# KnoGo Final Report

Group 1033

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University of California, Berkeley

Engineering 29: Manufacturing and Design Communications

Professor Sara McMains

9 December 2022

A. **Cover page** with the name of your project, your group number, the group members' full names, and a photograph of your final assembled device.

B. **Comprehensive description** of who did what over the course of the entire project. Please start by describing who did what for all of the earlier labs where you worked on the project, labeled by lab, and then describe who has done what tasks since, including CAD, prototyping, lab 13, Jacobs showcase demo, assembly drawings, detail drawings, other portions of the final report, etc.

Emily Chin: [LAB 7] Formatted and organized the report and contributed to the concept generation. Helped brainstorm and synthesize ideas into one and identify the main components of our idea [LAB 8] Contributed to discussion about personal goals and desired team dynamics. Discussed with Meghna and Antonio about the Combined Piston toy engine components. Helped with the citations and organization of the report. [LAB 9] Discussed and helped decide methods of attachment for the main body and overall design, labeled parts of design pictures, contributed to a brief explanation of how the concept will function. [LAB 10] completed individual measurements in stage 1, 2, and 4 and the stage 6 question regarding variability of measurements. [LAB 11] Contributed to a table of inter-component grades and fit, dimensions and tolerances and helped discuss roles. [PROJECT] Edited table of inter-component grades and fit, dimensions and tolerances, contributed the reflection and differentiation questions.

Aeden Gasser-Brennan: [LAB 7] Concept design drawing [LAB 9] Added to descriptions of (1), (2), (3), (4), (5), described function of fit. [LAB 11] Completed CAD models and technical drawings of all components. [PROJECT] Responsible for all CAD models and initial assembly renderings. Printed and assembled the prototype.

Antonio Herrera: [LAB 7] Description of how we narrowed down our problem into one from three. [LAB 8] Contributed to discussion about personal goals and desired team dynamics. Discussed with Meghna and Emily about the Combined Piston toy engine components. Helped to write down descriptions of hypothesized materials and manufacturing processes in the table. Summarized team answers to (#7) in the Lab Report. [LAB 9] Added problem description, discussed implications of user demographics for our design, described fit class in fits table. [LAB 10] Individual measurements in each stage, measurements in Stage 3, (#5) In Lab Report. [LAB 11] Contributed to Table 1, organized deadlines and communications for Lab 11, discussed roles and responsibilities. [PROJECT] Designed both assembly drawings and detail drawing for clamp arm, organized logistics in terms of deliverable deadlines, alerted teammates of upcoming deadlines.

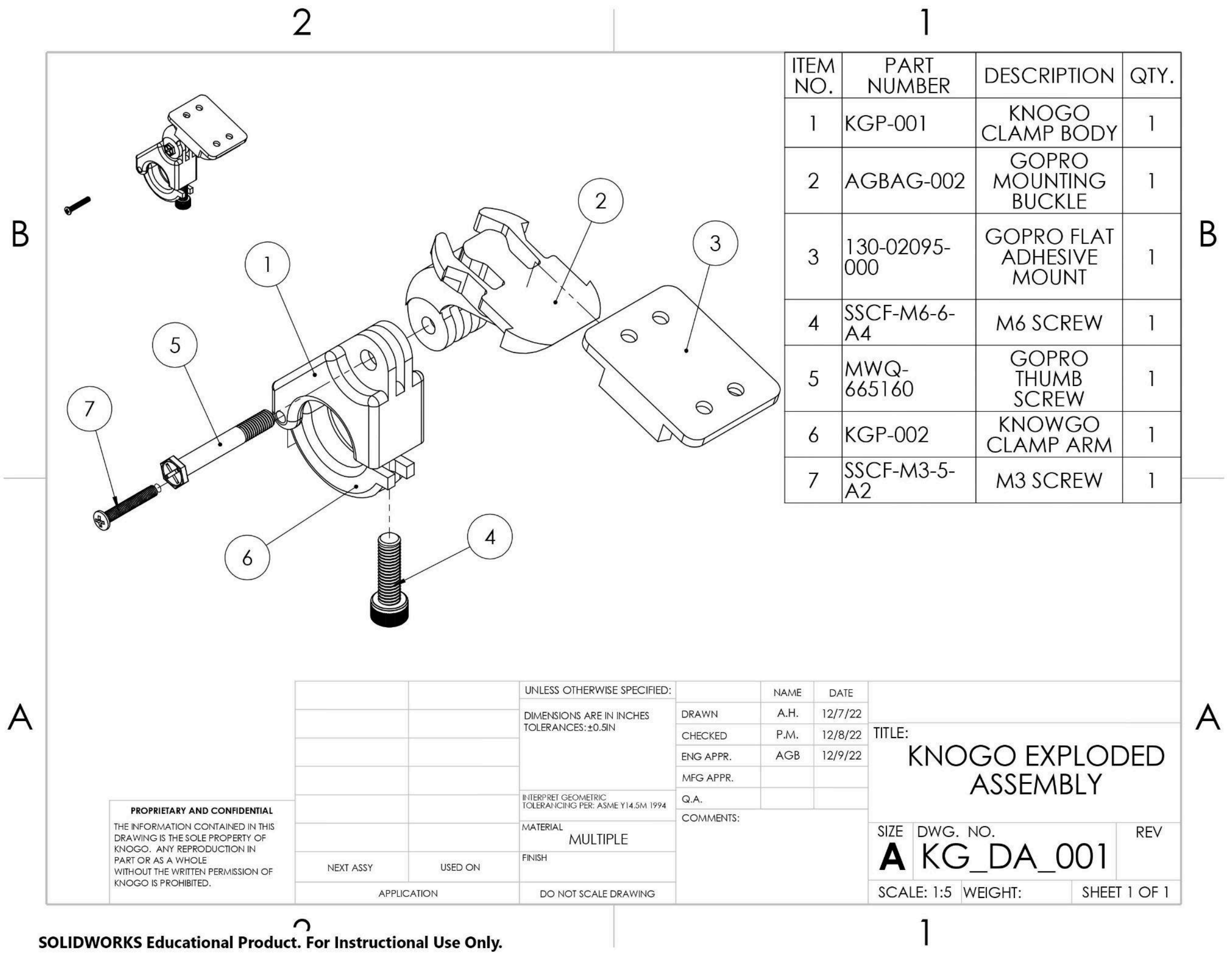
Henry Libermann: [LAB 7] Contributed to the comparison of current and past solutions of chosen problems. Also contributed to preliminary sketches and designs. [LAB 8] Contributed to discussion in relation to personal goals, desired team dynamics, and goals for the group as a whole. Held discussions about manufacturing processes with teammates Aeden and Patrick. Wrote down half of the descriptions of hypothesized materials and manufacturing processes along with their justifications in the second table. [LAB 9] Completed the description of the problem that we chose to address. Completed the description of the proposed project, and how it solves the problem. Completed the description of the additional design details that were drawn up during the concept phase. Helped determine methods of attachment for the phone. Described the function fits. [LAB 10] Completed the measurements in stages 1, 2, and 4. Answered the questions regarding the tools used to complete the measurements. Completed the additional analysis regarding variability of measurements. [LAB 11] Created the header template for all Solidworks drawings. Completed the description of the roles and responsibilities. Helped modify the design of the mounting solution. Contributed to the table containing inter-component fits, dimensions, and tolerances. [PROJECT] Aided in revisions to the design, and helped determine prototype process selection. Completed/revised the drawing for the clamp arm (arm) and completed the process selection for the prototype. Helped to present the prototype at the Jacob's Design Showcase.

Patrick Mishreky: Lab7: Description of process, concept generation and drawing. Lab8: Contributed to discussion about personal goals and desired team dynamics and goals for each team member. Discussed with Aeden and Henry the Stirling Engine (Separate Piston), analyzing details of the engine and presenting it to the class. wrote down half of the descriptions of hypothesized materials and manufacturing processes in the second table below. Lab9: Drew the initial design for the mechanism to attach to the mount, helped with the tolerance table and description of tolerances. Lab10: Helped with stage one and took measurements. Helped with calculating the tolerances and helped with the additional analysis in stage 4. Lab 11: Completed the materials choice column for the table of components and candidate materials process. Helped assign roles. PROJECT: Discussed with Aeden and Henry manufacturing process. Helped research possible solutions to the problem. Market analysis and provided user-experience as well as the scooter used to design the phone-holder. Took measurements of the scooter to help with tolerances and fits. Helped the team present at the Jacob's Design Showcase. Created the format for the final report and organized the questions. Helped test it out during the Jacob's Showcase

Meghna Sharma: [LAB 7] Contributed to concept generation discussion, completed the concept sketch, helped brainstorm and synthesize ideas into one and identify the main components of our idea. Helped narrow problem statements and identify the user base. [LAB 8] Helped establish team dynamics, worked with Antonio and Emily to decompose the stirling engine, completed the online research to make a more educated guess on materials and processes and organized them into the sheet and cited them. [LAB 9] Hand-drew the sketch of what our product should look like overall, as well as hand-sketching all views of the clamping mechanism. Redefined our user to clarify the use of our product. [LAB 10] Did one part in each step of measurement (everyone took turns doing their part). Analyzed measurements in stages 2 and 3 using the calculated standard deviation, mean, and standard error. [LAB 11] Began some preliminary CAD designs. Helped reframe our new product details after deciding to use the GoPro mount through whiteboard and brainstorming sessions. Described the change in fits due to the updated parts. Helped establish and delegate team roles. [PROJECT] Helped research solutions. Theorized our part's large-scale production model by researching optimal processes and materials and compiling and citing to our paper's sources list. Helped the team present and test at the Jacobs Design Showcase.

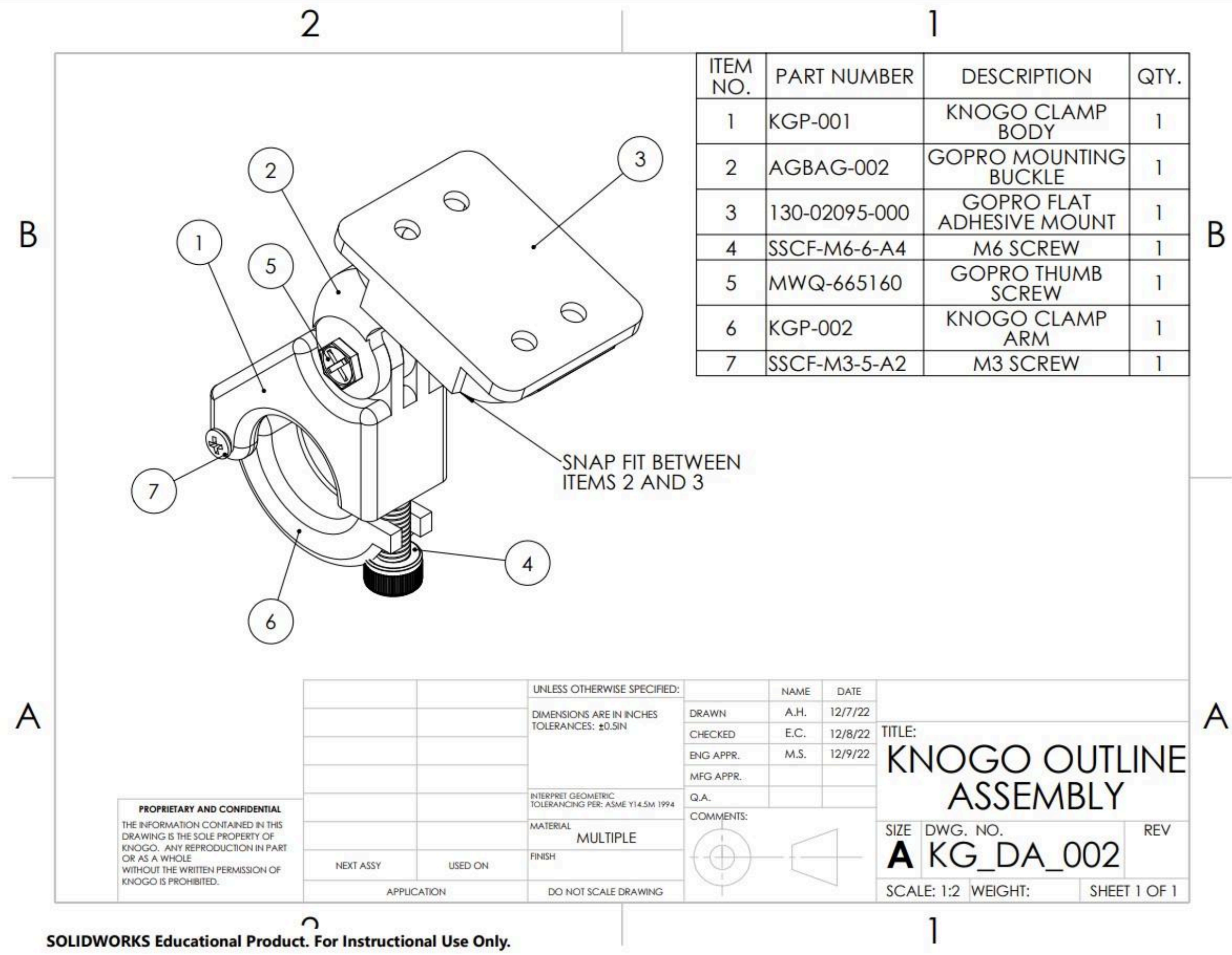
C. **Working Drawings** (in this order; use the full version of Adobe Acrobat to assemble into your pdf):

a. **Exploded Isometric Assembly Drawing(s)** Clearly showing all parts, exploded so they are visible and arranged in logical order corresponding to how they are assembled, labeled with ballooned item numbers, with route lines showing how they connect, and a collapsed isometric view in the corner. If you have a complex project, you may need to divide it into subassemblies and make separate assembly drawings for each in order to make it all legible.



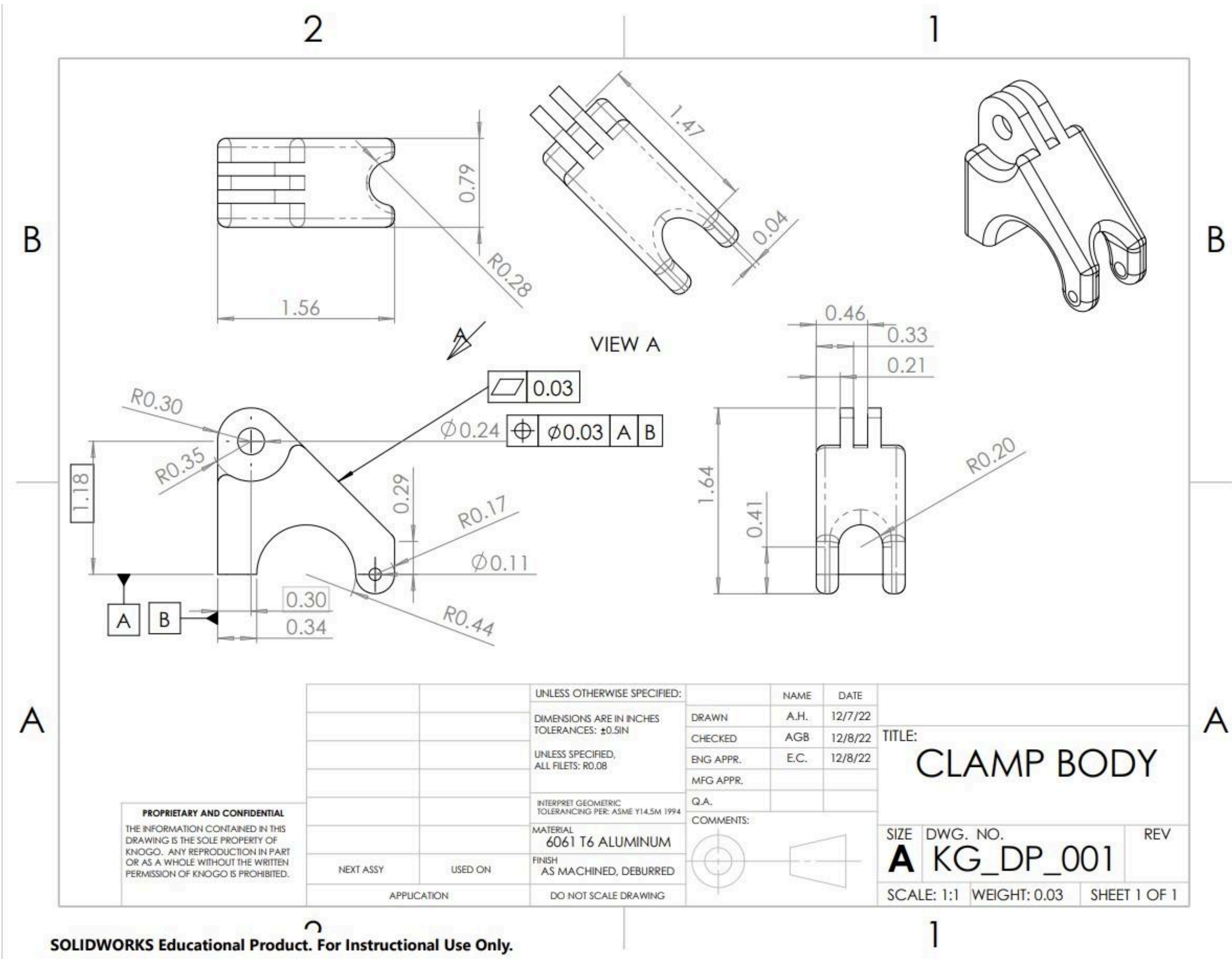

| ITEM NO. | PART NUMBER | DESCRIPTION | QTY. |
|---|---|---|---|
| 1 | KGP-001 | KNOGO CLAMP BODY | 1 |
| 2 | AGBAG-002 | GOPRO MOUNTING BUCKLE | 1 |
| 3 | 130-02095-000 | GOPRO FLAT ADHESIVE MOUNT | 1 |
| 4 | SSCF-M6-6-A4 | M6 SCREW | 1 |
| 5 | MWQ-665160 | GOPRO THUMB SCREW | 1 |
| 6 | KGP-002 | KNOWGO CLAMP ARM | 1 |
| 7 | SSCF-M3-5-A2 | M3 SCREW | 1 |

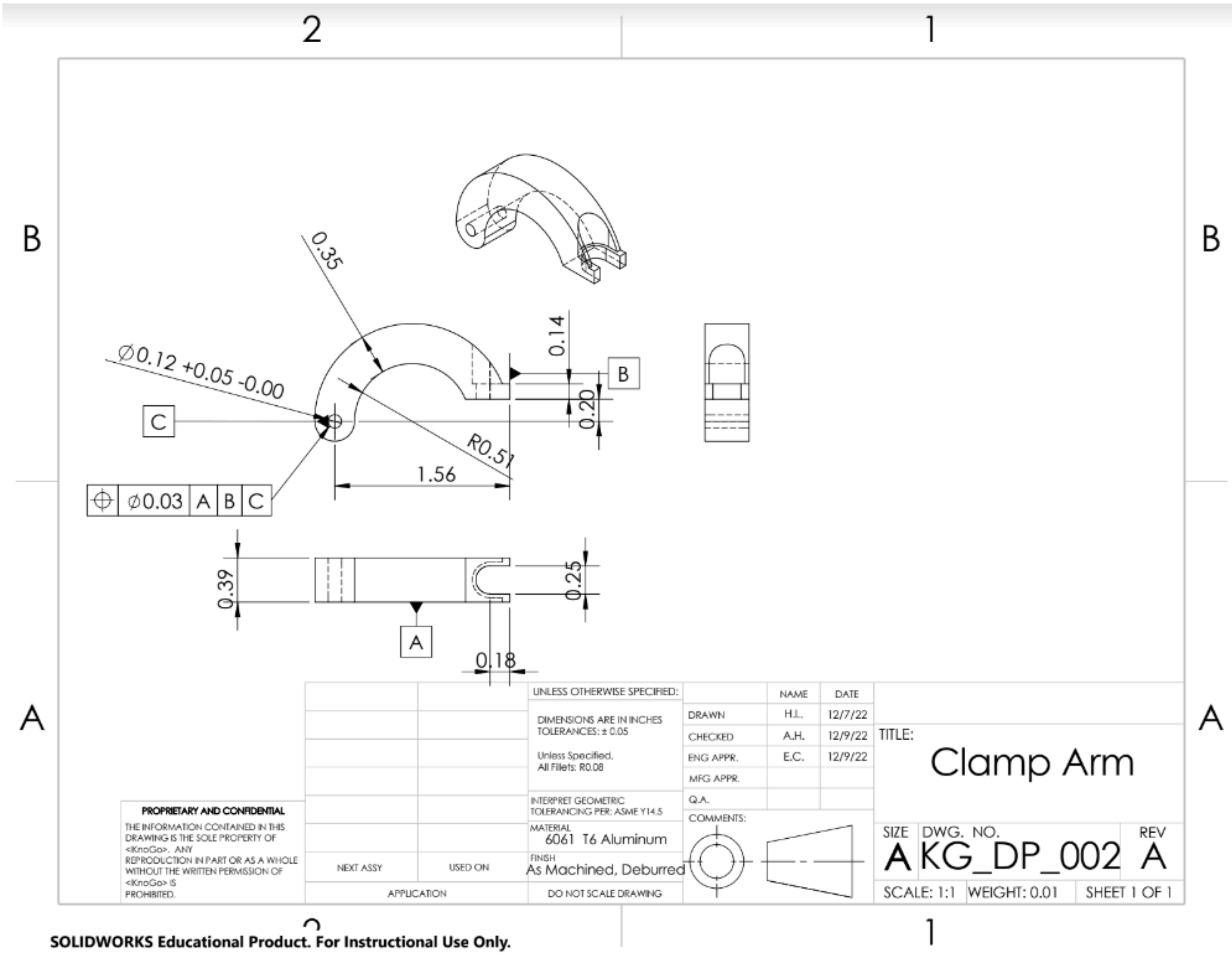
b. **Outline Assembly (Layout) Drawing(s)** 3rd angle projection, collapsed multiview with sections and enlargements if needed for clarity, and the same ballooned item numbers. Specify how any parts that are glued or welded together are fastened, using weld symbols or numbered notes that reference the corresponding surfaces on the drawings. Include any dimensions between parts that are needed to clarify assembly. Do not show dimensions of individual parts.




c. **Bill of Materials (BOM)** List all parts and materials used, including stock parts. The BOM must have columns for item number (matching ballooned item numbers in the assembly drawings), part number, part name, material, and quantity for each item. The BOM can be included on the exploded assembly if there is room, or it can be on a separate page. You may even do it in an unlinked text file if your solid modeling software isn't working out for you. If you have separate assemblies and subassemblies, group items by subassembly in the BOM, indented under the subassembly name, or produce separate BOMs for each.

d. **Detail Drawings** A third-angle projection multiview drawing for each fabricated part, with as many views as needed for clarity (see grading checklist), fully dimensioned and toleranced. Somewhere in your drawings, you must use at least 3 different GD&T symbols, at least two with datums. You do not need to use GD&T for every drawing. (For an unmodified stock part you purchase, no detailed drawing is needed.) Each part must have a unique part number and a unique descriptive part name.






D. The remainder of the report should contain the following (in this order) – revise from earlier lab reports where applicable:

a. **Market need**: Describe the problem you are solving.

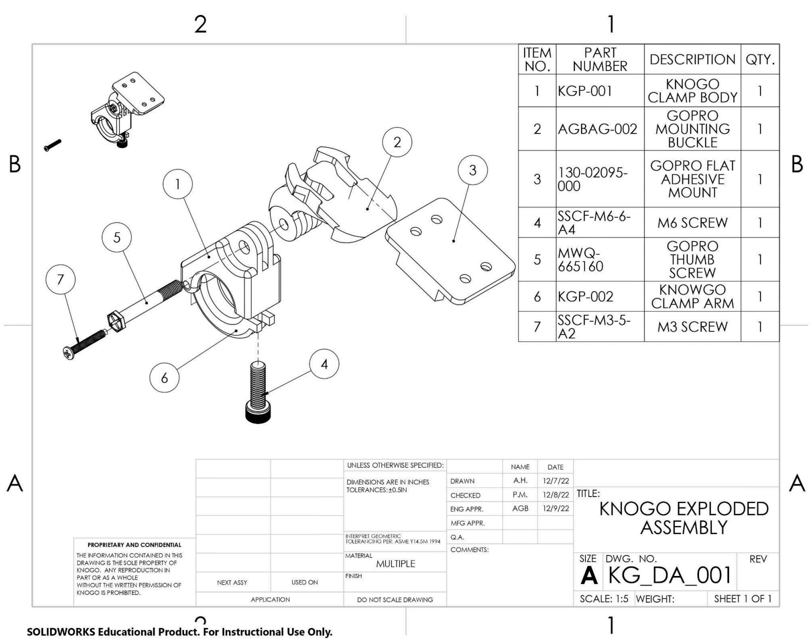
We have decided to address the issue of using your phone while riding an electric scooter. It is nearly impossible to read directions while on a scooter since it is so difficult to hold onto your phone while steering safely. We also intend to fix issues with current solutions, specifically increasing rigidity of connection between the phone and phone holder.

b. **Description of your cool project**!! Describe how your device solves this problem. How does it function?

i. The KnoGo equips scooter riders with the capacity to follow directions from a securely-mounted smartphone. The KnowGo builds upon the principles of previous smartphone mount designs by incorporating mounting technology primarily used in extreme sporting/acclimate conditions. The KnoGo prioritizes ease of use with a "one-and-done" setup process.

c. **Differentiation**: How do people currently solve the problem you are solving, and how does your idea solve the problem in a better way? What is novel about your approach?
   i. We created a functional phone mount for an electric scooter. Our mount is cheap and easy to produce, and is sturdy enough to be used for a while. A lot of the current mounts are either very expensive or have negative reviews that say the customer's phone falls off or the mount breaks. Our design is novel because it combines the design concepts from the expensive designs in a low cost way. The design concept is having an attachment attached directly onto the phone that just clips into the scooter mount.

d. **Exploded view assembly drawing**: From your working drawings, copy over the exploded view drawing with item numbers and include it again here in the report. This is for us to easily identify the fits labeled in the fits and tolerance table you'll provide below. If possible, include this on the same page as the table if that doesn't make it too small to read easily.




e. **Fits and tolerances table**: This will be based on the table you created previously in the lab, updated as needed, and without the column labeled "Can your chosen manufacturing process deliver the required tolerance(s)?". We also request that for the component identification, you include both the number from the exploded view, as well as the official part name (e.g. clamp base, light plate, vertical rod, etc).

| Fit # | Connects component #... (A) | … to component # (B) | Function of fit | ANSI Class of Fit | Critical dimension and tolerance (A) | Critical dimension and tolerance (B) | Can chosen manufacturing process deliver required tolerance? |
|---|---|---|---|---|---|---|---|
| 7 | SSCF-M3-5-A2 | KGP-002 | Allow the clamp hinge to rotate freely about the pin when the clamp hinge is not bolted tight | RC2 - *Sliding capability necessary for the pin to fit within the clamp arm and ensure adjustability.* | Outer diameter: 0.125-0.15 -0.35 | Hole diameter: 0.125+0.3 +0 | Yes, this process can deliver this tolerance |
| | SSCF-M3-5-A2 | KGP-001 | Align the clamp hinge with the corresponding point of the main body to make the clamp hinge follow the desired pin | RC2 - *Pin must be able to fit into a hole made within the main body via a sliding fit to ensure clamp can be attached to the main body.* | Outer diameter: 0.125-0.15 -0.35 | Hole diameter: 0.125+0.3 +0 | Yes, the chosen manufacturing process can deliver the required tolerance |
| | SSCF-M6-6-A4 | KGP-001 | Create a clamping force around the handle by tightly | ¼ x 20 UNC threaded hold - *Ensures rigid* | N/A | N/A | Yes, the chosen manufacturing process can |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | connecting the clamp hinge to the main body. | *connection within clamp so that main body remains attached to scooter during rough motion.* | | | deliver the required tolerance |
| | AGBAG-002 | MWQ-665160 | Attaches the phone mount to the bike handlebar mount | *Pre-fabricated* | N/A | N/A | N/A |

f. **Additional fits and tolerances**: Description of what your rationale was for your GD&T tolerance choices (that are included in the engineering drawings), and any additional description of fits and tolerances rationales from the table above if you have anything to add that the table didn't cover. How does your choice of fits serve intended functionality?

i. Most of our rationale for the tolerance choices above was to ensure the main component would function normally even after mass manufactured parts come out not as exact as anticipated. Most of our tolerances ensure that the clamp arm is allowed to still rotate during adjustment and that the clamp body and arm are locked together after adjustment. One of the main tolerances not mentioned in the table above is between the GoPro mounting buckle and adhesive mount, in which a forced fit is required as predetermined by the manufacturer. This type of fit ensures the user's phone will remain locked in place after continuous use of the product, meaning they can take their phone on and off and still have the same secure fit every time.

g. **Process selection**: Explain the manufacturing processes that you selected for the prototype that you built. Why did you consider these to be the best choices?

i. The manufacturing process that we chose for our prototype was 3D-printing because this was a very cheap option that could still deliver high quality results that are close to our indicated tolerances. This process was also the one that was most easily accessible to our group because the equipment was owned by one of our team members. We also considered machining the parts at the beginning of our project, but this method was quickly dismissed because it is not as cost effective as 3D-printing. In addition to this, we felt that 3D-printing would give us a product that is closer in appearance and feel to one that would result from our selected mass-manufacturing process. Our selected prototype manufacturing process also gives us an advantage because it allows us to quickly change our design and produce another prototype if necessary.

h. **Scaled-up production plan**: You probably selected processes (and materials) to which you had easy access for making your prototype, but which would not be your preferred option for full-scale production. If so, please explain which selections you would change if this product were to be mass produced, and why those would be the best choices.
    i. We manufactured our prototype using 3D-printing as it was the cheapest and most available option. However, we would utilize a casting process to scale it as a high-volume production process (Castadmin). Deciding between investment, sand, and die casting, we would use sand casting as it's cheaper and more flexible in the metal type that can be inputted. We ruled out investment casting as we're not looking for extreme precision in detail with our part and are willing to have a slightly lesser surface finish as this part is to be screwed on a handle, not held by a user (Creature Works). Also, die casting did provide speed in its manufacturing, but it's expensive, cannot be used for steels, and would be better for parts that have very complex geometry (Lieu et.al., 2017).

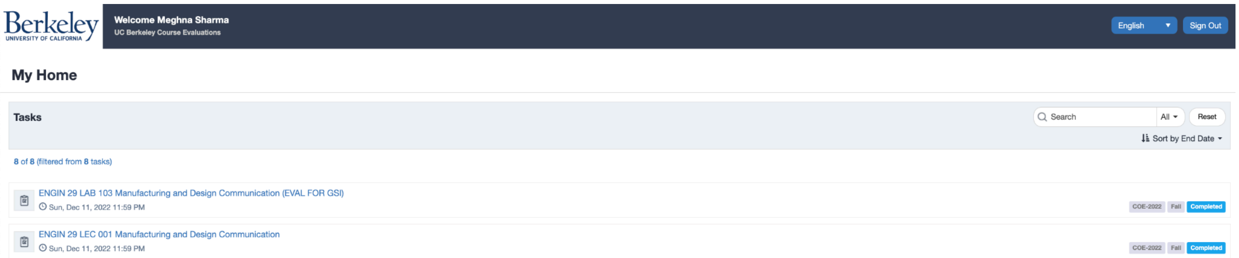
i. **Materials choices**: Explain why you selected the mass production materials that you chose for the different components.
    i. For the 3D-printed prototype, we used ABS plastic which is a sturdy plastic to use for that manufacturing type. However, in mass production, we would use aluminum to guarantee utmost durability, strength, lightweight, and corrosion resistance (thyssenkrupp Materials). Specifically, we would use aluminum alloy A380 for its fluidity, pressure tightness, and resistance to hot cracking ("Aluminum Alloy A380 Properties: Aluminum Die Casting.")

j. **Design for Manufacturing**: Describe how manufacturing considerations influenced your design. E.g. redesigning to remove undercuts for molded parts, reconsidering how tight tolerances needed to be based on process considerations, choice of a certain GD&T tolerance, … Provide at least one example that is specific for your project.
    i. The process of manufacturing brought to light new issues of tolerances, budgets, manufacturing speed and quality of mass manufactured parts. Since we wanted the phone holder to be inexpensive, we chose manufacturing processes where the cost per part was low and the part could be produced very quickly.

k. **Reflection**: What is your biggest takeaway from this project? What did you learn from prototyping and testing your design? What did you learn from assembling and watching others assemble your prototype from your drawings? What was the most challenging task you faced? What stood out or surprised you the most about the project or any of the processes you've learned about? What did you learn about working in teams? What else did you learn during this project? What would you do differently in the future?

   i. We learned that it is hard to assemble the part using just the assembly drawings. When we tried to assemble the other team's product, we had to ask them questions about the specific orientation of parts. When the other team assembled our product, they had a hard time assembling the GoPro mount because it took multiple maneuvers to put the piece on. We could not specify the maneuvers on the assembly drawing.
   ii. The most challenging task we've faced was initially trying to incorporate everyone's ideas into our product. Over worksessions and project meetings we were able to incorporate a version of everyone's ideas to make a piece that resembled our entire team's effort and creativity.
   iii. Working in teams was a challenge in the beginning because we were all not accustomed to working together but overtime we were able to learn of everyone's work habits which helped us be as productive as possible
   iv. In the future our group would take some extra time in the beginning dedicated to getting to know each other's professional strengths and weaknesses which would help later in the project.

l. **New -- Extra Credit**: At the end of your team's final report, include a section with screenshots showing proof of each team member's completed course evaluation (do not include the evaluation itself—simply a screenshot of your portal showing your name and that the evaluation has been completed). If all team members complete their evaluation, your team will receive an extra 1% on your final project report grade.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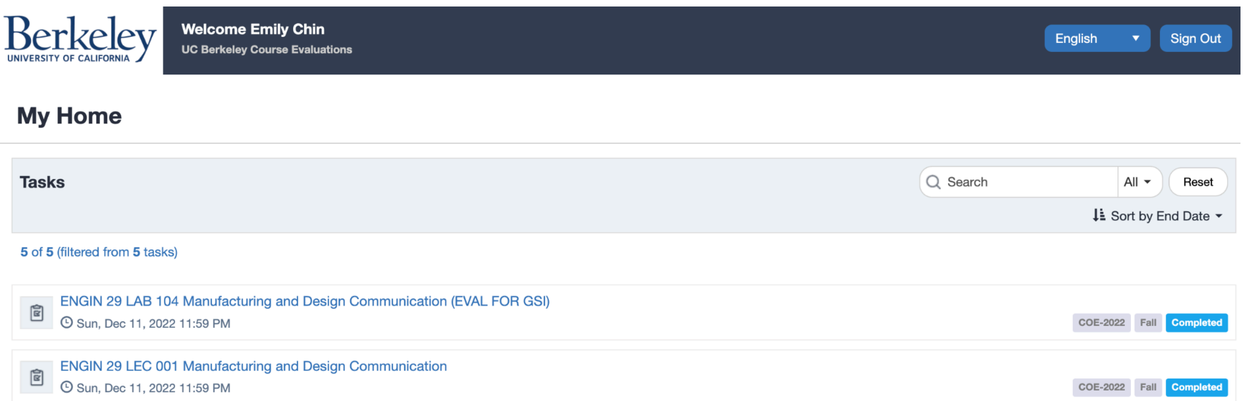
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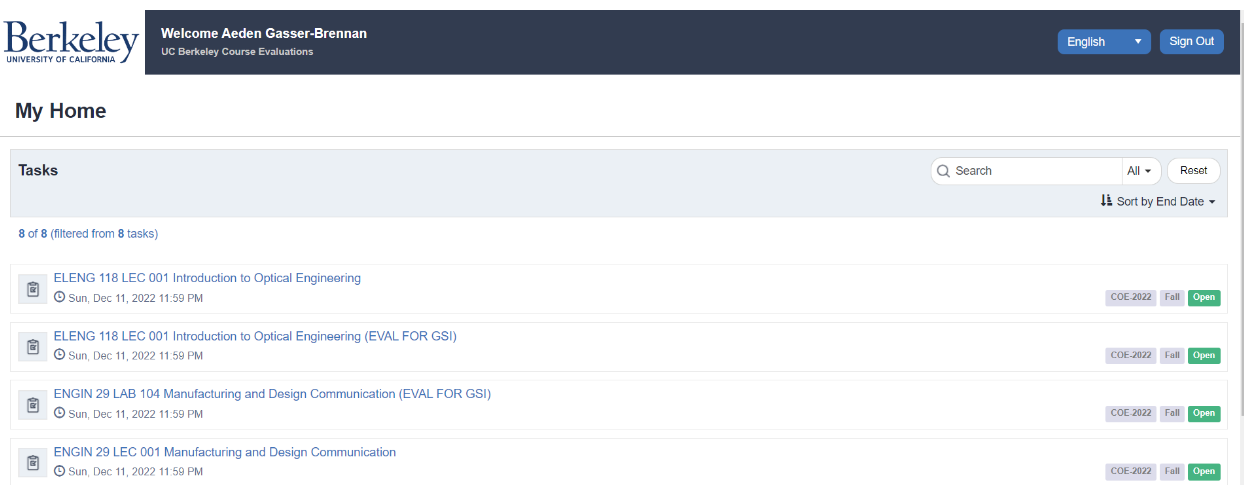
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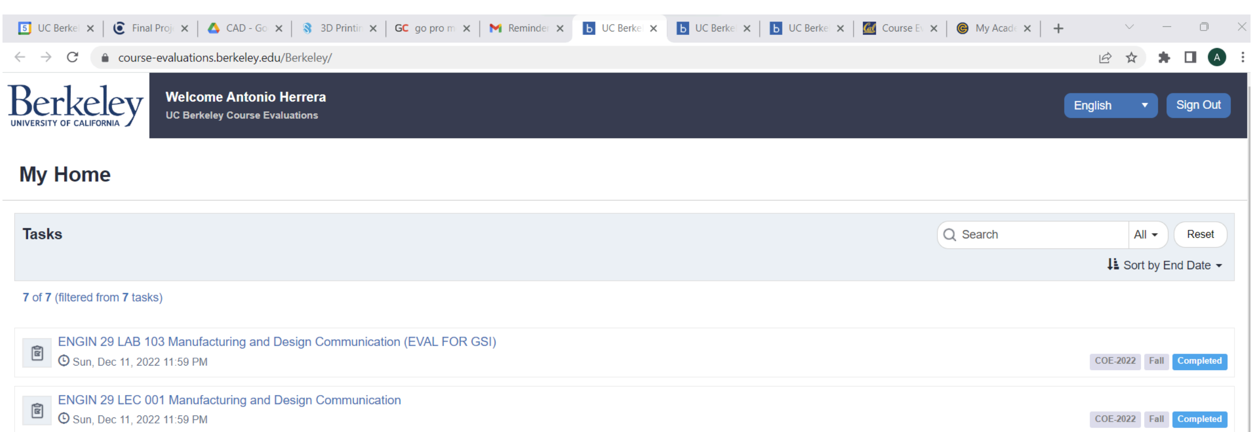
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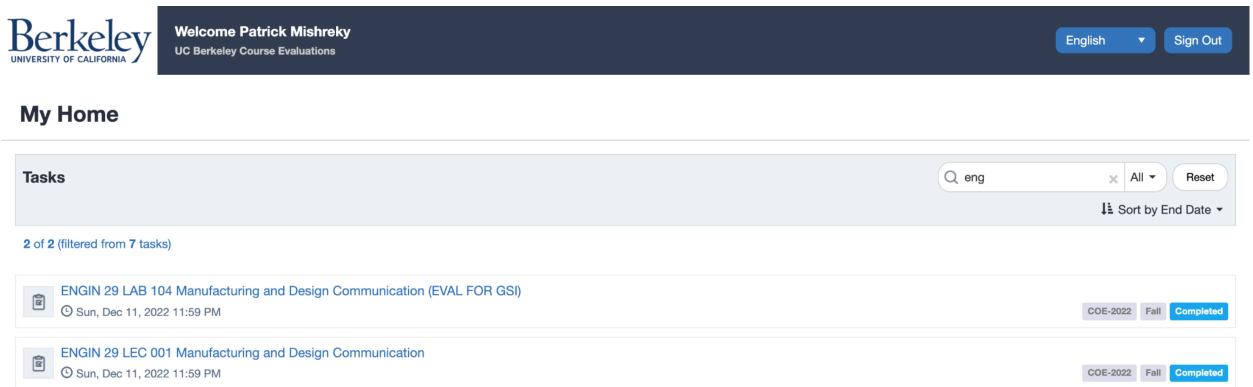
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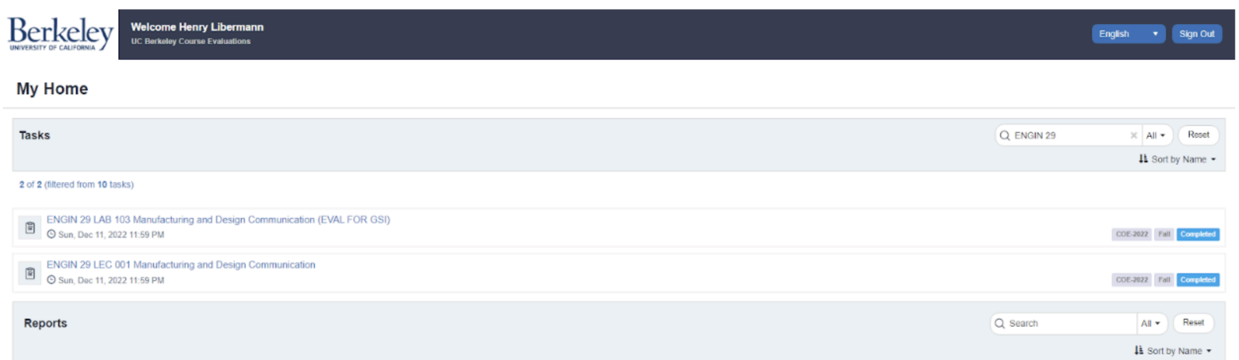
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