# Application Summary

## Competition Details

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<tr>
<th>Competition Title:</th>
<th>2021 Innovation and Excellence in Laboratory Instruction Award</th>
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<td>Category:</td>
<td>Institutional Awards - CTL</td>
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<td>Submission Deadline:</td>
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## Application Information

<table>
<thead>
<tr>
<th>Submitted By:</th>
<th>Himani Sharma</th>
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<tr>
<td>Application ID:</td>
<td>5848</td>
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<tr>
<td>Application Title:</td>
<td>Himani Sharma</td>
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<tr>
<td>Date Submitted:</td>
<td>02/25/2021 10:35 AM</td>
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## Personal Details

<table>
<thead>
<tr>
<th>Applicant First Name:</th>
<th>Himani</th>
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<tbody>
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<td>Phone Number:</td>
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### Primary School or Department
School of Material Science and Engineering

<table>
<thead>
<tr>
<th>Primary Appointment Title:</th>
<th>Lecturer</th>
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## Application Details

### Proposal Title
Himani Sharma
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Recommendation Letter

Dr. Naresh Thadhani, (Chair, MSE)

Support letter from Colleague

Dr. Mary Lynn Realff (Associate Chair for undergraduate studies, MSE)

Graduate TA support letters

  • Nicholas Kane
  • Amy Brummer

Students (Undergraduates) support letters

  • Jonathan Yaeger (student and TA)
  • Rachel Borrelli
  • Samantha Hestad
  • Thomas Miller
Executive Summary
The undergraduate laboratory courses in MSE were in serious need of revitalization by 2017 due to steady increase in student enrollment since MSE-PTFE (Polymer, Textile, and Fiber Engineering) merger in 2010. The laboratory courses suffered from host of problems stemming from being demonstrative in nature, having disconnected lecture and lab components, and lacking clear learning objectives. The key initiatives taken to revive the two MSE’s core lab courses that led to significant impact on student experience and learning will be discussed henceforth;

- Promote Experiential Learning by redesigning the laboratory activities to include hands-on learning;
- Enhancing student learning by reorganizing instruction
  - Integrating lecture and laboratory component of the courses
  - Scaffolding lab reports into focused weekly assignments;
  - Creating lab manuals for each lab module
- Provide student opportunities by engaging with relevant industry members in pedagogical collaboration
- Build and strengthen student-instructional-team relationship by creating an environment of mutual respect and appreciation

To lay a strong foundation for lab courses, short-term and long-term goals were delineated to improve the instructional effectiveness. Short-term goals included restructuring the labs from a “demonstration” format to a “facilitated hands-on” approach for a guided inquiry laboratory. Guided inquiry promotes students’ active engagement in learning while providing more structure through the inquiry process and has been shown to improve student outcomes. To achieve this, several changes in area of logistics, resources, lectures, and lab experiments were implemented. Long-term goals include the implementation of complete inquiry-based laboratory, promoting diversified industry collaborations, and developing forward-looking labs with emphasis on sustainable materials.

Background
In 2010, when School of Material Science and Engineering (MSE) merged with School of Polymer, Textile, and Fiber Engineering (PTFE), the undergraduate curriculum was revised to include Polymers to already established Ceramics and Metal concentrations. This was a welcome change and the department saw steady increase in student enrollment. However, the merger also brought the challenges that arise from larger student enrollment in the courses. Hands-on activities, in laboratory courses decreased steadily with increase in student enrollment due to lack of equipment, funding, and instructional resources. This required the labs to evolve and adapt regularly. However, the efforts in this direction were limited and the labs were run unaltered with minimal to no restructuring. This caused several issues that are described below, in the “Course summary and challenges” section.

MSE has two separate sequential undergraduate laboratory courses, MSE 3021 and MSE 4022 that are required courses for all MSE majors. The main objective of these laboratory courses is to teach students how the theoretical concepts learned in lecture-type courses are applied to real life engineering problems. This makes these courses vital for the MSE curriculum because of their broad scope that encompasses many scientific/engineering concepts as well as ensuring writing and communication skills (Fig. 1). If executed well these can deepen student’s interest in the subject, enhance material understanding, and raise their confidence to perform exceedingly well in research and/or industry setting, following their graduation.
Course Summary and Challenges

MSE 3021 is a “material properties” characterization lab offered in Spring while MSE 4022 is a “materials processing” lab, that aims to highlight processing-properties-performance relationship, and is offered in Fall. Both courses are sectioned into three modules each; (Mechanical, Electrical and Thermal for MSE 3021 and Ceramics, Metals and Polymers for MSE 4022) and have similar structural framework. Each course sees 70-100 students in a semester, which are divided in 3-4 sections every week with each lab section containing ~25 students. Both courses have a weekly lecture component which historically had been delivered by a guest area-expert-faculty.

MSE 3021 (often called as Lab-I) introduces various material characterization techniques that requires modern instrumentation. This course should allow students to comprehend and apply various methods and types of diagnostics that are used to collect data in numerous material systems. However, due to high cost of the modern instruments, only a handful of these testing machines are available in any School for the students to use. The challenge increases when the class size is moderately large which leads to reduced-to-none hands-on experience for the students. Prior to 2018, a lab-section of 25 students crammed around one of the instruments and watched a TA demonstrate the operation of the tool in the lab. The data was collected by the TA and sent out to the entire class generally a week before their lab reports were due. Students were then asked to process the data and write elaborate lab reports after each module. This approach failed in achieving desired learning objectives, while overwhelming students with large data processing and report writing, who in-turn started to disengage and lose interest in the laboratory courses. The lecture component in both courses, were disjointed from the labs, delivered by a guest area-expert faculty and only introducing the general concepts for the week, with little continued correlations. The nature of the lectures were such that they laid no emphasis on specifics of material, testing, processing or data analysis pertaining to the lab performed during the week.

MSE 4022 (Lab-II) faced similar challenges of TA-led demonstrative approach to the lab, instead of student-driven, hands-on experience. Additionally, the experiments were complex with results not always consistent with those expected, inherent with processing experiments, and required longer duration to complete, further requiring TAs to finish carrying out the lab work outside the allotted lab time. This invariably further reduced students’ active participation. Due to the nature of these advanced labs, it required students to apply concepts and techniques learnt in Lab-I. Having taken Lab-I almost 6 months prior, retention of both technical and laboratory skills is often lower among students. Short lecture periods and time-crunched labs did not allow any room for revision and heavily relied on the student to recall the needed information.

The teaching methodologies and strategies employed to address these challenges are described, in the subsequent sections 1-5.

1. Promoting Experiential Learning

To promote hands-on activities for all students in the lab, the first thing I implemented was to create a small group atmosphere. First, each lab section was separated into two smaller sections (~12 students each). Each of the lab sections were later further separated into groups of 3-4 students and only two groups of students were invited in the lab for a 45-60 min lab period. Since the total lab time was cut in half, the lab experiments were condensed ensuring that the main objectives of each lab were achieved. Each group in a section acquired data on different set of material (or condition) using same methodology, and later they shared the data among themselves. This way every student got a chance to operate the instrument and independently acquire data, which substantially improved their lab experience. The practice was especially useful during the COVID-restrictions, when the labs were offered in hybrid
mode with fewer people in the labs at any given point. An example of condensed-lab work distribution is shown in the Table-1.

In past semesters, each student was required to collect data of every sample listed in the table. Since this was not practical for 25 students who arrived at one time in the lab, the TAs gathered all students around the test set up, made the measurements themselves and read out the digital readings for students to write it down. The new condensed approach to the lab may seem reduced activity for a student, however, it does provide a much needed direct and hands-on experience albeit on fewer samples. This an important skill to learn and can be easily extended to measure other specimens.

Table-1: Group-1 (in each time-slot) carries out measurements labeled “X”. Group-2 is required to measure samples marked “O”.

<table>
<thead>
<tr>
<th>Sample</th>
<th>2-Electrode</th>
<th>4-Electrode/4-Point Probe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Potentiostic</td>
<td>Galvanostatic</td>
</tr>
<tr>
<td>Cu Wire</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>100 Ω Resistor</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Steel Spring</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Boron Carbide bar</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>FTO thin film (4-po</td>
<td></td>
<td></td>
</tr>
<tr>
<td>probe)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silicon (1mm)</td>
<td></td>
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1A. Redesigning the experiments & Leveraging resources:

Redesigning of the experiments was needed in modules where the experiments were elaborate, time-consuming, and required using the only available single experimental setup. In the past student engagement was thus, restricted to mere passive observation. To address this limitation, following steps were taken –

a) Design simpler experiments that aligned with material processing techniques, yet required simple, portable and affordable equipment;
b) Newer, portable and cheaper processing tools were acquired to set up several work stations to support the class size and have more hands-on activities;
c) Elaborate experiment demonstrations were recorded as short (<10 min) videos and given to students as pre-lab assignment. Some of these included a low-stake quiz to ensure that students pay attention to the content and took notes.

To demonstrate how this was done, we will look at the polymer processing module in MSE 4022 and how it was redesigned.

In the original MSE 4022’s Polymer processing lab module, a twin-screw compounder was used to make polymer blends which were then characterized for mechanical and structural properties in a period of 2-3 weeks. In week-1, students saw a TA demonstrating the polymer blend using Twin-screw compounder. The compounder itself was an old, bulky machine with no heat shields around it with temperatures reaching >250°C during operation. This made it highly unsafe for the undergrads to use, restricting the operation only to experienced graduate TA who gathered the students around the machine and demonstrated the process. Week-2 and 3 were dedicated to fiber-extrusion and
mechanical testing respectively. These weeks too, followed the same demonstration-type labs as week-1. This was not engaging for the students or the graduate TA. In order to make the lab engaging and introducing hands-on activities, three main changes were done- (a) condensing 3 weeks activities to 2 weeks; (b) introducing new processing techniques and (c) collaborating with maker space and research labs to gain access to other operable machines.

In week-1; *instead of using the bulky twin-screw extruder, a smaller and modern machine (Microcompounder)* was borrowed from an MSE research lab. The micro-compounder did the same level of compounding as twin-screw compounder but in smaller quantities and was much safer for students to work with. The bulkier twin-screw compounder was still used and operated by a TA but only for demonstrative purposes. In turn, small groups of 3-4 students operated the Micro-compounder station, in presence of an experienced graduate TA and collected their own samples. This group then moved to the Extruder station and spun their polymer fibers, making way for another group to use the Microcompounder. This allowed all students to operate the equipment and experience all steps of the process in small batches. By the end of week-1 all students had collected their own samples ready to test them in Week-2. For testing, *I collaborated with MSE’s make and measure space, The MILL, which is well equipped with various diagnostic and characterization tools. The students took their extruded polymer fibers to the MILL and ran mechanical tests and optical imaging to collect data.*

Condensing three weeks of lab into two weeks, allowed me to introduce a new polymer processing technique to the third week of the lab. Thermoforming is a commonly used technique to process polymer sheets into final products such as take-out containers, disposable containers and plastic lids. Acquiring several units of economical and simple $100 Thermoformers, let groups of 2-3 students study changes in polymer crystallinity as a function of mold’s aspect ratio. The groups then, observed the phenomenon of Birefringence on the thermoformed-polymer using polarized microscopes already available in the lab. Students appreciated the newly added technique as evident from their positive feedback in CIOS surveys:

- “The best was being able to use the equipment and learn methods for processing for each type of material.”
- “Very hands on. The class was kept modern and updated.”
- “This [MSE 4022] was the first "hands on" lab I've ever taken at Georgia Tech... I feel like every lab should be set up in this manner.”
- “The best [part of the course] was being able to use the equipment and learn methods for processing for each type of material.”

In summary, utilizing existing resources judiciously and acquiring latest, affordable and simpler tools hold a key in allowing students the access to machines they need, to run their tests and gain important operational skills.

1B. Leveraging Technology

With growing demand of remote lab activities, especially with challenges imposed by the pandemic, it is imperative that we convert the challenge into an opportunity to develop and make use of online resources and virtual tools. In spring 2020, when there was an urgent need for sudden transition to remote teaching, we relied on technology to not only deliver content but also engage students in a meaningful interaction with TAs, instructor and fellow students. Although, it is particularly hard to replicate the experience of engineering labs, for example, there is nothing quite like the experience of opening the door of a hot furnace (for instance, casting metal) and feeling the radiated heat, one can utilize simulation training systems of furnace operation that can serve as a partial substitute. However, the easiest switch was to use existing public educational videos that demonstrate the actual operations of equipment or illustrate with animation the various material processes.

To start with, the instructional team (technical TAs and me) made video demonstrations, edited using Kaltura (to convert them into low stake quiz) and uploaded on Canvas. In my search to supplement our lab videos, I discovered...
scientific video journal, JoVE that has very well-curated content, with plenty of animations and illustrations, and accurate descriptions of engineering experiment protocols. It is important to note that though there are numerous databases of online labs in fields like Biology, Chemistry or Geology, Material Science and Engineering online labs or simulations are fairly limited. I used JoVE videos in labs related to metallography, mechanical testing and electrochemical processes as a prelab assignment, including illustrating key safety components. Additionally, certain YouTube videos that demonstrated relevant engineering labs in different universities, were also quite useful.

A crucial component of the undergraduate lab courses is to nurture the basic attitude and the habit of prudent behavior, so safety in labs ingrains among students. Undergraduates in MSE labs, under a TA supervision, often operate high temperature furnaces, heavy load machinery, pressurized chambers and electrical set ups that can pose safety threats when not handled with care. I have created videos that emphasize on lab safety pertaining to the specific experiment/process/tool operation for each module. In fact, some of the videos were also used as part of our ABET portfolio and they received much praise by the program evaluator viewing those. I also constantly update my resources with interactive and abundantly illustrative training tutorials from other universities and tool vendors that students can watch before they come to the lab.

2. Enhancing Student Learning by reorganizing instruction

2A. Integrating Lectures and Laboratory Components

Since the inception of MSE’s undergraduate lab courses, the lecture part of the course invited expert faculty to deliver the content. Lecturers would change every lab module with few modules seeing upto three different faculty on a topic. Majority of times, these expert-delivered lectures covered a broader view of the subject and general lab exercise. Due to the lack of specific details on lab activities and how the content in lecture was connected to the experiment, the lectures were low-value add. Many students mentioned that they were only worth attending for attendance points.

<table>
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<th>Elements</th>
<th>Original Structure</th>
<th>Modified Structure</th>
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<tr>
<td>Lab-lecture</td>
<td>Broad material background is covered without specific details of lab and how they are related</td>
<td>Only concepts pertaining to each week are covered</td>
</tr>
<tr>
<td>Alignment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up</td>
<td>No feedback on the labs after the lab was conducted</td>
<td>What worked and didn’t work in the lab is discussed every week during lecture</td>
</tr>
<tr>
<td>Instructors</td>
<td>• Invited guest field experts</td>
<td>• One instructor, throughout semester;</td>
</tr>
<tr>
<td></td>
<td>• Changed every 2-3 weeks</td>
<td>• Students’ familiar with teaching style</td>
</tr>
<tr>
<td>Organization</td>
<td>Lectures were fragmented and disorganized</td>
<td>Lectures are organized by weekly objective-technical concept-experiment details-feedback of previous week</td>
</tr>
<tr>
<td>Student feedback</td>
<td>• Not worth attending</td>
<td>• Good preview of labs</td>
</tr>
<tr>
<td></td>
<td>• Seem extraneous</td>
<td>• Lectures were good and pertinent to the material utilized in the labs</td>
</tr>
<tr>
<td></td>
<td>• Not helpful/applicable</td>
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The original and the new modified lecture structure are compared in Table-2. The key changes included weaning off guest lecturers, aligning lectures with the weekly labs and providing weekly feedback on the previous week’s lab. The changes are well received by the students and the guest faculty, who still provide their expertise when requested, in specific modules.

2B. Introduction of Weekly Assignments:
The most common form of assessment in most lab courses is a Lab-report. For MSE 3021 and 4022 too, prior to 2018, 90% of the total grade for the lab course came from the three bulky assignments. Attendance and lab notebook made up for the remaining 10% of the grade. This assessment-type has one major disadvantage;

Students, habitually, procrastinate till week before the submission deadline to even start working on their lab reports. Invariably, students face one of the following scenarios; they realize that (a) they don’t have all the needed data; or (b) don’t know how to process the data; or (c) don’t recall how to interpret the graphs; or (d) this assignment will take time away from all their other courses for a week, even if they have what is needed and know how to do it. The feeling of urgency quickly turns into helplessness, making them either work feverishly on the report in a very stressful mind frame or completely giving up on the assignment. Both situations, typically leaves students with bad overall experience.

The situation can be easily salvaged if students don’t leave the large chunk of work for the last week, but unfortunately that is the case for majority of the students. The idea of post-lab assignments originated to circumvent this challenge. As a part of weekly assignment, students were asked to process the data (examples include- plot graphs, process images, carry out calculations) they acquired in a week and submit it before their lab the following week. The data in weekly assignments can them be analyzed and discussed as a part of the Lab report/Memo writing. This way, students aren’t overwhelmed with all the data processing and analyzing, at the end of 3 weeks. The smaller, yet focused assignments also helped them retain information better and make improved correlations for their. For certain advanced lab module, a short but important pre-lab exercise is assigned that helps student gain greater technical insights of what the lab would entail. These exercises also saves student time in the lab by making them do the mathematical calculations needed to carry out the experiment prior to the lab. One example of the exercise/questions from the Ceramics processing lab is shown in the adjacent picture.

Learning to write scientific document professionally is also a key learning objective of the lab courses. Lab reports were evaluated for both technical merit (70% of grade) and writing quality (30% of course grade). The formatting, styling and language are the components that writing assessment is based upon. Without any prior experience in
writing large scientific documents, students find it difficult to confidently report their technical findings while keeping the writing concise and professional during their first two modules, especially in the junior lab course. Thus, addition of weekly assignments, added a scaffolding approach to learning scientific writing for the students. Students are given weekly feedback on how to format graphs, and other visuals, styling tips and language on their post/pre-lab submissions. This builds up their confidence while they course-correct weekly. This way students don’t find the bulkier assignments as intimidating as before. Furthermore, instead of full-blown reports, for the first module, students are asked to submit “Memos” that focus on presenting and discussing their scientific results. These Memo assignments are relatively shorter in length and don’t contain all sections of a typical lab-report. With each successive memo, a new section is added (say an Introduction or Experimental) to build student’s writing skills. This scaffolding approach has been welcomed by the students and has paved a much stronger foundation of technical as well as writing skills. The learning outcomes for this initiative was assessed by comparing class average scores in every successive Memo which showed higher overall scores.

2C. Laboratory Manuals

A laboratory manual for engineering labs can be seen as an important aid to promote guided inquiry-based learning among students. It is used as an essential component of teaching subjects that require hands on practices. Both the MSE labs are divided in 3 distinct modules, each focusing on a unique material set, their processing and properties. One of the first task towards re-designing the labs was to create well structured, designed and formatted lab manuals for each module in both the courses. The focal point for curating these manuals was to synchronize theoretical topics with laboratories tools and processing. In addition to technical information, the manuals also included logistical details such as TA contact, assignment guideline (applicable to specific module), resources and module layout. Additionally the manual comprised of Lab-report writing guidelines and grading rubric. Having the rubric at the start of the module, provided students the areas they needed to focus and work upon to successfully carry out the bulky assignments. Examples of table of content of two lab manuals Ceramic Processing module in MSE 4022 and Electrical module in MSE 3021 are shown above. The structure and format of the manuals was intentionally kept same in subsequent semester so students know what to expect and where to find the needed information. Lab-manuals are also being continuously updated and improved with every semester to reflect the course evolution. At the front-end, students found lab manuals a useful resource with organized information. Most students brought a printed copy of the manual
to the lab and felt prepared to handle the lab activities with minimum TA support. Manuals are also now considered the first stop to look for answers instead of relying on friends/lab members.

3. Opportunities for students to investigate/solve real-world problems

3A. Collaboration with Industry

In an ongoing effort to provide students with opportunities to think beyond the labs and engage in real-world problems and solutions, I collaborated with engineers in the materials engineering industry. Specifically, the pedagogical-collaboration with Novelis (world’s leader in aluminum rolling and recycling), yielded content that has enhanced the laboratory course. Over the past two Fall semesters, engineers from Novelis worked with me to curate a series of video tutorials that showcase important aluminum processing techniques such as rolling and casting. These videos show in-plant, manufacturing scale steps in making of the aluminum consumer products. Since these were made from educational stand-point, several fundamental concepts were discussed and explained. The videos were then shared with the students in a sequential manner during the metal processing module. What is wonderful about this partnership is the synergy between the course content and the industry-curated videos. As a part of the Metals processing module, students made aluminum casting and cold-rolled steel, the focus of Novelis videos. This helped students build direct correlation between lab-scale and large-scale processing and their challenges.

Furthermore, a highly interactive live session was organized in class with Novelis engineers. The engineers restricted themselves to only two of Novelis’s markets- Automotive and Cans, both of which students use in their daily life. We designed the activities for the live session such that Novelis engineers presented real case-studies (one example from Tesla), divided students in small break-out rooms and required them to propose the best Aluminum alloy or the process suited for the application. The activity required students to apply knowledge learnt from the labs to solve the real challenge industry was facing. The groups came back with their proposals and reasons, to discuss with Novelis engineers. To say that the students loved this session would be an understatement. Not only did they appreciate the broader application of the fundamental concepts, direct interaction with “real engineers”, take a virtual tour of their processing techniques, they were also excited about their prospective of internship or job opportunities that were mentioned by the Novelis personnel.

Some comments from students from CIOS survey included, “Novelis lecture was great”; “It was wonderful to interact with engineers from industry”; “The partnership with Novelis for the metals portion of this lab was very fun and it provided a real experience which was not gained in other labs.”

To build on this success, I plan to partner with industry in polymer and ceramic processing to develop similar pedagogical resources. Especially with polymer processing, I wish to develop a module on Sustainability and collaborate with industry who focus on recycling and sustainable future. Exposing students to current and tomorrow’s challenges with materials will encourage them to be a part of the solution by leveraging information they gain in MSE labs.

3B. Independent Student/ Team Projects

Achieving an affective outcome, such as motivation for additional learning or a change in attitude is probably the most critical and satisfying end result of teaching. A major indicator for gauging student affective outcome is when individual or group of students approach instructors to discuss the projects that they maybe working on and see the value of skills and concepts learnt in the lab. I have had a couple of such interactions every semester.
Here is an example; A student shared a picture of a ceramic mug (Fig. 2, left) she made herself and had this to say “I recently got to go see my first soda ash firing and because of things I learned in your class, it was pretty cool crossover of my two interests of materials and pottery. Soda ash is mixed with water and then sprayed into a kiln after the bending of the fifth cone which is around 2110 degrees Celsius. Soda ash is sprayed into the kiln and separates from the water molecule and is attracted to the silica which is in the clay. Thanks to your class, I know all about silica in clay and it was very cool moment for me.” (The student is referring to the Ceramic Processing Module in MSE 4022 lab.)

Fig 2: Right: Ceramic mug made by a student as an independent project; Left: Student pictured gathering metal pipes to make their own wind-chime.

In yet another example, a student was building a wind-chime from scrap metal. It required a lot of information on material properties, on unknown material supplies they had gathered. They needed to run several tests on metal pipe that they found, but didn’t know how to and which techniques to use. During their material characterization lab (MSE 3021), a student approached me to discuss the challenges. It was quite satisfying to see how quickly they connected the dots and came up with ways to design the metal for testing, with minimum guidance.

4. Build and strengthen Student-Instructional-Team Relationship

Teaching Assistant Training and Community Building

A critical element in successful execution of moderately/large sized undergraduate lab classes is the involvement and participation of entire instructional team that includes both the instructors and the Teaching Assistants (TAs). In the School of MSE, all graduate students are required to TA for points that are counted towards their degree. Since these required teaching assistantships are unpaid in MSE, most graduate student don’t volunteer and mostly TA only for their thesis advisor. A one-question survey by GSAG (graduate student association) for MSE graduate students in 2018, asking if they would like to TA for an undergrad lab course, resulted in a whopping 75% indicating, “No”. The lab courses, clearly, had gained a bad reputation over the years, steering graduate students away from this opportunity. The biggest hurdle, therefore, was to regain graduate students’ trust and engage them in a conversation. I started by setting up meetings with GTAs who had TA’ed for MSE 3021, 4022 before, including the ones who had graduated but were kind enough to engage in a virtual discussion. It was abundantly evident that TAs felt under-valued, over-worked and under-prepared to run the entire labs without proper training or guidance.

After several discussions, we (senior graduate students and me) came up with a list of expectations for the TAs with details of well-defined TA duties, time commitment and expected student-TA engagement. Armed with past TA approved expectation list, I held a town-hall with pizza (Ofcourse!) for grad students to attend a session where the changes in lab course organization and TA role and expectations were highlighted. This followed a more open discussion, feedback and renewed interest in lab courses, among the graduate students.
Next came, execution of the TA-plan (shown in Fig. 3)- creating TA teams (3-4 TAs/module), training, organizing practice sessions, assigning tasks and ensuring that TAs feel the ownership for their teaching modules. Based on the motivation, background and prior experience, one TA is assigned a role of Head TA who acts as a bridge between instructor and other TAs and coordinates activities for the team. Having weekly meetings with each team helped us brain-storm ideas to work out logistics, experiments and learning goals for the students, which TA felt motivated to execute. Eventually, graduate students started seeing themselves as co-instructors and equal stakeholders who cared and strived to deliver a good learning experience to their class. In summary, a team of 3-4 TA per module (3-4 weeks) was an efficient approach in both 3021 and 4022 labs where TAs didn’t feel burnt-out, maintained teaching motivation throughout their module and were effective facilitators in the labs. On the front-end, TA efforts were well-received and appreciated by the students as evident from the TIOS scores- with comments such as “Best TA ever”, “Really enthusiastic and approachable”, “Heart of a Teacher”, “Most proactive TA—very helpful, knowledgeable, and explanatory” to mention a few.

TA Adaptability with Remote/Hybrid Teaching
As we switched from in-person to completely remote in Spring 2020 and hybrid mode in Fall 2020, TAs played a critical role in ensuring a smooth transition and a successful completion. For complete remote mode, TAs started with recording tutorials and process/tool demonstrations, turning them into quiz and sharing with the class. TAs held labs synchronously for each section where the lab activities were discussed while playing recorded video clips of the lab. To encourage student participation, TAs would pose questions and split the sections in smaller groups for discussions.

During Fall 2020, when the labs were offered in hybrid mode, TAs activities needed to be ramped up. At any given time, 30% of the students were physically present in the lab, while the rest of the class was watching live lab sessions through Bluejeans. After the initial weeks, when a TA handled both in-lab and online students simultaneously, we realized the ineffectiveness of the approach, and made the switch to separate TAs for each modality. This way, a dedicated TA for online students coordinated the live demonstrations, answered questions and engaged in discussions. The TAs set-up Bluejeans cameras on several cellular and laptop devices in the lab and switched back-and-forth between them, focusing on different aspect of the labs. TAs also utilized headphones with microphones to ensure they were heard clearly. This parallel approach with two separate TAs showed distinct advantages (i) engaged the online students in discussions; (ii) reduced feedback time from TA; (iii) relieving pressure on in-lab TA for coordinating both modes.

5. Student’s Overall Well-Being (Academic and Personal)
It is well known that only when a person is in a pleasant state of mind and body, can they perform to their fullest and tap in their full potential. As a world’s leading academic institute, GT is beginning to make strides in achieving overall well-being for their student community. Personally, I feel it is of utmost importance that our students feel empowered by the time they graduate, with not just the technical skills but also life-skills they would need to lead a successful career and life. As a small step in this direction, I collaborated with like-minded faculty in Seattle University and created a module on “Health and Well-being”. This module (Fig. 4) is now a part of all the courses I teach. It is an optional, do-
it-at-your pace module with articles, videos and TED-talks on science behind various techniques one can use for their mental well-being.

Laboratory courses are wonderful opportunities to inculcate a sense of community among students. When paired consciously, such that student’s strength and weaknesses are complemented, these group interactions can serve as seedbeds for ideas and innovations. Several students, for variety of reasons, find it difficult to express themselves in larger settings but if provided space and opportunities in smaller settings can really contribute meaningfully. I’m well aware that these ideas are overarching and not easy to execute but keeping a broader view and larger goal of student success is critical and a need of the hour.

6. Evaluating the effectiveness of the initiatives

The effectiveness of the initiatives can be evaluated by end of the term CIOS survey as well as in class student feedback. I regularly seek formal (ungraded survey) and informal feedback (student reflections) from the students during a course of the semester. Generally, the feedback after the first module gives a good indication of class needs, and allows me to adapt the course accordingly. The feedback guides me to make changes such as switch from pre-lab to post lab assignment or vice-versa, add an extra office hours, or modify the lab instruction time to include a sample data crunching session. In absence of CIOS survey (in Spring 2020), students were required to submit their reflections for a small part of their grade and I find these incredibly helpful when planning for future semesters. Additionally, the improved quality of the submitted assignments both in terms of technical and communications, are indicative of the extent to which these initiatives have helped the students. Student ability to employ the concepts learned in the lab,
to their personal or group engineering projects, outside of their curriculum is yet another evaluator as described in section 3B.

CIOS scores from MSE 3021 and MSE 4022 indicate that the changes made to the lab have been valuable to student learning. The overall course effectiveness for both the courses is 4.15 and the instructor effectiveness is ~4.69. Students have also shared their experiences in the labs as thank-a-teacher notes. The selected examples are provided below;

“Dr. Sharma, I wanted to thank you for your support and commitment to making the lab classes more interesting/interactive for students. While taking this class, I felt like I was learning new skills and concepts, despite challenges surrounding covid-19. I’m grateful for your commitment to teaching which fueled my interest to learn and produce high quality lab reports.”

“Thank you Dr. Sharma for wanting your students to take real life skills into the world, not just a good/bad grade. I will always remember your kindness, and will strive everyday to help people who work for/with me to feel as you made me feel :)”

7. Future Plans
The initiatives described here have enhanced the student experience and education, with new activities that better meet the learning objectives of the course, a training program that equips TAs to be meaningful partners to the instructors and students, and a focus on a student as a whole. Further refining of the laboratories is ongoing. Increasing industry involvement to link to real world materials processing, decreasing the time between submission and feedback of student work, incorporating state of the art knowledge and technology, and providing more support to student learning through inclusion of a “Learning Assistant Program,” will make the courses an even better experience.

To further expand the scope of the lab, I would work to increase the industry-MSE collaborations by partnering with companies in polymers and ceramics fields to incorporate manufacturing aspects in our undergraduate courses. As a long-term goal for MSE undergrad labs, I would explore ways to implement complete inquiry-based laboratory approach for advanced lab so students feel better prepared for their senior design projects and beyond.

It is a challenge to get students feedback quickly given the number of students and the need to be actively engaged with them during all of the lab sessions. The time lag between the submission and individual feedback from TAs can also lead to repetitive mistakes by the student and cause frustration. One way to address this is by redesigning weekly assignments as Canvas quizzes that can provide automated and quick feedback on common mistakes.

Revitalizing and upgrading engineering undergrad lab courses is an iterative process. It requires constant revaluation and modernizing of technical content while adopting latest pedagogical tools to meet the learning goals. The role of MSE in creating a sustainable environment and future is among the most vital in all branches of engineering. Introducing undergraduates to the latest material systems, processes and techniques will not only usher them to innovate but also open several prospects for their careers. With that goal, I would like to develop labs focusing on student-driven research in materials relevant for future.

I also intend to utilize the “Learning Assistant Program” (pilot program from Tutoring and Academic Support and CTL) to better scaffold student learning by incorporating small group technical interactions into the laboratory courses. This would supplement the graduate TA interactions that are currently limited due to the short supply of graduate TAs.

Not only have the courses changed dramatically, I have also learned a lot in the process. The future is bright and the support is strong to make these laboratory courses even better in the future.
Dear Dr. Weinsheimer,

It is with great pleasure that I support the nomination of Dr. Himani Sharma for the CTL Innovation and Excellence in Lab Instruction Award. Dr. Sharma has worked tirelessly to reimagine and redevelop the instructional undergraduate level laboratory courses in our School of Materials Science and Engineering (MSE) making them increasingly hands-on and promoting student interest and participation. I believe that Dr. Sharma has done a fantastic job in enhancing student experience in MSE labs, in addition to their well-being, for which I believe that she is most deserving of the 2021 Laboratory Instruction Award. Let me provide below, some of the highlights of her efforts.

In 2018, Dr. Sharma was selected for the Office of the Executive Vice President of Research (EVPR) Research Faculty Teaching Fellow Program and was assigned to teach the MSE 4022 undergraduate lab course. Based on her performance and positive feedback from students, she was later hired as full-time Lecturer in MSE, responsible for redesigning and teaching our undergrad lab courses, mainly MSE 3021 and MSE 4022. These laboratory courses see ~200 undergrad students and several teaching assistants annually.

Since the MSE School merged with the Polymer Textiles and Fiber Engineering School in 2010, there has been a steady increase in student enrollment, and thus higher numbers of students coming through the labs. The lab courses in particular, started facing issues that generally arise from higher student enrollment. The main concern was how to continue to effectively educate students so they learn essential skills with limited availability of resources such as laboratory instruments, while ensuring safety, so that each student is able to get a hands-on experience. The need for updating and revising the lab courses was evident from dissatisfied student CIOS feedback and their exit interviews for several years in a row. From Day-1, Dr. Sharma started working to address the issues head on – she did her home-work by talking to her students, faculty, and graduate students involved as TAs for these courses, and made detailed plans to tackle each major challenge and execute them meticulously. Dr. Sharma’s deep sense of commitment towards her students and their education soon brought the much needed improvements to our two required laboratory based courses in MSE.

Over the past several semesters, Dr. Sharma has redesigned the two courses to promote hands-on activities to facilitate active learning. This has been greatly appreciated by the students who had been seeking opportunities to learn how to process their own samples, run
their own diagnostic tests and operate characterization equipment independently. To achieve this, Dr. Sharma creatively employed methods that used existing resources, acquired more economic and compact instruments that demonstrated the same scientific concepts, and built small student learning groups. This staggered student approach with smaller group sizes also enabled students to work on the experiment/instrument and get the much needed hands-on experience. Dr. Sharma has constantly emphasized the need for modernizing and diversifying the lab courses and has introduced new experiments with the objective of introducing modern material processing techniques. Be it, the introduction of newer polymer processing techniques in MSE 4022 processing lab, or thermal expansion testing in the MSE 3021 properties based lab, she has strived to regularly expand and evolve the technical content. Dr. Sharma has also continued to work with area-expert faculty in different concentrations (metals, polymers and ceramics) in efforts to bring the latest research relevant to the technical content covered in the undergrad labs. In her efforts to enhance student learning, she has carried out several riveting changes in her courses. Starting with reimagining core learning objectives, developing lab manuals for each module, introducing weekly assignments, to adopting a scaffolding approach to lab reports, she has made a positive impact in student learning experience. Having replaced bulky lab report assignments with shorter assignments, not only relieved student pressure but required them to have better understanding of what they are doing in the labs.

Another significant change that Dr. Sharma has brought in the MSE undergrad labs is the more direct involvement of graduate teaching assistants. Running a successful multi-faceted engineering lab course is a team effort and Dr. Sharma has warranted that her team of TAs feel welcomed and appreciated for their efforts. She has set up a TA-retention system in which she identifies and selects graduate student TAs, forms teams of 3-4 TAs for each module, arranges training sessions for each team and meets with them weekly to brain storm ideas and plan out the semester. She is very cognizant of her TA’s time and works to accommodate their schedule. Her involvement with graduate TAs, providing them appropriate freedom, willingness to listen and adopt their ideas has raised TA trust in her and made them take ownership of their part.

Dr. Sharma has also worked with industry partners to create more effective and engaging lab based education for the students. Her collaboration with Novelis to curate educational tutorials in summer of 2020 provided students with key perspectives of large-scale metal manufacturing processes. These videos are not only relevant to the processing lab but are also applicable in other metal-focused courses. She also invited Novelis engineers to her classroom for direct and livelier interaction with the students who saw this as a wonderful opportunity to not only learn the technical knowledge, but also for networking.

During the sudden transition to remote instruction in Spring 2020, Dr. Sharma not only swiftly created recorded lab activities but also ensured student participation wasn’t hampered. She and her TAs engaged students in smaller groups in synchronous lab sessions, explaining methodology, concept, procedure and expected results. She quickly adapted to new setting and converted the large assignments into smaller weekly submissions that didn’t overwhelm the students and out them in an already stressful situation. Dr. Sharma’s endeavors continued
in Fall 2020 when she adapted the lab course to a hybrid mode. The objective was to provide in-lab experience to interested students and having live synchronous lab sessions for ones who weren’t able to attend the lab physically due to health or safety concerns, through pre-recorded videos. In fact some of the videos she developed showing not only the equipment details but also the safety protocols, turned out to be a major positive comment highlighted by our program evaluator during last Fall’s successful ABET evaluation of our MSE program.

The CIOS survey results (for MSE 4022), after Himani joined, have shown marked improvement from 3.3 (in Fall 2017) to 4.15 (in Fall 2020) in Overall course effectiveness. As an instructor, Dr. Sharma’s overall effectiveness is also rated high with the latest score of 4.69 in Fall 2020. A few student’s comments from CIOS survey (MSE 3021 and MSE 4022) that highlighted their appreciation for Dr. Sharma’s contributions are listed below;

“Thank you Dr. Sharma for revamping the labs! I hated 3021 and it really made me question why I selected this major when we literally had no lab time. This course [MSE 4022] was really fun and completely opposite.”

“Professor Sharma really cares about her students and wants them to succeed. It shows and makes the class into a much more learning friendly environment.”

“I really appreciated how Dr. Sharma maintained good communication with the students. I appreciated that she talked to us on the last day of class about what she thought could be improved in the future. I believe that the lab classes will continue to improve because of Dr. Sharma's efforts.”

“Dr. Sharma was the saving grace of this class. She often explained the concepts, checked our understanding of the material, and cared about the amount of work given to us and would check to see how everyone was doing on the reports. She is the reason I am looking forward to Lab 2 in the future.”

“It [MSE 4022, Fall 2020] was very well adapted to the hybrid format. Having fewer students come into the lab made the in-lab experience better, and being able to watch online was nice given the health climate. I appreciated the openness to our opinions.”

In summary, I find Dr. Himani Sharma to be a passionate educator who has a larger vision for undergraduate laboratory education and will continue to make a positive impact on hundreds of undergraduate students in years to come. I most enthusiastically support her nomination for this award and believe her to be most deserving of the recognition for her contributions in redesigning and implementing successful laboratory courses.

Yours Sincerely

Naresh Thadhani
February 22, 2021

Dear Joyce and member of the selection committee,

It is my great pleasure to support the nomination of Dr. Himani Sharma, Lecturer in Materials Science & Engineering for the Innovation and Excellence in Laboratory Instruction Award. She has contributed to a positive student learning experience, engages students to deepen their understanding about materials engineering and materials processing, has added reflection, analysis and investigation into the two laboratory courses that she teaches, has included collaboration with industry to aid students to discuss and consider real-world problems, and has added a student collaboration component to the educational experience. I can think of no other person more deserving of this award. She took our two laboratory sequence from the weakest part of our undergraduate curriculum and turned it into an educational experience that was highlighted as one of MSE’s strengths in the recent ABET Assessment visit.

I worked closely with Himani and have seen her in the classroom and laboratory. I have seen her training the graduate TAs and interacting with the undergraduate TAs for the course. Himani has applied what she has learned in the many CTL workshops to change the laboratory courses. Each semester, I interview every undergraduate student who is graduating. After Himani restructured the laboratories the comments from students went from complaining about the laboratories as one of the worst things about MSE to one of the best things about MSE. When our ABET assessment was moved to a virtual format, Himani and I prepared video tours of the laboratories. Himani explained how she utilizes the laboratory spaces that are spread across four different buildings on campus and how students use the laboratory equipment in the laboratory courses. The ABET evaluator commented that the virtual lab tours allow her to really understand what the students are learning and experiencing in the lab courses.

The hiring of Dr. Himani Sharma in Fall 2018 as the research faculty teaching fellow, and subsequently as lecturer in MSE, has allowed her to work with faculty, and restructure and improve the Materials Lab II (MSE 4022) course. Exit interviews from Fall 2018 indicated that students see the changes implemented in this course as positive. Additionally, course assessment indicated an increase in attainment of ABET student outcomes (1) from 2.26 to 2.68, outcome (3) from 2.00 to 2.42, and outcome (6) from 2.63 to 2.79, as measured Fall 2018 and Fall 2019. Subsequently, Dr. Sharma also taught Materials Lab I (MSE 3021) and again fully restructured and made it a more effective course. The instructional laboratories also saw an infusion of new/used equipment during this time, through the help of the External Advisory Board (EAB) and industry partners and with technology fee funding received from the Institute. The training and management of graduate teaching assistants (GTAs) and paid undergraduate TAs assigned to the laboratories have improved student learning. GTAs attend a CTL training course before joining the laboratories and instructors have provided more training on the specific experiments that students perform in the laboratory experiments. Additionally, the lab sections are now divided into additional smaller groups, ensuring increased opportunities for hands-on participation by students. In addition to these targeted areas of improvement, the facilities in the MSE make-and-measure space, the MILL, are also used. As shown in the table below, student course opinion surveys rated the newly designed laboratory courses as substantially improved in several dimensions during the course of just one year. Students also favorably mentioned the improvement in the laboratory courses during exit interviews.
Course Instructor Opinion (CIOS) Survey, 1-5 Point Scale showing improvements in MSE 4022 in FALL 2017 and FALL 2018, and MSE 3021 in SPRING 2018 and SPRING 2019.

<table>
<thead>
<tr>
<th>CIOS Question</th>
<th>MSE 4022 Fall 2017</th>
<th>MSE 4022 Fall 2018</th>
<th>MSE 3021 Spring 2018</th>
<th>MSE 3021 Spring 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>#6 – Course: Amount learned</td>
<td>3</td>
<td>4</td>
<td>2.6</td>
<td>4.1</td>
</tr>
<tr>
<td>#7 – Course: Assignments facilitated learning</td>
<td>3.3</td>
<td>4.5</td>
<td>2.5</td>
<td>4.2</td>
</tr>
<tr>
<td>#8 – Course: Assignments measured knowledge</td>
<td>3.1</td>
<td>4</td>
<td>3.2</td>
<td>4.2</td>
</tr>
<tr>
<td>#9 – Course: Overall effectiveness</td>
<td>3.3</td>
<td>4.3</td>
<td>2</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Himani Sharma’s innovations in teaching the laboratory courses and her ability to collaborate with others to implement her innovations has impacted our undergraduate and graduate students in a large way. Understanding the type of person that the Innovation and Excellence in Laboratory Instruction Award recognizes, I can think of no one more deserving of this award.

Sincerely,

Mary L. Realff, Ph.D.
Associate Chair for Undergraduate Program
School of Materials Science and Engineering
Georgia Institute of Technology
801 Ferst Drive, NW
Atlanta, GA 30332-0295
Dear CETL Awards Committee,

I am writing to express my full support for Dr. Himani Sharma for the CETL's Innovation and Excellence in Laboratory Instruction Award. Over the past four years, Himani has transformed the materials science undergraduate labs and greatly improved the student’s learning experience. I can attest to this dramatic improvement from a very unique perspective; I took the courses myself years ago, was a teaching assistant before Himani took over, and have continued to teach under Himani as the head TA of the ceramics section of MSE 4022.

I graduated with my Bachelor’s from GT in MSE in 2016, having taken all three undergraduate lab courses myself (MSE 2021, 3021, and 4022). During my exit interview, I expressed my displeasure with the laboratory courses, as they were at times disorganized and haphazardly run. Students spent a lot of time waiting or watching, as opposed to working themselves. Dr. Fred Cook said that was a reoccurring theme the administration had been hearing. In the fall of 2017, I started my graduate career at Tech and was recruited to TA the ceramics section of MSE 4022 under the direction of the previous professor. Quite frankly, I was surprised by the lack of organization on the instruction side of the course. There was no master guide or professor assistance. The TAs ran a lot of the course alone. This was not something I expected to see at a top tier university, but it aligned with my experience of the course as a student. All of this is to say that the courses were not in good shape and needed a lot of time and effort to improve the quality.

Everything changed when Himani became the instructor of the courses. It was immediately clear that Himani was very passionate about teaching and was going to put in the work to transform the course. She began assembling a team of TAs who had experience with the course material and shared her desire to improve the quality. We then spent hours discussing what the course needed and how we would make those changes. This is when Himani’s organization set up the foundation for success. She delegated tasks to the different teams but remained deeply involved in the details of each team. Over the course of a summer, Himani orchestrated meetings to redesign the course to maximize student involvement, while becoming intimately familiar with the details of the lab. She acquired new equipment to give students more time working with the tools. Himani also recorded equipment introduction videos for viewing before lab to maximize the time the students worked with the equipment. For the ceramics course, we ran experiments to optimize the viscosity of our slip so that the students would have more repeatable results. We also complied the entire ceramics section into a single lab manual, containing background information, experimental procedures, discussion questions, and course logistics. The lab manual greatly helped students stay organized, understand the overall theme, and ultimately perform well in the lab.

The results of Himani’s hard work were immediately clear during the first semester running the lab. The students greatly appreciated the improved quality of the course. This was especially clear with the students in the first semester of MSE 4022 who previously took MSE 3021 before Himani took over. One student commented, “Wow it was so awesome to be actively working with my hands the whole lab.” The labs ran so much smoother too. Since everything was well prepared and the students had their lab manual to follow, Himani and the TAs were able to engage in deeper discussion with the students, as opposed to mere procedural instruction. The quality of the lab reports has also risen, as more students now gain a better understanding of the fundamental science and have more resources to prepare a superior report.

In my four years as a TA, Himani has transformed the undergraduate labs, providing a better learning experience for the students. I am very proud of the work we have done and can confidently say it would not
have been possible without Himani. Himani has continuously proved her dedication to the students and the lab courses. Thus, I believe she is deserving of this award as recognition of her accomplishments.

Best,

Nicholas Kane

Graduate Research Assistant
Georgia Institute of Technology
To the Selection Committee:

I am writing to you to express my enthusiastic support for Dr. Himani Sharma for the Innovation and Excellence in Laboratory Instruction Award. I am a PhD student in the School of Materials Science and Engineering at Georgia Tech, and I have been a working as a teaching assistant (TA) for Dr. Sharma over the last three years. I was a TA for the ceramics portion of the Materials Processing Lab (MSE 4022) during the fall semesters of 2018, 2019 and 2020, and I was a TA for the electrical properties portion of the Materials Characterization Lab (MSE 3021) during the spring semester of 2019.

From the beginning, as soon as I started working with Dr. Sharma, I could immediately tell how passionate she was about creating the best possible learning environment for everyone in the course. Not only did she put an enormous amount of effort in to revamp the lab courses to make them more interactive and meaningful, but she also did her best to come in during the lab sections (that are typically only run by the TA’s) to interact with the students. I remember seeing her stop by each lab group to talk to the students about the experiment they were working on, answering all of their questions, connecting the lab experiment with what they discussed in lectures to reinforce the topics, and truly making an effort to connect with each student and listen to what they had to say.

As I mentioned earlier, Dr. Sharma devoted a significant amount of time to revamp the MSE lab courses, which were initially not known to be very effective courses, especially due to the lack of hands-on experimental work. As soon as Dr. Sharma got involved, she was excited to figure how we could improve the lab courses and she was ready to do whatever it took to make the lab courses more effective and meaningful for the students. Dr. Sharma made the extra effort to proactively reach out to graduate students studying relevant fields to find TA’s who would be a good fit for the labs, and then made sure we were all trained sufficiently to lead our lab section. And she worked very closely with us during the course as well as in the time leading up to it, scheduling meetings for the TA’s to see the lab space, test the experiments, and go through all the necessary details before the start of the semester. And Dr. Sharma worked with the TA’s to redesign the experiment procedures to make sure the students would be able to actively participate in every part of the lab. She really focused on making sure that each part of the lab would allow the students to learn topics that were directly relevant to the learning objectives of the course.

Another thing that really stood out to me was how devoted Dr. Sharma was to getting feedback. She went through great lengths to encourage the students to submit feedback on the course, at multiple times throughout the semester, genuinely hoping to find new ways to further improve the courses. And I know that she actually read through everything they would submit because the following year when I assisted with the same course again, she mentioned all the comments that students had about ways we could improve. And she would also check in with the TA’s periodically after our lab sections to ask our thoughts about how it went and what we could change to make things better.

In addition to the exceptional work that I have seen Dr. Sharma invest in the sections with which I have assisted, I know there is so much more she has done that I have not seen directly. And she has done this
all while, at the same time, encouraging and fostering a positive and comfortable learning environment. Dr. Sharma is easy to talk to about school, work, or even personal topics, and I can see that she genuinely cares about the students and the teaching assistants and their well-being. Especially over this past year, I saw how she gracefully handled all the challenges that arose from COVID in a very responsible, caring, and understanding way, for both the students and the TA’s. It has been a joy to work with Dr. Sharma over the past few years, and I cannot think of anyone more deserving of this award!

Sincerely,

Amy Brummer
Graduate Student
School of Materials Science and Engineering
Georgia Institute of Technology
February 24, 2021

To the Selection Committee:

It is my absolute pleasure to recommend Dr. Himani Sharma for the Innovation and Excellence in Laboratory Instruction Award. I first met Himani as an undergraduate student in Materials Laboratory II (MSE 4022), a course which she had just redesigned. I then had the opportunity to help her redesign the Materials Laboratory I (MSE 3021) course and serve as her undergraduate teaching assistant (TA). Throughout my experiences working with Himani, I have found her to be an exceptionally effective instructor—and a great mentor—with a passion for making the laboratory experience both educationally valuable and enjoyable for her students.

Prior to Himani’s arrival, the MSE laboratory courses were widely considered by students to be subpar. I can attest to this firsthand, having taken MSE 3021 the semester prior. The lab materials were written years prior by a professor who was no longer teaching the course, the curriculum did not feel cohesive, and there was a clear lack of coordination and preparation from the professor and TAs. Perhaps worst of all, students were more spectators than participants in the laboratory sessions. I left the course feeling that I had gained no practical skills for a career in materials science and engineering.

I entered MSE 4022 expecting a similar experience, but I could not have been more wrong. From the first day of the course, Himani was openly enthusiastic about teaching the course and making sure it was better than it had been in the past. She and the TAs had restructured the course from the ground up, and the differences were notable. Each section of the course felt like a cohesive unit that tied together materials science concepts in an intuitive manner, and the laboratory manuals were both thorough and clear. The laboratory sessions were well-run, and it was clear that the TAs had all prepared for the experiments. During the experiments, Himani would walk around, getting to know the students and making sure we understood what we were doing. Most importantly, Himani put an emphasis on giving every student a hands-on experience in the laboratory. To accomplish this, she divided the class into small groups, each of which would come in separately for a focused laboratory session that allowed each student to participate. She also replaced our final laboratory report with a poster that we would present at a simulated poster session, which proved to be helpful practice for a conference I would attend the next year. By the end of the course, I felt confident in adding several new laboratory skills to my resume. Simply put, my experience was the polar opposite of my experience in MSE 3021, and it was undoubtedly due to Himani’s excellent work in restructuring the course.

As a result of overwhelmingly positive student feedback, the MSE administration asked Himani to pursue a similar course rework with MSE 3021 the following semester. Himani approached me to discuss my experiences with MSE 3021, and we had an excellent conversation in which we identified the most significant problems with the course and began thinking of potential solutions. Himani asked me to be an undergraduate TA for the course, a position which I was excited to accept after seeing what she had done with MSE 4022. Shortly afterward, Himani gathered a group of undergraduate and graduate TAs and held a series of meetings in which
we restructured and fully planned out the upcoming course. Many of the innovations were ones that had proven successful during Himani’s first year running the MSE 4022 course. For example, Himani decided to divide the TAs between the three sections of the course. This allowed the TAs to fully concentrate on preparing for their specific section without feeling overworked. Additionally, she once again divided the laboratory into many small groups rather than holding overcrowded, non-interactive laboratory sessions that could be mistaken for lectures. Himani also incorporated new features based on student feedback. A notable example was the inclusion of detailed rubrics for laboratory reports after students complained of vague requirements and inconsistent grading in previous years of MSE 3021.

Once the redesigned course began, my experience working as Himani’s TA was more enjoyable and rewarding than I could have hoped. In the month prior to the start of my section of the course, Himani worked closely with the other TAs and me to train us and perform “dry runs” of each experiment. This preparation ensured that all the TAs knew how to fully explain and perform each experiment. It also meant that we could gather reference data sets which we could use as a baseline for evaluating student data or as backup in case any students were unable to obtain usable data. As a bonus, it gave the TAs a chance to bond with each other and with Himani, which fostered a great work culture. During the laboratory sessions with students, Himani made sure the TAs felt supported while giving us full control over the laboratory environment. When it came time to grade the students’ reports, Himani divided up the grading in a way that maximized grading efficiency and minimized the TA workload. Overall, I could not have been happier with the way Himani had run the course, and the feedback I received from students universally echoed that sentiment.

In the time I have known Himani, I have watched her have an exceedingly positive influence on the MSE department and everyone who has had the pleasure of working with her and learning from her. She is enthusiastic about giving students a hands-on laboratory experience that teaches them valuable scientific skills, and she is both ambitious and highly successful in her attempts to do so. I can think of no person more deserving of an award recognizing excellence in laboratory instruction.

Sincerely,

Jonathan Yaeger
Dear Selection Committee,

I am a second-degree-seeking transfer student from Emory, currently finishing up my B.S. in Materials Science and Engineering at Georgia Tech. I have now completed all of the major MSE requirements, and none of those courses have been as valuable to my internships and undergraduate lab experience as Materials Laboratory I & II. As an older undergrad I have been exposed to a wide variety of teachers, classes, and instruction styles, which affords me a unique perspective on this subject; one thing I can say for sure is that Dr. Sharma’s passion for enriching her students learning experience makes her a rare and invaluable asset to the MSE department. Not only is Dr. Sharma beloved by students for her earnest and charismatic dedication to her subject (it probably won’t surprise you to learn that she is many students’ favorite teacher) but her open, honest communication style encourages feedback to improve the labs and ensure her students are getting the most out of these courses.

On a personal note, I have found the two lab courses complement other courses in the MSE curriculum, and I have benefited from taking some of those courses concurrently. Dr. Sharma is expressly interested in aligning her courses with others in the curriculum to better integrate the overall learning experience. I have also found both lab courses to be useful in building my confidence operating lab equipment and learning basic lab techniques, which has translated to experiences ranging from undergraduate research at Georgia Tech, to internships in various engineering fields. In fact, when I was interviewed for my NASA internship, I was asked at length about my course curriculum and lab experience. The internship involved working in a clean room and operating expensive equipment on a regular basis with little post-training supervision. I believe my supervisor selected me for the position as a result of my confidence when describing my understanding of the characterization tools I was familiar with from Dr. Sharma’s course, as well as my familiarity with lab safety and procedures.

It goes without saying that this past semester was difficult for students and faculty alike in the wake of the COVID-19 pandemic. Rather than simply continuing the course plan to the best of her ability (as many professors did, and which is admirable enough, given the circumstances), Dr. Sharma actually turned challenging circumstances into an opportunity to make her course even better. Since it was impossible for students to use the lab equipment once campus was closed, Dr. Sharma and her TAs made videos to explain equipment operation and the underlying scientific principles behind how they work, and collected data for us to analyze. These videos were supplemented with online lectures and several virtual office hours scheduled to aid in our completion of the accompanying assignments. This is just one example of who Dr. Sharma is as an educator and a leader in her tireless dedication to her students’ learning outcomes.

In summary, Dr. Sharma is an exceptional steward of Georgia Tech’s mission to instill students with not only fundamental engineering knowledge but valuable hands-on experience that can be applied to real-world problems, and I can think of no one more deserving of this award.

Sincerely,

Rachel Borrelli (Class of 2020)
To Whom It May Concern:

I am writing this letter in support of Dr. Sharma’s application for the GT-CETL Innovation and Excellence in Laboratory Instruction Award. As a Materials Science and Engineering undergraduate student, I took Materials Laboratory I and II with Dr. Sharma during the first semesters she taught the courses. Dr. Sharma’s teaching style exemplifies her priority for both student engagement in the laboratory setting and comprehension of fundamental materials science concepts. She is an excellent representation of Georgia Tech’s MSE department and well deserving of this award.

Dr. Sharma has done an outstanding job of revamping what I would consider two highly important classes in preparing students for the materials science industry and research. After the first lab course on material characterization, I felt competent not only in conducting mechanical testing and using thermal characterization equipment but also in explaining the concepts behind these tools. When I was interning for a manufacturer in the polymer industry, I was able to instruct the Quality Control department on how to calculate the degree of crystallinity from DSC curves. Since Dr. Sharma emphasized a hands-on approach to the course, I was confident in applying my knowledge in a real-world setting.

I could tell that Dr. Sharma implemented changes based on student feedback when organizing the second course. This was the most interactive course I have taken in MSE, and I hope that other lab courses follow this example in the future. Dr. Sharma designed the course so that we could see each experiment from start to finish, so I was able to observe the importance of our pre-lab calculations and reflect on how small variations in our processing technique changed our results. She frequently attended my lab section and engaged us in discussions on further applications and implications of the experiments.

Dr. Sharma has designed these lab courses to emphasize both depth of knowledge and breadth of technical skill. As a result of taking these courses, I have increased my proficiency in writing technical documents and analyzing data. Writing lengthy lab reports encouraged me to improve my note taking technique during labs. Discussing the results helped me identify areas my group and I could have been more precise in during the lab and understand potential consequences if this had been implemented in a real world setting. Dr. Sharma’s expectations for the reports required me to comprehend how my data related to the material properties and solidified my conceptual understanding.

I think of Dr. Sharma not only as a skilled professor but also a mentor. I was surprised that she knew everyone’s names early in the course; I cannot say that many of my other professors have taken the effort to do so. Whenever I run into Dr. Sharma on campus, I can tell that she is genuinely interested in how I am doing when she asks about my career and post-graduation plans. Dr. Sharma’s actions speak for themselves. I can think of no one more deserving of the Innovation and Excellence in Laboratory Instruction Award than Dr. Sharma.

Sincerely,

Samantha Hestad
February 13, 2021

To the Laboratory Award Selection Committee,

I received my BS in Materials Science and Engineering (MSE) in December 2020 and I am just starting my career as a Process Engineer for Texas Instruments. During the Summer of 2018, I had the pleasure of meeting Dr. Himani Sharma while I was completing a fellowship at the Materials Innovation and Learning Laboratory (MILL), the Make-and-Measure space of the school of MSE. From my first interaction with Dr. Sharma, she showed a deep passion for maximizing student outcomes through hands-on learning. Our shared passion for applied learning immediately made us collaborators to incorporate the MILL into her courses.

During my first meeting with Dr. Sharma, she expressed an interest to incorporate the MILL into her revitalization of the Materials Laboratory courses as an opportunity to expand hands-on opportunities for students. This would provide not only learning opportunities to students in the Materials Laboratory course, but also a valuable teaching experience for students staffing the MILL. The result was an extra-credit week where students in the Materials Laboratory course could get trained on a piece of equipment in the MILL by a student staffer. The skills the students learned during these training sessions could be directly transferred to their Senior Design coursework in the upcoming semester. Dr. Sharma showed an outstanding interest in collaboration to improve the learning outcomes of the laboratory courses by utilizing all of the recourses available within our school.

As a student in the Materials Laboratory courses, I saw firsthand how Dr. Sharma dramatically improved the ability for students to directly engage with experiments. Instead of having large groups of students watch a TA perform an experiment, the labs were split into smaller subgroups, allowing small teams of students to complete the experiments. One such example was the Ceramics Processing Laboratory. The procedure to complete the Ceramics Processing Laboratory was specifically designed to be relatively straightforward to complete for a well-functioning group of 4 students. In this laboratory, we were focused not only on the fundamental science of slip-casting porcelain ceramics, but also how to collaborate with a small team of our peers to most effectively complete an unfamiliar experiment. Dr. Sharma’s courses consistently demanded the application of multiple skillsets required to be a successful engineer.

Dr. Sharma’s innovative focus on collaboration throughout the department and small team settings provided me with learning experiences that will long be valuable to my career. Dr. Himani Sharma has my utmost recommendation to receive this award.

Sincerely,

Thomas Miller