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# Teaching Mechanical Properties of Materials through Crochet

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# Teaching Mechanical Properties of Materials Through Crochet


Abstract

The growth of the maker movement has led to a 14-fold increase in the number of makerspaces worldwide over the past decade [1], yet many institutions struggle to retain a gender-diverse user base of these facilities [2]. Gendered ideas persist about who belongs in a makerspace, with masculine-stereotyped environments setting a less-than-inclusive tone [3]. Yet women are the predominant practitioners of fiber arts [4], one of humanity's original engineering skills that dates back to the Neolithic time period [5]. This work aims to challenge students' preconceived notions of which skills belong in a maker space by introducing mechanical properties of materials through crochet, a fiber art that has exploded in popularity since the COVID-19 pandemic.

We present a laboratory experiment for an Introduction to Materials Science and Engineering (MSE) course for non-MSE majors in which students 1) learn basic crochet stitches to fabricate samples for tensile testing and 2) perform tensile testing on their samples to determine how the mechanical properties of un-crocheted strands of yarn differ from the crocheted yarn. Throughout this experiment, students will learn how to create and analyze a stress-strain curve, and identify Young's Modulus, yield strength, and tensile strength of materials. The session culminates in a historical and cultural perspective on fiber arts as an engineering practice. Students will also become familiar with the relevance of the skills learned in this experiment to the textile industry.

We implement a pre- and post-lab student survey to understand whether students' attitudes towards fiber arts as an engineering skill evolve after completing the lab. We believe this work will have implications for creating more inclusive makerspaces and curricula that value all types of engineering skills. This work could also be implemented as STEAM outreach to engage middle or high school students in Materials Science and Engineering through art.


## Introduction

From the first artifact thought to be a needle found in Sibudu Cave in South Africa [6], to modern-day smart fabrics that can detect and respond to the motion of the user [7], textiles have told stories throughout history at the intersection of culture, art, and engineering. Today, the textile market represents 2% of the global GDP [8], and textile engineering has applications in aerospace, biomedical engineering, construction, electronics, and nanotechnology, to name a few industries. However, unlike techniques such as metal casting or plastics processing, students in Materials Science and Engineering (MSE) programs are not often introduced to the production of textiles in their introductory lab courses.

Given the explosion in popularity of the fiber arts that's taken place since the COVID-19 pandemic (at time of writing, 59.5 million posts are tagged on Instagram with the crochet hashtag, and crochet videos on Tiktok have received 52 million views), we identified an opportunity not only to educate MSE students about textiles, but to increase student interest in MSE by bringing textiles into the curriculum via the fiber arts.

The fiber arts include knitting, crochet, weaving, needlework, quilting, felting, and embroidery – any art form that uses textiles, fibers, or fabrics. The term was coined post-World War II to describe the work of (mostly female) artists who used fibers and textiles as their medium [9]. Because the fiber arts have often not been given the same recognition as other fine art forms [10], it is important to state that in an art context, the term fiber arts often refers to fine art created "where the resulting work is valued for aesthetic and artistic expression over utility" [11]. For the purposes of this paper, we will consider the fiber arts to include art forms using textiles, fibers, or fabrics to create items of decorative or practical use. This definition aligns with the type of products created by the online community known as the fiber arts community.

To bring fiber arts into the MSE curriculum, our aim was to focus on a technique that results in the production of textiles from yarn, which would allow us to explore how the technique influences the properties of the yarn. We chose to focus on crochet for this work because it is widely considered to be easier to learn than knitting.

The introduction of crochet into an engineering lab also holds implications for the inclusivity of the space. Makerspaces often struggle to retain students who belong to racial or gender groups historically underrepresented in STEM [2]. Engineering spaces, including makerspaces, tend to be masculine-stereotyped due to the over-representation of male users, the physical decoration of the space, and the type of equipment often present [3]. A 2020 study by Marijel Melo found that students predominantly associated 3D printing tools, laser cutters, and hand tools with male makerspace users as opposed to female or non-binary users, while sewing machines and other textiles equipment were associated with female users [12]. The makerspace studied in Schauer, Schaufel, and Fu's 2023 work experienced an increase in female users after the introduction of equipment that is more typically associated with "crafting" such as sewing machines, button makers, and vinyl cutters [3]. Based on the historical gendering of crafting and fiber arts as "female," we asked ourselves: by using crochet to study mechanical properties of materials, can we flip the script on typical gender stereotypes that exist in an engineering course? Would students come away with an updated understanding of fiber arts as a form of engineering? Could positioning fiber arts in the context of engineering send the message that skills that women have been developing for millennia are just as much of an asset to an engineering skillset as 3D printing and the use of hand tools?

In this paper, we present a lesson plan that can be used to introduce mechanical properties of materials through crochet in a 2-hour lab session for an introductory MSE course. We piloted this lesson plan with a group of undergraduate and graduate students, and we suggest ways to modify the content for more experienced MSE students. We surveyed students on their preconceived notions of what maker skills are, before introducing students to crochet and having them fabricate and test their own crocheted samples. We administered a post-lab survey to elucidate how students' attitudes towards crochet and the fiber arts may or may not have shifted as a result of participating in the lesson. With our small group of 9 participants, we cannot draw conclusions about the students' attitudes on this activity based on gender, but we can share lessons learned on student perceptions of the activity, which could be useful for instructors interested in expanding their engineering curriculum to include skills less traditionally associated with engineering.

## Methods

This work involved developing the experiment and carrying out the lesson, as well as recruiting and surveying of participants. Here, we discuss each of these components of our methods in a separate sub-section.

### *Participant recruitment and data collection*

This study was conducted at Stevens Institute of Technology, in the form of a 2-hour stand-alone laboratory session facilitated by the authors of this paper. Participants were recruited for this study through announcements to graduate and undergraduate engineering student email lists. The email announcement indicated that the study was related to mechanical properties of materials, but did not mention crochet or fiber arts. Students were incentivized to participate via the promise of coffee and donuts before the activity. The broad call for volunteers led to a group of participants with a wide range of backgrounds, from undergraduate students who had not yet been exposed to mechanical properties of materials in their coursework, to graduate students who had served as Teaching Assistants for lab courses on mechanical behavior of materials. Table 1 shows the demographics of the students who participated in the study.

Table 1: Demographics of participants.

| | | Number of participants |
|---|---|---|
| Program | Undergraduate | 3 |
| | Masters | 3 |
| | PhD | 3 |
| Gender | Non-binary | 2 |
| | Female | 3 |
| | Male | 3 |
| | Did not respond | 1 |

Participants were asked to fill out a pre-lab survey prior to starting the session, and a post-lab survey upon completion of the session (Table 2). Participants generated an anonymous, unique identifying code that linked their pre- and post- survey data. Eight participants completed the pre-lab survey, and all 9 participants completed the post-lab survey. In this paper, we have assigned a number to each participant for ease of reference.

Table 2: Pre-lab and post-lab survey questions.

| **Pre-lab Survey Questions** | **Post-lab Survey questions** |
|---|---|
| 1. What skills do you consider to be "maker" skills? Please list as many as you would like below.<br>2. Which of the following best describes your experience with maker spaces?<br>a. I have no experience with maker spaces<br>b. I got a tour or did a training on some equipment at a maker space but have not used it since then<br>c. I have used a makerspace for a course, but not on my own<br>d. I use a makerspace on my own a couple of times a semester<br>e. I use a makerspace on my own on a regular basis<br>3. Please describe your past experience with crochet and knitting. For example, do you know how to crochet and knit? Did you learn a long time ago? Do you crochet or knit often?<br>4. What is your gender identity? | 1. How did this activity impact your perception of the fiber arts as "maker" skills or "engineering" skills?<br>2. Please describe your experience making the crocheted samples.<br>3. What did you like best about the activity?<br>4. Was there anything about this activity that could be improved? |

*Lesson Plan*

The 2-hour laboratory session began with a discussion of mechanical behavior of materials, followed by a crochet lesson and sample fabrication. Once the samples had been prepared, the participants were split into two groups with one tensile tester available to each group. With the help of a facilitator, participants tested two types of samples: single strands of yarn that had not been crocheted, and crocheted samples that consisted of a single row of stitches (Figure 1). Next, we analyzed the results as a group and ended with a discussion of the historical context of fiber arts and its relevance to MSE. Table 3 provides details on the components of the lesson and the approximate time spent on each.

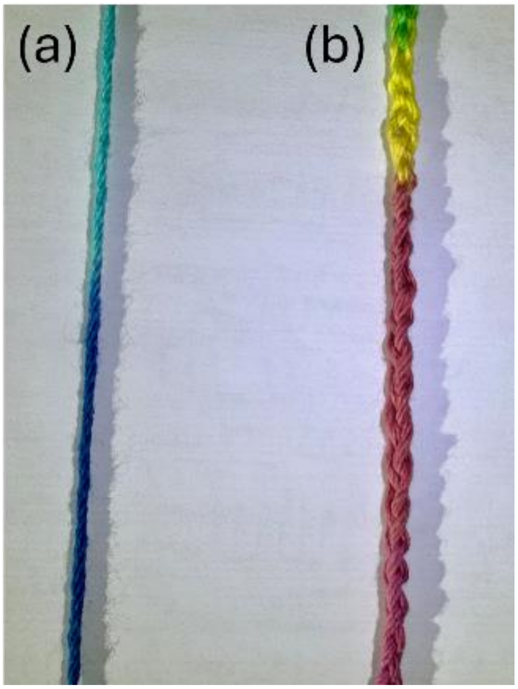


Figure 1: Photo of (a) un-crocheted and (b) crocheted samples.

Table 3: Lesson plan details

| Activity | Duration | Description |
|---|---|---|
| Pre-lab survey | 5 min | See Table 2 |
| Intro to mechanical behavior of materials | 20 min | Opened with two broad questions for discussion: 1) Why are we interested in determining the mechanical properties of materials? 2) How would you go about measuring the mechanical properties of a material?<br>We converged on responses to these two questions as a group. Facilitators showed a video of tensile testing of metals, and participants discussed the type of data that is collected in a tensile test. Facilitators explained how a stress-strain curve is generated based on load vs elongation data from the tensile test. |
| Introduction of experiment | 5 min | Facilitators explained the objective: For participants to compare the maximum tensile strength of crocheted and un-crocheted samples, and for students to learn how to crochet in order to make their own samples. Participants made predictions about the behavior of the un-crocheted vs crocheted samples. |
| Crochet lesson and sample fabrication | 30 min | Facilitators provided multiple avenues through which participants could learn crochet: schematics of each step, demonstrations, and hands-on assistance. Facilitators provided |

| | | |
|---|---|---|
| | | feedback on how to hold the yarn and crochet hook, the proper tension of the yarn, and how to start and finish stitches. |
| Data collection | 25 min | Facilitators assisted each group of participants in using the tensile testers to collect force vs elongation data for both the un-crocheted and crocheted yarn. |
| Data analysis | 15 min | Force vs load data for the un-crocheted and crocheted yarn were discussed, focusing on the maximum load at failure and the shape of the plots. |
| Contextualization of crochet and fiber arts in engineering | 10 min | Facilitators transitioned the discussion from the improvements that were seen in the behavior of the yarn once it had been crocheted to how crochet relates to engineering. Facilitators presented examples of the earliest forms of textiles and discussed current engineering challenges related to the fiber arts such as the fabrication of smart textiles and the use of carbon fibers to manufacture advanced composites. |
| Post-lab survey | 5 min | See Table 2. |

*Laboratory procedure and materials*

Tensile tester: We built two in-house tensile testers that could accommodate low tension. Most commercial-grade tension testers are designed for applications requiring precise load cell readings for elongation. In contrast, the tensile tester we built was developed to address the specific needs of high elongation and low tensioning scenarios. We built a device capable of measuring tensions up to 200N with an elongation resolution of 0.01 mm, all while ensuring the system is affordable for educational purposes. This approach emphasizes accessibility and functionality for academic environments.

The measuring system incorporates a DYMH-103 load cell, a signal amplifier, and a KA-300 glass scale with TTL signal output. An ESP32 mini board processes the inputs, utilizing two digital pins for elongation signals from the glass scale and one analog pin for tension signals from the load cell. While the digital signals maintain high accuracy, the analog tension signals are subject to resolution limitations determined by the formula (maximum force × amplifier voltage) / DAQ resolution (12-bit). The resulting device achieves a step tensioning sensitivity of 0.16 N and an elongation resolution of 5 µm, meeting the project's performance goals. The data is visualized and stored through a user-friendly NodeRED UI on a Raspberry Pi, with asynchronous sampling at 100 Hz to ensure efficient data acquisition and storage.

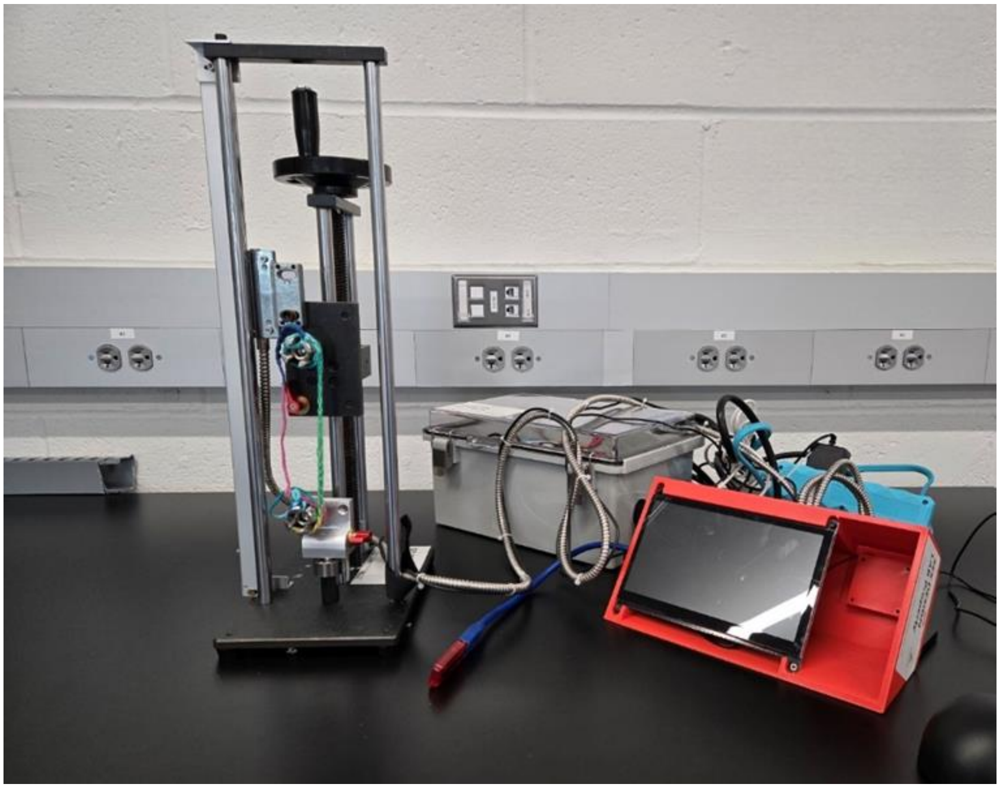

Figure 2: Tensile tester set up to test a crocheted sample.

To load the sample, the yarn was tied to the bottom of the load cell using a square knot, wrapped around the cylindrical holder at the bottom of the load cell three times, wrapped around the holder of the upper portion of the load cell three times, and then tied off with another square knot. For the crocheted samples, the entire length of the sample should be crocheted from the first knot to the last – ie the parts of the sample wrapped around the cylindrical holders should also be crocheted, as the entire sample is being pulled in tension.

Crochet materials: We used Loops and Threads 100% cotton yarn, which is a medium-weight yarn found at the craft store Michaels. Before selecting the composition and brand of yarn to use for the lesson, we tested several styles to ensure that both the crocheted and un-crocheted samples would fail at a reasonable tension that could be achieved with our equipment. We chose a bright multi-colored low-loft yarn, which is recommended for beginners as the bright colors help to differentiate stitches, and low-loft yarns are more slip-resistant while being manipulated.

Each student was provided with a 3 mm crochet hook and a pre-started crocheted sample, in which the first few stitches of the row had been completed, to facilitate the learning process.

## Data and Analysis

Here, we can analyze both the participant experience, as well as the force vs elongation data that was collected by the participants. First, we will address analysis related to the participant surveys, and next we will address the analysis of the force vs elongation plots.

### *Participant experience*

Pre-lab survey:

Table 4 displays the results of the participant survey. When asked to list "maker" skills, only Participant 2 included fiber arts techniques (knitting and crocheting). This participant indicated that maker skills include "any kind of art where there is an end product." Other participants listed instruments or techniques that are more commonly associated with engineering, such as woodworking, 3D printing, soldering, and welding. We expect that the topic of the lesson did not influence participants' responses because participants were not made aware that the activity involved fiber arts. Additionally, the question in the pre-lab survey regarding crochet experience was made visible after the question in which participants were asked to identify maker skills. Participants were likely influenced by the makerspace offerings at the university in which this study took place, which include 3D printing, soldering, welding, woodworking, and metalworking, but not access to textiles equipment. Participant 8, who indicated that he had no experience with makerspaces, provided vague ideas of what might count as maker skills, such as "creativity" and "eye for details." The participants' responses to this question align with our hypothesis that many students do not think of fiber arts when they think of maker skills or engineering.

When asking participants to identify their gender, we felt it was important for this question to be open-ended; participants' gender identities are included in Table 4 exactly as they were reported. While we cannot draw conclusions about trends based on gender, it can be noted that two out of three male students had no experience with fiber arts, and the remaining male student had little experience. The majority of female and non-binary students (both gender minorities in STEM) had at least some experience with some form of fiber arts. This limited data set follows the same trends as larger studies [13].

Post-lab survey:

When asked in the post-lab survey to describe how the activity impacted their perception of the fiber arts as "maker" skills or "engineering" skills, most participants indicated that this exercise showed them how crocheting or fiber arts fall under the umbrella of engineering. Participants 4 and 5 alluded to the idea that the investigation of structure-property relationships led to their understanding of the fiber arts as maker skills. Participant 4 stated that she had "always been focused more on the aesthetics of crochet more than how it can impact the material properties of a fabric." Participant 5 considered how crocheting "manipulates the properties of materials," leading her to categorize it as an engineering skill. Structure-property relationships are central to the study of MSE, so it is promising that students who have learned crochet in an engineering context recognize it as a tool to engineer materials properties by manipulating their structure. Of the participants who had previous experience with crochet, all of them indicated that this exercise led them to think of crochet or other fiber arts skills as engineering. A follow-up to this study could investigate whether viewing fiber arts as engineering skills promotes a greater sense of belonging in engineering for students experienced in the fiber arts.

When describing their experience crocheting the samples, many participants included language that implied that they practiced resilience or growth mindset throughout the lab. Participant 4, who had no prior experience with crochet, stated:

> "I had a lot of fun and I think I found a new hobby! At first, it was tough to get the hang of and I didn't find the diagram on the slides particularly helpful. But once other people showed me how to do it and I tried it on my own a few times, I really got the hang of it. I sort of got into a rhythm and I really had fun."

Participant 7, who also had no prior crochet experience, found the experience "challenging, but interesting once I got [the] hang of it. It is an amazing innovative re-engineering technique." While Participants 4 and 7 acknowledged that learning to crochet came as a challenge, they both indicated that they improved over time. Participants 8 and 9 also alluded to the theme of resilience. Participant 8 stated "It showed me that more practice will make me better," and Participant 9 summarized their experience by saying "First time [I] did this, will get better in future." It is noteworthy that all three participants who had no prior experience with crochet discussed being able to practice and improve. In the intro to MSE lab that is taught at this university, most of the experiments do not provide sufficient materials for groups to prepare samples multiple times if they have failed on their first try, or there is not enough time in the lab session for students to master a skill. Yarn is inexpensive, and students could remake their samples within the lab session if they were not satisfied with the outcome. Therefore, offering crochet as a sample preparation method gives students the opportunity to hone a new engineering skill. Furthermore, whereas other skills taught in a makerspace or lab courses require specialized equipment, students can continue practicing crochet at home.

The themes of community and relaxation also emerged as participants described their experience crocheting the samples. Participant 1 "enjoyed the sense of serenity and community [the activity] built by crocheting alongside other people." Participant 2 stated "When we were talking with friends and also crocheting, it was nice," and Participant 5 found crocheting to be "stress releasing." Six out of 9 participants referred to their experience crocheting the samples as "fun" or "nice." Given recent concerns about loneliness in college students – a 2024 study by ActiveMinds found that two-thirds of college students report feelings of loneliness, and that college students who report feeling lonely are four times more likely to experience severe psychological distress – it could be beneficial to incorporate mindful, collaborative activities into engineering courses [14]. Anecdotally, we noticed that as the students worked on crocheting their samples, they formed a circle. At the start of the activity, the chairs were dispersed randomly throughout the lab, so we believe that the collaborative work of helping each other learn to crochet led the participants to congregate together.

Participants' favorite aspects of the activity included conducting the tensile tests, learning to crochet, preparing the crocheted samples, and learning about the history of fiber arts. Participants indicated in the post-lab survey that increasing the number of tensile testers available and having more time to test their samples would have improved their experience.

While we seek to understand whether crochet can be implemented as an avenue towards studying the mechanical behavior of materials and how students perceive this implementation, it is important to state that we do not seek to "legitimize" crochet and other forms of fiber arts by ushering them under the umbrella of engineering, as discussed in Vossoughi, Hooper, and Escudé's 2016 article in the *Harvard Educational Review* [15]. Rather, we wish to upset the pre-existing gender-based power dynamics that are often found within an engineering course, based on who has been previously exposed to stereotypical "making" skills.

Table 4: Participant responses to selected pre- and post- lab survey questions.

| | **Pre-Lab Survey** | | | **Post-Lab Survey** |
|---|---|---|---|---|
| Participant Number | **What skills do you consider to be "maker" skills? Please list as many as you would like** | **Describe your past experience with crochet and knitting. For example, do you know how to crochet and knit? Did you learn a long time ago? Do you crochet or knit often?** | **What is your gender identity?** | **How did this activity impact your perception of the fiber arts as "maker" skills or "engineering" skills?** |
| 1 | Planning, Choosing Materials, Learning how to use tools, using tools effectively, being able to follow an instruction set | I have attempted to learn a couple of times but didn't really continue afterwards | Non-binary | It made gain a deeper understanding of how fibers and be used for engineering applications and as such how making textiles is an engineering skill. |
| 2 | Knitting, crafting, sculpting, crocheting, drawing, painting, cooking, baking; basically any kind of art where there is an end product | I've knitted using a loom many times. However, when it comes to ordinary crocheting and ordinary knitting I've only dabbled — learning the basics from friends but never learning them well enough to make anything other than a pretty awful row or two that got unwound quickly. | Non-binary (they/she) | This activity brought me a different understanding of what crocheting is and what it does — It keeps my perception of the fiber arts as a 'maker' skill very positive and interested |

| | | | | |
|---|---|---|---|---|
| 3 | Fabrication, Welding | I learnt how to crochet a while back | Female | My perception of maker space usually had to do with metal fabrication and wood work but this activity made me learn how fiber arts fits into the engineering skill set. |
| 4 | 3D printing, woodworking (like using a bandsaw), metallurgy, CAD | I have no experience with crochet and knitting. I like to watch people on TikTok make projects. | Female (she/her /hers) | Before this, I wouldn't have considered crochet to be an engineering skill. I've always seen it as an art form. My exposure to crochet has mostly been people showing off the beautiful pieces they've made. I've always been focused more on the aesthetics of crochet more than how it can impact the material properties of a fabric. |
| 5 | 3D printing, testing materials, prototyping | I used to be very good at crocheting a couple years ago but have no practiced since. I have no experience with knitting. | Female, she/her | It introduced me to the potential that crocheting, or more generally, how organization and the arts can influence more quantitative data such as force and strength. Also how simple changes like crocheting a string can be considered an engineering skill as it manipulates properties of materials. |
| 6 | I would consider being able to use hand tools a maker skill. Soldering can also be a maker skill. 3-D printing or welding also. | I've tried to crochet but never got it down. | Male | It showed the at crocheting or knitting is another maker skill. |
| 7 | AutoCAD | I didn't learn crochet and knit before. | Male | I usually underestimate the kind of effort and work that goes into this. I now kinda have a broader knowledge of the impact of this research area in everyday activities. |
| 8 | Creativity, innovative, intelligent, eye for details, | No, I would love to though because I see people around me do it all the time. | Male | This really boosted my thoughts around fiber being an engineering material. |

| | | | | |
|---|---|---|---|---|
| 9 | N/A | N/A | N/A | More think about textiles and tensile strength. |

*Materials Science of Crochet*

Figure 3 displays example data for an un-crocheted and crocheted sample. Neither sample encountered any tension until it had been elongated by about 11 cm. This value fluctuated between 10 – 15 mm for the majority of samples we tested and depended on the tension with which the sample was fixed to the load cell. One major weakness of this experimental setup is the variability in data that resulted from fixing the yarn to the load cell through knot tying. For future iterations of this work, we plan to utilize a grab test, which is more traditionally used for testing fabrics. In this type of tensile test, the fiber sample is attached to the load cell via a clamp at either end. We also encountered the issue of the yarn breaking at the attachment points to the load cell, rather than in the middle of the sample. We disregarded data for which the break did not occur in the middle of the sample.

The crocheted samples consistently exhibited a greater load at fracture than the un-crocheted samples. Participants observed that this could be due to the ability of the crocheted sample to continue to support load even after one or more of the constituent fibers breaks. For the crocheted sample in Figure 3, this appears to occur at about 15.5 mm and 18.5 mm. Once the un-crocheted sample partially fails at 19.75 mm, it was not able to sustain additional load.

Participants also noted that the shape of the force vs elongation curve depended on the strain rate, which was not a factor we controlled for in this experiment. Participants elongated the sample by manually turning a wheel on top of the tensile tester.

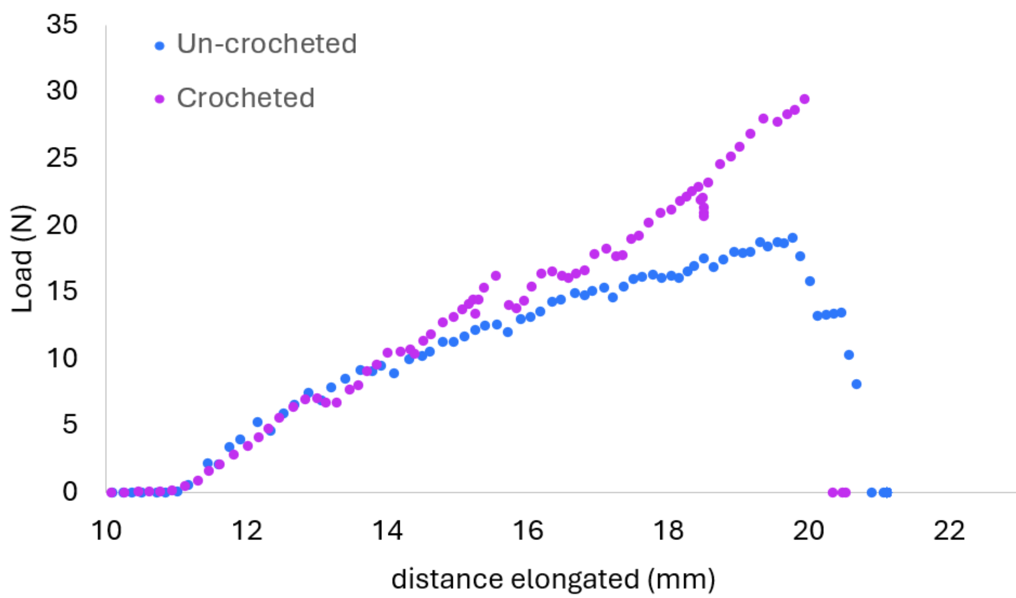


Figure 3: Force vs elongation for un-crocheted and crocheted samples.

## Conclusion

Our participants' comments strongly support that introducing crochet into a MSE lab course could a) be an effective way to introduce the concept of tensile testing, b) shape students' views on the fiber arts to potentially promote a more inclusive view of engineering, c) build community, d) create a relaxing environment, and e) promote resilience. Based on our participants' positive responses to learning to crochet and their shifting viewpoints on the fiber arts over the course of the activity, we believe that the experiment presented here has the potential to create a more inclusive environment in lab courses and makerspaces by highlighting a historically feminine way of making.

If this lesson were to be extended beyond a single 2-hour time block, or if it were to be performed with more advanced MSE students, there are a number of ways in which it could be expanded upon. In our limited time with our participants, we did not ask them to calculate the stress-strain curve from the force vs elongation data, but given more time, that would be a clear next step. In order to calculate stress and strain, students should note the length of the sample from the lower knot on the tensile tester to the upper knot. The cross-sectional area can be measured using a caliper. Given the stress-strain curve, students could calculate the Young's Modulus of the samples. A question that arose from our participants during the discussion of results was how the tensile strength of multiple un-crocheted strands of yarn would compare to the crocheted sample. Ultimately, in order to make fabric, some form of knotting is necessary, so we believe that comparing the mechanical properties of a single strand of un-crocheted yarn versus a crocheted sample still has merit. A next step in this work would be to develop a comparison between crocheted and un-crocheted samples that takes into account the density of material in the sample.

For students who are more advanced in fiber arts, or if additional time is available, the lesson could be expanded to include instruction on how to crochet multiple rows in order to create and test a 2D sample. Different types of crochet stitches could be taught, and yarn of different compositions could be tested. This lesson could also be adapted for middle or high school students who are new to engineering (but perhaps experienced in fiber arts).

## Notes from the PI

Both topics discussed in this paper, fiber arts and inclusivity in STEM, are quite personal to me, so I feel that this work would be incomplete without discussing my motivations.

I came upon the idea for this study while leading a coffee hour series in my department for students and faculty. As a new faculty member, and a prolific crafter, I brought a creative activity to each coffee hour, hoping it would help me get to know both students and faculty as we made art together. The crafts were a huge hit with the students, but the faculty? Not so much. Many of them congregated in corners, aloof, glancing at our origami or beading or balloon-animal-making with an air of condescension. (Although shout-out to the real ones who got in there with me). Their please-don't-make-me-do-this attitude frustrated me in a way I couldn't quite articulate, but that undoubtedly overlapped with gender and "status" in the department. What is the difference, really, between creating a file that directs an electron beam to write a pattern on a chip, and creating a design for a cute paper circuit greeting card? It's the same skill – drawing – but somehow, in a certain context, it becomes taboo to a certain subset of academics. The dismissive nature of community crafting seemed to me to reflect broader trends in academia of who is included, who is excluded, which skills are traditionally valued, and which skills – however applicable to engineering – are looked down upon. So while this experiment may have started out as a way to spite a handful of anti-craft colleagues, it turned into much more.

The stress-relieving benefits of crochet that our participants encountered feels almost ironic to me in the best possible way. So many people have taken pride in creating an environment in STEM that has caused others so much trauma. I know this from my personal experience and the experiences of my friends and colleagues. Wouldn't it be ironic, then, if we could teach engineering through a medium that is meditative, relaxing, and promotes community? I wanted to reject the notion that engineering has to be a place that causes harm to students by intentionally incorporating a practice that can be, in a way, healing.

Introducing crochet into an engineering course may seem like a small addition, but I believe it is a radical act. One that blurs the carefully-fabricated line between "engineering" and "art" – a line that has often been exploited for the purpose of excluding specific communities from engineering.

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