is free from the most serious flaws but is confused, or is obscured by poor phrasing. "What if…" and "What does it mean?" questions are answered but not placed in the context of this particular lab.	Physics discussion is free from conceptual errors, but might contain minor confusion of terms. "What if…" and "What does it mean?" questions are answered, and the relevance of the questions to this lab is pointed out but perhaps not expanded upon.	Physics discussion is clear and cogent, with consistent use of terminology. "What if…" and "What does it mean?" questions are answered and placed in the context of this lab with specific examples.	Physics discussion demonstrates a mastery of physics concepts and a fluency in physics terminology. Discussion of general conclusions and principles, no matter how abstract, is tied explicitly to specific examples from this lab.
5	**Production/Delivery** *Lighting & resolution, audio quality, in-video distractions, overall production quality, reinforcement of message by visuals, vocal qualities in narration*	Audio is unintelligible. Text is unreadable. Video has very low production quality.	Figures in the video are legible, but not always relevant or effective. Video and/or audio have distracting elements (e.g., frequent flipping back and forth between slides, irritating sounds in background, unnecessary music or sound effects). Narration is overall intelligible but sometimes hard to make out.	Figures are legible and relevant. Video and audio are free from distracting elements. Narration is solid but perhaps a little rough around the edges.	Visual presentation is attractive and has a coherent style without reducing legibility. Figures are used to convey information which reinforces the content of narration.	Narration is fluid and rehearsed without sounding stiff. Figures are used to reinforce and also expand upon the content of narration.

B. Individual Problem Presentation Rubric

Each student will be asked to present a solution to one of the following problems. Your presentation should include: an introduction of the problem and main result, identification of the fundamental principles involved, a detailed solution, and some discussion on the reasonableness of the answer.

Collaboration: When preparing your presentation you may consult any outside resources but the work you present must be your own.

Grading Rubric: During your presentation your instructor will evaluate your presentation with the following rubric:

- Introduction 20 points
  - 10 Points: The presenter introduces the problem and main results in their own words.
  - 10 Points: The presenter starts their solution from a fundamental principle and includes a diagram when appropriate.
- Content 60 points
  - 10 Points: The presenter provides adequate supporting work for their result (e.g. diagrams, derivations, and assumptions)
  - 50 Points: When judging the quality of your physics results, your instructor will deduct points for errors using the guidelines listed below. For questions with multiple parts, these points should be distributed equally to each question part.
    - 5 points: Clerical errors, missing units or bad notation
    - 10 points: Minor physics or mathematical errors
    - 20 points: Major physics errors
    - 40 points: Better than nothing
- Conclusion 20 points
  - 10 Points: The presenter checks the reasonableness of their results.
  - 10 Points: The presenter correctly answers questions from the instructor.

Good Advice: A good physics solution has many of these elements

A. Your work is organized and clearly legible
B. Your work includes diagrams that synthesize the problem statement
C. You show what goes into a calculation, not just the final result
D. For problems with numerical values, solutions are derived symbolically and numerical values are inserted as the last step of the calculation.
E. Make explanations correct but brief. You do not need to write a lot of prose.

C. Representative Online PHYS 2211 Lab Instructions

Lab 5: Choose Your Own Adventure

Read the lab instructions below. You will need to create a 5-minute video lab report (which you need to upload to youtube). Submit a link to your GlowScript code and a link to your video lab report in the **Lab 5 Submission** assignment.

Lab Instructions

For this lab you have the choice to investigate and model any system of interest to you. We want you to pick a topic that you are passionate about or that piques your curiosity. That being said, don't worry if you can't think of a topic, we have listed several examples below to help get you started.

The basic idea is for you to take the tools and methods you've developed in the lab and lecture this semester, and apply them to a complex physical system. Regardless of the topic you choose, you should be sure to complete the following tasks:

- **Obtain real data from your own video, observations, or the internet**
  - Use the tools and techniques you master to obtain motion data from video
  - If videos aren't practical, see if you can find data on the internet
- **Use at least one physics model to predict something observed in your data**
  - You don't have to constrain yourself to something we discussed this semester
  - Your model should focus on physics principles and not be overly specific
    - A complex analysis of the Antikythera Mechanism would be inappropriate for this lab
- **Use GlowScript as a computational modeling tool**
  - To predict physics outcomes

Like all good physics investigations, you will need to make estimates and approximations. When presenting your results you should discuss these and provide some form of rationale or justification. As usual, you will submit a video presentation of your investigation to be evaluated by other students in the course.

When you're done, upload your video to youtube. Make sure the video's privacy is set to **public** or **unlisted**. Do not set it to private, as this will make it impossible for others to review your video.

Getting Help

Please feel free to consult the instructors or other students for help. Don't be shy about soliciting feedback on Canvas Discussions on potential topics or beta clips of your video presentation. We want you to have a finished project that you are proud of!

- As usual you have the opportunity to give a practice presentation of your results to your TA and lab group before the final submission deadline.

Video Lab Report Rubric

Your video lab report will be evaluated with the rubric linked here: **Video_Lab_Report_Rubric.pdf.** Please read it before making your video!

Potential Adventures

The Rope Swing

You may have seen a video of a person jumping off a natural bridge in Utah and swinging on the world's largest rope swing. If you missed it, you can watch it here: https://www.youtube.com/watch?v=4B36Lr0Unp4

Details about the swing can be found in a "making of" video here: Behind The Scenes - World's Largest Rope Swing

Model this rope swing using physics principles, approximations, and VPython/GlowScript. Some potential questions to guide your investigation (you don't have to answer these particular questions; they're only suggestions):

1. Predict the motion of the jumper
2. Determine the speed of the jumper and tension in an ideal (no stretch) rope
3. At several locations along the trajectory of the jumper
    a. Estimate the stretch of a real (springs) rope at the bottom of the swing.
    b. Predict the speed of the jumper and tension of a real rope.
    c. At several locations along the trajectory. Where are they maximum?

d. Compute the parallel and perpendicular components of the net force on the jumper.
e. What effect does including damping and/or air resistance have on your predictions?

The Human Rocket

Felix Baumgartner jumped out of a balloon at an altitude of 120,000 feet as seen here in an attempt to break the speed of sound. Model Felix's free fall using physics principles, approximations and VPython. Some potential questions to guide your investigation (you don't have to answer these particular questions; they're only suggestions):

1. What is an appropriate model for air resistance in this problem?
2. Test the speed of sound model for air.
   a. How high Felix should jump if he wants to break the sound barrier in free fall?
   b. What effect does a change in the density of air with altitude have on your predictions?
   c. What effect does a change in temperature with altitude have on your predictions?
   d. Did Felix increase in temperature as he fell? By how much?
   e. How long could he wait before he had to open his parachute?

The Impossible Trampoline

Model the motion of Christoph as he jumps on trampolines as seen here: New Extreme Sport: Trampoline Wall. Christophe Hamel Demo 2012.mov

Has he discovered a way to violate conservation of energy?

The Falling Slinky

Model the motion of a stretched slinky dropped from static equilibrium as seen in this video: Slinky Drop

Does the bottom of your model slinky stay stationary just like in the video?