Board 71:Work in Progress: Creation of Teaching Materials to Support Identification of Authentic Needs that Inform Engineering-Design Projects

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Abstract

WORK IN PROGRESS – ACADEMIC PRACTICE/DESIGN INTERVENTION. A significant challenge facing design educators is "needs finding" – namely sourcing (i.e. identifying) and specifying (i.e. appropriately bounding) student design projects. To develop authentic, community-based or client-sponsored projects, faculty spend considerable time making contacts, discussing problems, and packaging tractable design projects to meet the design problems needs of first year to graduate design teams. The skills of sourcing and specifying projects can also be important for students themselves to learn, as solutions to well-articulated and important needs can create value for our society.

Over the past few years, a team of faculty and students at Duke University have developed educational materials to develop and support faculty and student skills to do the important task of "needs finding." For this paper, we will share a series of modules that support the following educational learning outcomes: 1) identify needs through observation; 2) identify needs through interviewing; and 3) write well-scoped need statements. Note that these materials can be used across all engineering disciplines and their design courses.

A series of modules have been created for each of the learning outcomes. Each module contains four to nine videos, multiple in-class exercises, and instructor resources. Together, the modules could fill up to half a semester if used in sequence. These produced materials are currently used in several courses across the curriculum at Duke University including first-year design and a graduate design course; to date, direct assessment on the modules is limited. Most created materials are used during a summer internship when teams are tasked to identify problems and write cogent needs statements. To date, feedback has been positive, especially on the exercises where students practice observing and interviewing to identify unmet needs.

Introduction

As discussed by Howe and Goldberg, design-focused education can cover topics ranging from project management, design constraints and requirements, prototyping, search for prior art, and identification of customer needs [1]. Depending on the length of the course, the level of the student, and the focus of the course, instructors may "source" the needs or problems from the community, including local industry and non-profits. In other courses, students or student teams may take responsibility for identifying the problem that drives the design project [2].

Engineering faculty at Duke University recognizes the skills of sourcing and specifying problems and their related needs statements can also be important for students themselves to learn, as solutions to well-articulated and important needs can create value for our society. For example, in biomedical engineering capstone courses at Duke University, senior-level students may either identify a need from their personal experiences, or they may validate and refine a need that is given to them by the course instructor. In the graduate-level design courses, the needs-finding

experience is more structured, and student teams have complete ownership over the needs they pursue. Students may take up to four months in a structured needs-finding process, immersing themselves in the end-user's environment and using applied ethnographic research methods.

Problem-sourcing is a mode of research highly suited to the guiding insights of cultural anthropology. This is because ethnographic methods are often exploratory and allow for open-ended inquiry situated in social interactions [3]. That is, ethnographic interviewing occurs in real-time, allowing both researcher and interviewee to think together about a common question [4]. This relational interview process is fundamental to ethnographic interviewing [5].

Similarly, participant observation allows researchers to relationally discover, in-situ, how clients understand and articulate problems. Neither insider nor outsider, the role of the participant-observer is to gain understanding through immersion, often reflected in ethnographic fieldnotes [6]. Thus, observation is another important skill to be developed.

In terms of pedagogical design, the team decided to use a flipped classroom strategy. Over the past decade, flipped classrooms have become increasingly popular in engineering [7, 8]. In a recent meta-analysis in engineering education in K-12 and higher education contexts, the authors examined student achievement [9]. There was an overall significant effect in favor of the flipped classroom over traditional lecturing. Their findings suggest that self-paced learning and more problem-solving activities were the two most frequently reported benefits that promoted student learning. Improvements in student learning have been documented in higher education outside of engineering as well [10]. Among the many advantages of the flipped classroom model is the opportunity to use classroom time to practice skills and concepts.

Methods

After teaching for several years and robust discussion, a group of faculty from the Duke engineering and anthropology departments recognized a need to codify tested strategies that can support other faculty and students as they identify important needs that lead to engineering design projects. The faculty team then collaborated to define the scope of the material, including interviewing, ethnography, formulation of needs statements, and decomposition. The team laid out the learning outcomes for the six modules (Table 1) and storyboards for the instructor videos. Next, the faculty team worked with on-campus resources to produce the instructional videos. The situational videos (e.g., baking a cake, changing a tire) were done by the faculty team themselves, often with family, because of concerns during the pandemic. Student assistants helped to edit the videos so that relevant text and examples were clear. The faculty team also developed in-class exercises, which were refined based on input from students before and after using the teaching materials.

The topics, methods, and activities described in the videos and in-class exercises build on research-based best practices. For example, interviewing strategies align with established best-practices in the field of anthropology [4]. Recording observations using the 4 Ps (People, Process, Products, Place) is similar in intention, but formulated differently, from other published ethnography and needs finding strategies including AEIOU [11] and POEMS [12]. The 4Ps was

developed as a tool by one of the co-authors (Paul Fearis) during 20+ year career in medical device design. Root cause analysis builds on 5 WHYs, a well-known method [13].

Table 1. Student learning outcomes for created needs-finding modules.

Topic/Module	Student Learning Outcomes
1. Interviewing to Identify Engineering Problems	- Consider types of interviews and questions used during an interview - Develop stem, probe and lead questions - Pilot and refine an interview guide - Apply skills of pile-sorting to infer key themes of an interview - Reflect on process
2. Market Research to Support Identifying Needs	- Identify stakeholders in a contextualized problem - Differentiate between upstream and downstream research - Conduct research segmentation - When to narrow or broaden a problem space for investigation - Gaining appropriate permissions and consent - Describing primary and secondary research in needs finding - Define a need
3. Observing to Identify Engineering Problems	- Observe a situation and complete a detailed record on its people, process, products and place (4 Ps) - Identify discontinuities and work arounds - Document observations (namely the 4Ps) on a mindmap
4. Observing to Identify Engineering Problems - Practice	- Conduct observations using the 4Ps (people, process, products, places) - Recognize discontinuities while observing
5. Root Cause Analysis & Writing Needs Statements	- Explain and practice functional decomposition - Explain and practice structural decomposition - Explain and practice process decomposition - Explain and practice task decomposition
6. Decomposition – A Strategy for Tackling Complex Problems and Systems	- Write solution-agnostic needs statements - Complete a root-cause analysis on a list of observations by asking why-why-why? - Use a method of cluster to group similar needs - Prioritize needs based on importance and satisfaction

Developed Materials

Teaching a course or part of a course with these materials enables students to identify the problems that create value in their environment and organization. For faculty, these tools help them specify important design problems and projects for their students to tackle.

Thoughtful classroom modules have been developed to support students and faculty to develop the skills to source impactful design projects (Table 2). These materials walk students through two main methods - interviewing and ethnography (i.e., observing) - to identify unsolved, impactful needs. The procedures and best practices of both methods are discussed, together with many videos of user environments for practice. Materials on root cause analysis, market

research, needs statements, and decomposition enable the identified problems to be properly framed and carefully specified.

Each module contains substantive education material, with four to nine videos, multiple in-class exercises, and instructor resources. Together, the modules could fill half a semester. All materials are assembled and presented on Engineering Unleashed (engineeringunleashed.com), powered by KEEN [14]. To access the materials, go to https://engineeringunleashed.com/card. If you are not a member, you need to create a free account. Following that, search the cards for the listed numbers. A full list of the videos is in Appendix A (Table A1).

Table 2. Summary of created pedagogical materials, as organized by (*)Card Number on Engineering Unleashed (engineeringunleashed.com). One lesson is approximately 60 minutes of classroom material.

Topic/Module	**Card Number***	**Posted Materials**
1. Interviewing to Identify Engineering Problems	3824	4 lessons (4 videos + 4 in-class exercises)
2. Market Research to Support Identifying Needs	3833	6 lessons (8 videos + 5 in-class exercises)
3. Observing to Identify Engineering Problems	3834	5 lessons (6 videos + 3 in-class exercises)
4. Observing to Identify Engineering Problems - Practice	3831	9 videos + worksheets
5. Root Cause Analysis & Writing Needs Statements	3835	6 lessons (7 videos + 4 in-class exercises)
6. Decomposition – A Strategy for Tackling Complex Problems and Systems	3830	3 lessons (8 videos + 6 in-class exercises)

As an example, Module 1 centers on interviewing. Students watch one or two videos and then practice their new knowledge through the given collaborative exercises. In the videos, students learn about structured and informal interviewing styles, open- vs closed-ended questions, types of questions (e.g., probes, transition), how to avoid leading questions, making an interview guide, and how to review and synthesize answers from an interview. The associated in-class exercises have students evaluate a recorded interview, create questions, and conduct an interview on “what did you do last night?”. In-class examples for Interviewing are attached in Appendix 2.

In Modules 3, students learn to observe their environment by capturing the 4Ps: People, Process, Products, and Place. Students write what they observe in a formatted document that enables them to discover problems, which can then be turned into needs statements. For Module 4 (Observing to Identify Engineering Problems – Practice), there are nine videos that capture individuals conducting (somewhat) routine tasks (Table 3). These procedures reveal shortfalls in processes, tools, and use of tools. Since each video is less than 5 minutes, students can write down the 4Ps. Expert observations are provided (as a key) to support learning. For further details on the other Modules, please refer to the full suite of teaching materials on Engineering Unleashed.

Table 3. Videos associated with Module 4: Observing to Identify Engineering Problems - Practice

Procedure shown	Number of videos
Changing a tire on a car	4
Stringing a guitar	2
Cutting rebar	1
Replacing drywall	2

Implementation

These developed materials have been used in a number of venues at Duke University during the past two years. Over 500 students and six faculty have worked with the materials. Feedback on the developed materials from students and instructors at Duke University has been positive. Observed improvements to student learning is noted below with each course or program. However, no formal assessment has been done, although some plans are suggested at the end of this section.

As described below, the implementation of the materials at Duke has been as little as one concept or idea per course, or as broad as all materials within a course that fills a whole semester (Table 4). Depending on the learning outcomes of a course, a rigorous approach to needs finding may or may not be appropriate. At Duke, we have found that upper-class and graduate students are better positioned for this work; alternatively, more time needs to be dedicated, such as in the DukeEngage program. For a faculty member interested in using the materials in senior design, students could be exposed to observation and/or interviewing skills, but it is unlikely that they could rigorously apply the process (especially observation) to scope their own needs statements from scratch in <3-4 weeks (assuming 5-10 hours of outside work/week). However, they could certainly refine a need, using interviewing and observing, before proceeding. As reference, several summer (full-time, 4-8 weeks) clinical needs finding programs engage biomedical engineering students [15].

Table 4. Summary of how various Modules have been integrated into courses and programs at Duke University.

Course Name	Year of Student	Modules Used	Time Dedicated in Course
EGR 101	First-year	Parts of Modules 1, 5, 6	Each part at 2-3 days
DesignHealth	Upper-class and graduate	Modules 1-6	One full semester
XPRIZE (elective) courses	Upper-class	Module 6	1-2 weeks, spread out across the semester
DukeEngage	First- and second-year	Modules 1-5	2 weeks full time effort (~80 hrs total)

In first-year design (EGR 101), students learn the engineering design process and apply that to a community-sourced problem. Students used the developed materials on interviewing, writing needs statements, and decomposition. Equipped with knowledge on how to interview, students develop lists of 15-25 questions and then conduct interviews with key stakeholders. Teams

document their needs statements with an owner, action, desired outcome, and a vector of measurement. Decomposition is used when breaking a problem down during the brainstorming step, which has been helpful for spurring ideas across many dimensions of possible design solutions, as well as for project planning. The inclusion of these modules has particularly improved how teams write their needs statements, as the given structure of the needs statement was helpful for novice students.

At the graduate level, materials on market research, observation, root-cause analysis, and writing needs statements have been used in Duke's Design Health Program (designhealth.duke.edu). Design Health is an interdisciplinary graduate program focused on medical product development that includes students from the schools of engineering, business, nursing, medicine, and arts & sciences. The program is divided into three semesters, and the first is dedicated entirely to finding needs in the Duke Healthcare System. In the first semester, students are sorted into interdisciplinary teams and assigned a general "need area" within the hospital. This area is usually a medical procedure or process that can be observed repeatedly by the student team. Student teams have observed in the areas of cardiology, general surgery, pediatrics, and emergency medicine, among others. They receive the appropriate training, specifically a focus on the 4Ps, and relevant approvals over the first two to four weeks of the semester, then they apply this material to an example library of pre-recorded videos and interviews. They spend the next four weeks observing in clinical settings. The last six weeks are used to do a root cause analysis on their observations, extract needs statements, and narrow down the need statements using business and technical criteria. Only three needs are passed into the next phase of concept generation.

As an example, a team comprised of a medical resident, business student, and several engineers was assigned to observe the admission process of patients into the Duke Emergency Department (ED). Over the first several weeks, all team members spent approximately five hours each week in the ED observing patients, interviewing physicians and nurses, and learning about current processes. They generated several mind maps from which they extracted over 100 need statements using root cause analysis. Finally, they did patent searches, market sizing, and stakeholder analyses to narrow down their needs to three that were pitched to a panel of professors and healthcare professionals. This project continued into the second and third semesters of the program, where the team generated concepts, prototyped, built, and tested an IT system to efficiently triage, identify, and discharge the lowest-risk patients so providers could spend more time with high-risk patients.

The materials on decomposition have been used extensively in design courses related to the XPRIZE Rainforest Competition [16], which includes students from electrical and computer engineering, mechanical engineering, and the Nicholas School of the Environment. The XPRIZE competitions are multiyear competitions that are very challenging and broad in scope. The XPRIZE Rainforest competition was "challenging innovators to develop novel technologies to rapidly and comprehensively survey tropical rainforest biodiversity and use data to deliver new insights in near real-time that promote the health and conservation of this vital ecosystem." [16] Application of decomposition to the overall competition problem yielded many topics suitable for semester-long engineering design courses. Further application of decomposition by students yielded manageable subtasks that were formulated into design

projects that could be completed to achieve semester-long goals. To break the XPRIZE Rainforest Challenge into semester-long project chunks, the Duke team began with primary functional decomposition.

To survey rainforest biodiversity, the team asked biology experts for ways to identify plants, fungi, animals and microbial life. As an example, the students then broke "identify plants" down to images of leaves, images of flowers, DNA samples, 3D images of forest structure, and detection of volatile organic compounds. Decomposition was also used to re-risk the various tasks and identify which ones were suitable for projects in the class. As an example, one project became: fly camera drones into the understory and canopy of rainforest to take images of leaves, flowers, moss, fungi and lichens. Many, many other projects were spun off from other parts of the decomposition. Important aspects of this process were talks with experts and brainstorming to generate finer grain tasks and solutions.

All the developed materials have been used in a DukeEngage summer program in Uganda (joint program between Duke and Makerere University) during summer 2022 and summer 2023. For the DukeEngage program, materials were assembled into a 20-page workbook, which students used to find authentic problems in medical settings in Kampala, Uganda. Teams (two Duke students and two Makerere students) work through the introductory videos, with a special emphasis on sensitivity to context. Then, teams complete the interviewing modules, including "practice" interviews with medical professionals from Mulago Hospital. Teams then learn ethnography skills, practicing using the sample videos (e.g., changing the tire). Students spend two sequential days in hospitals; each team rotates through Kawempe Hospital, a large regional referral hospital that focuses on babies and mothers. Students then discuss their observations, extract problems, and write needs statements. By evaluating the problems against the two axes of importance and satisfaction, teams select the problems that will be the focus of their efforts that summer.

These needs finding activities take two weeks (~80 hours); the remainder of time in the summer (six weeks) is spent completing the engineering design process to design and build physical prototypes in the Shipping Container Makerspace [17]. For students in this program, learning how to observe clinical settings to identify unarticulated needs has been transformative for some students. Some medical personnel say "there are no problems" when you ask. Yet, when the students watch – even for a short while – they can identify possible avenues for how engineering solutions can decrease the global health burden.

Moving forward, the team plans to complete a more formal assessment of the developed materials. In the future, we would like to assess the materials three different ways:

- Use concept maps to track the evolution of students' understanding of topics and skills in needs finding [18].
- Compare the quality of the specificity of the needs statements written by teams using the materials vs those that don't.
- Evaluate the self-efficacy before and after using the material. This survey would focus on skills such as developing an interview guide, conducting interviews, critically observing and recording a scene, conducting a root cause analysis, and writing needs statements.

Since DesignHealth students submit graded assignments such as written needs statements, these materials can be evaluated (although there is not an obvious "control" (i.e., not using the prepared materials) to compare student work). Additional future work on this project includes developing an undergraduate course centered on needs finding.

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References

[1] S. Howe, J. Goldberg, "Engineering Capstone Design Education: Current Practices, Emerging Trends, and Successful Strategies." In *Design Education Today*, D. Schaefer, G. Coates, C. Eckert, C., Editors. Springer, Cham. 2019. https://doi.org/10.1007/978-3-030-17134-6_6

[2] S. Zenios, J. Makower, P. Yock. Biodesign: *The Process of Innovating Medical Technologies*, 1st edition. Cambridge University Press, 2009.

[3] L. Ghirotto, L. De Panfilis, S. Di Leo, "Health professionals learning qualitative research in their workplace: a focused ethnography," *BMC Med Educ* 20(269), 2020. https://doi.org/10.1186/s12909-020-02191-5.

[4] C. Marshall, G.B. Rossman, G.L. Blanco. *Designing Qualitative Research*, 7th edition. SAGE Publications Inc, 2021.

[5] B. Gillham, *Research Interviewing – The Range of Techniques*. Open University Press, McGraw-Hill Education, England, 2005.

[6] R. Sanjek, editor. *Fieldnotes: The Makings of Anthropology*. Cornell University Press, 2019.

[7] A. Karabulut-Ilgu, N. Jaramillo Cherrez, C.T. Jahren. "A systematic review of research on the flipped learning method in engineering education," *British Journal of Educational Technology*, 49(3):398-411, 2018. https://doi.org/10.1111/bjet.12548

[8] R. Talbert, *Flipped Learning: A Guide for Higher Education Faculty*. Routledge, 2017.

[9] C.K. Lo, K.F. Hew. "The impact of flipped classrooms on student achievement in engineering education: A meta-analysis of 10 years of research," *Journal of Engineering Education*, 108(4):523-546, 2019. https://doi.org/10.1002/jee.20293

[10] P. Strelan, A. Osborn, E. Palmer. "The flipped classroom: A meta-analysis of effects on student performance across disciplines and educational levels," *Educational Research Review*, 30:100314, 2020. https://doi.org/10.1016/j.edurev.2020.100314.

[11] AEIOU Observation Framework: A heuristic framework used for ethnographic observations. Contributed by Darcie Fitzpatrick, Nov 30, 2018, Open Practice Library, accessed 30 March 2024. https://openpracticelibrary.com/practice/aeiou-observation-framework/

[12] P.O.E.M.S User Snapshots, Lucidspark, 2024 Lucid Software, accessed 30 March 2024. https://lucidspark.com/templates/poems-user-snapshots

[13] Moaveni, S., K. Chou. "Using the Five Whys Methods in the Classroom: How to Turn Students into Problem Solvers." *Journal of STEM Education* 17(4), 2017. https://www.learntechlib.org/p/174416/

[14] Engineering Unleashed: Transforming engineering with an entrepreneurial mindset. https://engineeringunleashed.com/ Cards 3824, 3830, 3831, 3833, 3834, 3835. Kern Family Foundation, 2024.

[15] Guilford, W.H., Kotche, M. & Schmedlen, R.H. "A Survey of Clinical Immersion Experiences in Biomedical Engineering." *Biomed Eng Education* 3:113–122, 2023. https://doi.org/10.1007/s43683-023-00107-5

[16] XPRIZE: Discover. Understand. Preserve. https://www.xprize.org/prizes/rainforest XPRIZE Foundation, 2024.

[17] Drinkwater, K., C. Sendek, A. Stocks, J. Mugaga, R. Ssekitoleko, A. Saterbak. "Containing Design: Rethinking Design Instruction to Support Engineering Device Development for Low-Income Countries," American Society of Engineering Education Annual Meeting, Baltimore MD, June 2023.

[18] N.L. Schroeder, J.C., Nesbit, C.J. Anguiano, et al. "Studying and Constructing Concept Maps: a Meta-Analysis," *Educ Psychol Rev* 30:431–455, 2018. https://doi.org/10.1007/s10648-017-9403-9

Appendix A

Table A1. Full listing of created videos.

Intro1: Introduction to Needs Finding Modules
Intro2: Definition of Needs
IN1: Interviewing
IN2: Interview Guide
IN3: Conducting an Interview
IN4: Analyzing Interview Data
P0: Overview of Planning Phase
P1: Scoping
P2: Stakeholders and Research Segmentation
P3: Sources and Permission
P4: Primary and Secondary Research
P5: Downstream and Upstream Marketing
OR1: Observational Research: Intro to the 4 P's
OR2: Day in the Life and Discontinuities
OR3: OR - Cake Baking Example
OR4: OR - Cardiac Defibrillator Example
OR5: OR - Abdominal Surgery Example
OR6: Mindmapping
A0: Overview of Analysis
A1: Root Cause Analysis
A2: Root Cause Example
A3: Writing Needs Statements
A4: Writing Needs Statements Example
A5: Clustering
Pr1: Prioritization

Appendix B

Needs Finding - Interviewing

Activity 1: Analyzing an Interview

Learning objectives:

- Consider the type of interview and questions used during an interview
- Reflect on the interview

Time: suggested 20-30 min
Materials: Laptops, place to take notes
Recommended videos prior to activity:

- Interviewing #1 with Harris Solomon
- Interviewing #2 with Harris Solomon

Student tasks:

1. Watch the entire CNN interview with Kizzmekia "Kizzy" Corbett (KC). It is approximately 9 minutes long. There is a transcription of this interview on the document entitled *Transcript for Activity 1*.
   https://edition.cnn.com/videos/politics/2021/04/04/covid-vaccine-kizzmekia-corbett-black-scientist-orig.cnn/video/playlists/business-science-breakthroughs/

2. As you listen, independently write answer the following questions:
   a. Was this interview an informal, unstructured, semi-structured, or fully structured interview?
   b. Consider the different questions asked by the Interviewer. Which are stem questions? Which questions are probes? Which are leads?
   c. Which questions are open-ended? Which questions are closed-ended?
   d. Which questions are leading? Which are non-leading?

3. Working with a partner or in groups of three, answer the following questions:
   a. How would you describe the relationship between interviewer and interviewee based on what you watched?
   b. Which questions or components of the interview seemed to have stronger or weaker effects on KC's responses? Why?
   c. What, if anything, was missing? Were there opportunities to ask questions that didn't get taken up? Were any of the answers more or less satisfying?
   d. What would you say about circumstances outside the real-time interactions during the interview?
   e. Did the interviewer seem well-prepared? How do you think their preparation affected the interview's execution?
   f. Typically, the interviewer knows the questions ahead of time. Sometimes the respondent does, but sometimes the respondent does not. How might that change the interaction and discussion?
   g. What would you have asked differently even if you had the same information?

4. Share responses with class

Activity 2: Drafting an Interview Guide

Learning objectives:

- Develop stem, probe, and lead questions
- Consider an appropriate balance of stem, probe, and lead questions

Time: suggested 20-30 min
Materials: Index cards of three colors (e.g., blue, green, yellow)
Recommended videos prior to activity:

- Interviewing #1 with Harris Solomon
- Interviewing #2 with Harris Solomon

Instructor tasks:

1. Divide students into teams of four.
2. Give each team ten index cards including:
    - 5 blue cards
    - 3 green cards
    - 2 yellow cards

Student tasks:
Each team will develop a unique interview guide focused on a common topic:
What did you do last night?

Construct 10 questions that the interviewer can ask/say in their draft guide including:

- 5 stem questions, written on blue index cards
- 3 probe questions, written on green index cards
- 2 leads, written on yellow index cards

Make sure to ask only open-ended questions.

Once teams have completed their 10 questions, instructor should facilitate conversation with the class to discuss insights.

NOTE: In this activity, you should not conduct the interview!

Activity 3: Piloting an Interview Guide

Learning objectives:
- Pilot and refine interview guide
- Reflect on the interview from the perspective of different roles

Time: suggested 30 min
Materials: Developed interview guide, place to take notes
Recommended videos prior to activity:
- Interviewing #3 with Harris Solomon

Student tasks:
1. Reform teams from Activity 2: Drafting an Interview Guide. Student teams should retrieve and review their 10 questions around the common topic: *What did you do last night?*

2. With each team, assign the following roles:
   - 1 interviewer
   - 2 respondents
     - 1 (pre-assigned) "difficult" respondent. Respondent should answer in short, unelaborated answers, be purposefully elusive or vague, and may interrupt the interviewer.
     - 1 (pre-assigned) “cooperative” respondent. Respondent should answer questions thoughtfully and with appropriate detail and should be courteous to the interviewer.
   - 1 timekeeper/observer

3. Conduct activity
   - Timekeeper/observer sets a stopwatch for 5 minutes.
   - Interviewer asks questions drafted from the interview guide and with any probes conceived on the fly.
   - Respondents answer as they wish.
   - Timekeeper/observer takes notes.
   - Stop when 5 minutes are up.

4. Rotate roles and re-conduct interview
   - Redo the interview three more times, taking turns so that each person plays each role once.

5. Reflection on the exercise together, and ask the following questions:
   - How did the exercise go?
   - What were potential differences between expected and actual responses?
   - What did it feel like to be interrupted?
   - How did you navigate responses that were unclear or didn't answer the question at all?
   - How did what you observe and write down track during the interview?

Activity 4: Analyzing Data

Materials: Laptops, index cards or post-it notes

Associated Handout: Guide to Pile Sorts
Learning objectives:

- Apply skills of pile-sorting to infer key themes of an interview.

Time: suggested ~60 min
Materials: Index cards, interview transcript with KC, notebook
Recommended videos prior to activity:

- Interviewing #4 with Harris Solomon

Student tasks:

1. Read the transcript of the interview with Kizzy Corbett.
2. Provisionally assess 5-7 *unique* themes from the interview. Themes might include one topic, such as:
   - Personal biography
   - Ideas about science

   Themes might also be a relation, such as:
   - Relation between science and politics
   - Relation between science literacy and health
   - Relation between personal story and global phenomenon
3. Write each theme in the margins of the transcript. Then, write each theme on a separate index card.
4. Divide students into groups of four to pile sort themes from KC interview:
   a. Put all cards (5+ from each student) in the middle of the table.
   b. "Pile-sort" the cards, grouping them into piles of similar themes/ideas.
   c. As they sort, note down any points of discussion or debate about where a given card belongs. Key questions to think through include:
      i. Is there always concurrence in the groupings?
      ii. How does a card that was debated in terms of its proper place eventually land in a pile?
   d. Go back to the transcript and discuss your decisions based on the original data set.
   e. Once piles/groups are settled, document any relationships they infer *between the groups*. Some of the groups may be parent-child related, or sibling related, or in hierarchies of priority. Ask:
      i. What are some possible *different* arrangements between the groups?
      ii. What does a different arrangement do to the broader idea of understanding the transcript?

      Try to imagine at least two different arrangements of your data to see how the narrative from the data may shift depending on interpretation of concepts and quotes.

CNN Science Breakthroughs

Meet the trailblazing Black woman scientist behind a Covid-19 vaccine

Source: https://edition.cnn.com/videos/politics/2021/04/04/covid-vaccine-kizzmekia-corbett-black-scientist-orig.cnn/video/playlists/business-science-breakthroughs/

I (CNN's Abby Phillip): How does it feel to be one of the people responsible for these incredible vaccines that have basically saved the world from this, this pandemic?

KC (Kizzmekia Corbett, Ph.D.): You know, I, I don't know, I haven't been able to really feel it in full yet. Because there is this mix of - oh my God, we did it - and attached to - there's still work to be done, attached to - really what is, you know, still living in a pandemic?

I: Last year, a year ago, as you were watching some of these racial disparities unfolding as the pandemic spread. How did you feel seeing Black people and Hispanic people being disproportionately infected and killed and just suffering really severe consequences from COVID-19?

KC: It was a very sad time for me. It wasn't just about the pandemic that is COVID-19. But there was this juxtaposition with you know, George Floyd's murder and all of that, that really came together and just really put a burden on me in so many ways. And it made me get more motivated around what I needed to do, as far as getting this vaccine out. I understand that vaccines are really a way to help to level the playing field when it comes to health disparities. And so for me, it was motivating, but also very sad. I think, as I have looked back on the pandemic, and my work and my team's work in the pandemic, I feel like it was my purpose, almost. I came to UMBC, I started out being a biology major. I met this sociology professor, Dr. Kelly Moore, who was studying health disparities, and it really intrigued me. And then this moment, right, you know, I am in the forefront of developing a vaccine for a virus and a pandemic that is disproportionately targeting certain races. And yet things fall in order in that way; all things work together for the good.

I: Tell us about the journey to get to a point where this technology was ready in time for this very specific virus.

KC: You know, the journey actually predates me about 20 years, people scientists all over the world have been working on messenger RNA technologies to deliver all sorts of therapeutics, not just vaccines, but you know, cancer drugs and etc. And then when I got to the VRC, at the National Institutes of Health, it was 2014 and the cousin of the current Coronavirus, was circulating - the MERS Coronavirus. And it became very clear that nature was going to have its way if we did not prepare. The concept is called pandemic preparedness. And so we've been working on this, for a while at least in Coronavirus field, for about seven years now.

I: So when people say 'I'm worried that this messenger RNA technology is going to mess with my own DNA,' what do you tell them?

KC: Absolutely not. Absolutely not. The cells don't even work that way. And of course, we would, we would never put anyone in that kind of harm. Right? You know, your cells deal with messenger RNA on a day in and day out basis. This is how cells read things. And so we're not telling the cells to do anything that they normally wouldn't do, just giving them a little bit extra boost to produce a different type of protein so that you can alert your body to be protected against COVID.

I: You have become this sort of ambassador, not just for the vaccine that you worked on the Moderna one, but for vaccines in general. You have been there with the vice president Kamala Harris, Jesse Jackson Sr, TD Jakes has credited you with helping him get over some concerns or hesitancy that he might have had. What did you say to him, for example, or to others, that made a difference?

KC: You know what, Abby, I think there's really nothing that you say, it's really about listening. There is a subset of people who just hasn't been listened to around their health issues and around, you know, technology, really. And at this point, I just, I just felt like it was time for me to sit down and empathize with an entire group of people who had been ignored.

I: This last year, we've also seen this pandemic really highlight what seems to be just a political polarization of science in general. What was your reaction to watching that unfold as a scientist?

KC: Science is the truth. That's it. That's always my reaction to anything, to anyone who doesn't believe in science. Science is the truth, and eventually the truth shall set you free.

I: Are we ready for the next one, the next big pandemic?

KC: We're going to get ready. We are certainly going to get ready. I think if you can ever say anything good came out of this. One thing that did come out of this is that all in all, every scientist on the globe understands that there are viruses that have pandemic potential, and we better get ready.

I: What about the messenger RNA technology? Do you think that gives us a head start to be ready for the next vaccine that needs to be created?

KC: Absolutely, that is exactly how we think about it - plug and play. You really can drop just about anything into messenger RNA. And it works beautifully as we're seeing. And I think that the utility of this technology, towards vaccines, towards therapeutics, towards all sorts of things is just going to transform medicine in general.

I: We are talking a lot about these variants that are coming up, and whether the vaccines will be there to kind of combat that as quickly, as we hope. What's your expectation on that front?

KC: Right now, it looks like we have a good outlook around these vaccines, right? These variants are concerning. But this is exactly what the virus is built to do. And the vaccine is eliciting such good immune responses, that while there's a damper and efficacy, probably, it won't completely obliterate the response, especially on a pandemic scale.

I: Do you have a sense of when we might know maybe a little bit more definitively about what that looks like? Can someone who's vaccinated transmit the virus and be infected themselves from the virus?

KC: You know, I can't give you a sense of when we might know that, you know, data comes out in kind of real time these days. But I think that the signs are pointing in the direction that at least vaccinated people might not be able to transmit virus because there's less shedding of virus, which means that if you were to be vaccinated and come in contact with the virus, your body wouldn't replicate that virus to the point that you might be able to spread it someone else. But I think all in all, we're very hopeful about how well this vaccine is working not just on the disease perspective, but towards the utility towards transmission.

I: One thing that is so notable about you, obviously, you walk into a room, everyone notices you are a young woman, a young Black woman. What has it been like to be such a prominent face in the scientific effort on a personal level?

KC: You know, it's been fun, I will definitely admit that. I think it's been, it's been exciting to be able to be an inspiration. I'm happy to be visible if it means that more people understand the science behind this vaccine, and for vaccines to come.

I: And more Black and brown people are apparently applying to STEM programs and medical school. I mean, during this pandemic, why? Do you have any sense of why?

KC: I don't know, except for science is really cool. So I mean, I can't blame them. You know, I think that there is a lot to be said about people seeing how science can really transforming the world, and how technology can really transform the world.

I: Corbett was recruited here to the University of Maryland, Baltimore County Campus with a full ride Meyerhoff scholarship, a program that also produced a number of other Black leaders in science, including former Surgeon General Jerome Adams and Darian Cash, a senior scientist at Moderna. One of your mentors said about you that you are a reminder that there's so much untapped and nurtured potential among the students of color, especially in the sciences. Do you think that's true?

KC: Absolutely. I think about had I not had a mother who said, "you're going to go do an internship this summer rather than get, you know, any other job," or had I not been exposed to Dr. Rebelski and the Meyerhoff program when I was in high school and been recruited here. I think about what would have been different, and a lot. I'm not even so sure that I would be a scientist. And it's really about exposure and resources given to people.