

Employing the Zettelkasten Note-taking Method to Foster Socio-Technical Thinking in Engineering Educational Spaces

Mr. Connor LaSalle, University of Illinois at Urbana - Champaign

Connor LaSalle recently graduated with his Masters degree from the Department of Agricultural and Biological Engineering at the University of Illinois Urbana-Champaign. As a member of the Contextual Engineering Research Group (CERG), his work lies at the intersection of engineering and social science. Through education and participatory research, he seeks to integrate both community members and engineering consultants into the conversation of infrastructure design and engineering practice.

Dr. Emily Lawson-Bulten, Duquesne University

Emily Lawson-Bulten is a recent doctoral graduate from the University of Illinois at Urbana-Champaign. As a licensed civil engineer, she is concerned about equitable access to infrastructure, especially for WASH services in non-industrialized nations. Her research focuses on the influence of power dynamics between international NGOs, engineers, and their client communities on water system design. With a background in Contextual Engineering and International Development Studies, Emily utilizes participatory approaches to increase engineering awareness and community agency throughout the design process. As an educator, Emily integrates feminist and decolonial methodologies into the classroom for sociotechnical understanding.

Dr. Ann-Perry Witmer P.E., University of Illinois at Urbana - Champaign

A teaching professor, researcher, lecturer, and professional civil engineer, Ann-Perry Witmer is the architect of the emerging discipline of Contextual Engineering, which merges technical design with societal understanding to improve adoption outcomes.

Bethany Reed, University of Illinois at Urbana - Champaign

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Abstract

Engineering infrastructure has impacts which extend beyond the technical aspects of design, calling for engineers to have the ability to understand the broader societal, economic, and environmental impacts of their work. This awareness of social and environmental factors amidst the technical design process is often referred to as socio-technical thinking (STT). When STT is treated as a learnable trait, it becomes an area of focus within the engineering classroom. Growing out of dialogue surrounding experiential learning as a pedagogy for engaging engineering students with STT, this research explores how critical pedagogy can be used to make in-class experiential activities more meaningful and transformative for students. We present the Zettelkasten (ZK) note-taking method as this critical pedagogy, integrating it alongside experiential activities among both an in-depth summer research group and undergraduate engineering course. Student responses to the activity as well as their reflections serve as the basis of our results, which indicate that STT and a variety of other meaningful outcomes were fostered throughout. By outlining this case, we provide a useful resource and pedagogy for educators to foster and integrate meaningful engagement with STT among their engineering students.

Introduction and Literature review

According to the UN 2023 report and World Bank, 2.2 billion people lack safely managed drinking water, 675 million people still live in the dark, and 1.2 billion people are at risk of exposure to at least one critical climate hazard [1][2]. Despite the significant efforts to design infrastructure systems to address these issues, more than 80% of engineering design failures can be attributed to human causes rather than technical issues [3]. Engineering design has been described as a cultural process [4], supporting the claims that engineers displaying awarenesses of social and environmental factors represents a stronger understanding of design as a whole [5][6]. This awareness of social and environmental factors amidst the technical design process is referred to as Sociotechnical Thinking (STT) and focuses on the intersection of social and technical factors when evaluating a problem or design. The term “social” includes environmental, ethical, economic, health, safety, political, and cultural factors [7]. The “technical” is often framed as problems that are solved using mathematical and physical sciences, not including the context of the societal factors [7]. The push to incorporate STT into the engineering curriculum remains prevalent among scholars and academic institutions. For example, in the 2026-2027 ABET objectives for accrediting engineering programs, two objectives include socio-technical elements - “global, cultural, social, environmental, and economical factors” and “ethical and professional responsibilities” [8].

As per the definition, engagement with STT requires an engagement with the social factors. These social factors are often eclipsed in engineering educational spaces due to the inherent nature of the field and its exclusive focus on the techno-economic conditions. Experiential education as both a philosophy and methodology has been used by educators to facilitate STT among engineering students [7], [9-12]. Romkey, [10] conducted interviews with professors to determine what methods were being utilized for STT exposure. The authors found that educators relied on design projects (some involving real-world clientele), reverse engineering exercises, service learning, and role playing as effective means of discussing different perspectives and introducing contrasting motives of stakeholders. Pucha [11] focused on a design-based, first-year engineering course that incorporated community aid projects. Emphasis was placed on examining structural conditions, such as who suffers and who benefits, and the context behind the given problem. This emphasis proved to have a significant improvement of incorporating community-based sustainability perspectives into the course curriculum. Providing students with opportunities to listen to community members and naturally observe societal conditions was crucial for preparing engineers for the challenges of community engagement and improving their STT [13][14].

Fallacies of modern development theory such as mono-causalism, ahistorical framing, and technological determinism can still be seen impacting engineers’ ability to engage in STT [15]. Engaging students with STT through experiential learning has the ability to counter these ways of thinking [16]. It is not sufficient, however, to only expose students to societal elements or have them implement social science methods. Research has shown that STEM individuals who engage in community engagement without a foundational framework continue to propagate colonial [17], technological deterministic [18], and positivist views [15]. While experiential education and opportunities to engage with non-technical information have proven beneficial for fostering STT among engineering students, educators have argued for a more meaningful

integration of socio-technical awareness and understanding [19-21]. This integration requires a critical pedagogy, presented here as a teaching approach that directly engages students with culturally cognizant and community-based ways of thinking by placing students in context of their societies and utilizing problem posing in collaboration with students to discover answers [22]. Critical pedagogy within the context of STT centralizes power dynamics and uplifts place-based knowledge independent of traditional academic institutions and, resulting technological deterministic approaches. In this paper, we investigate core aspects of STT as it relates to design with societies.

We present the Zettelkasten (ZK) note-taking method as a form of critical pedagogy and experiential activity. Finally, we investigated two activities that engaged students at varying levels of the ZK method for how this approach functions as a critical pedagogy, encouraging students to understand socio-cultural elements, respond to alternative forms of knowledge, and engage with engineering as a political system in context.

Aspects of Sociotechnical Thinking

1) Societal Conditions:

It is important for students to understand what societal conditions impact the communities and populations for where they seek to design [4]. In Contextual Engineering, the contextual influences -- cultural, political, economic, educational, and mechanical -- are described as deriving from a community's societal context and when combined, represent the contextual 'footprint' of that community [23]. Drawing a relationship among these non-technical factors and the infrastructure that engineers build is an example of STT (Figure 1).

Societal Context : Needs, perspectives, and knowledge of the client community and its inhabitants

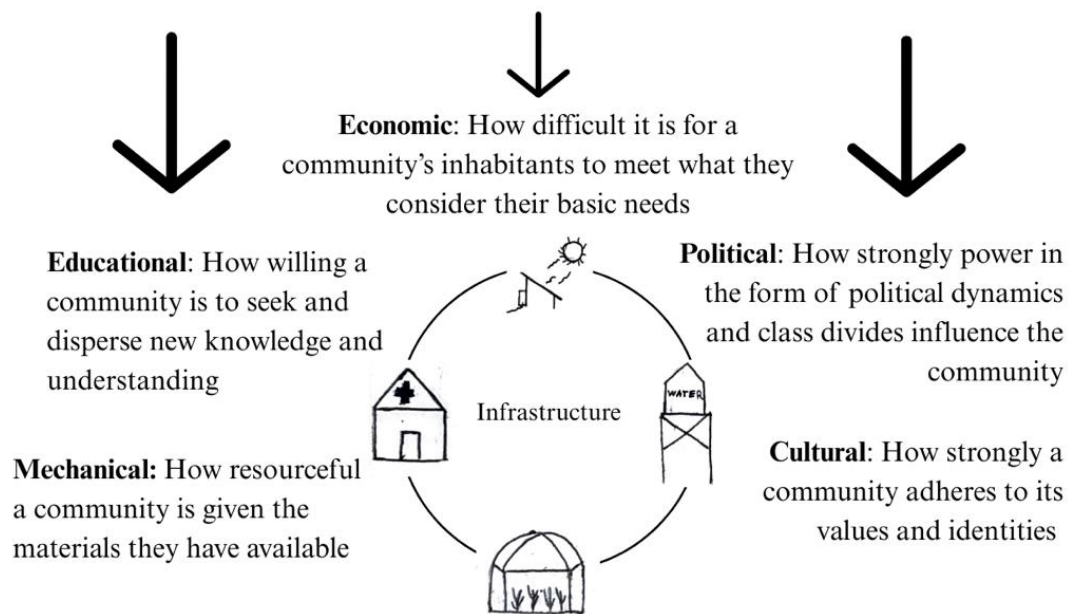


Figure 1. Contextual Engineering model of societal conditions

2) Stakeholder Perspectives and Positionality:

STT not only requires a deep understanding and acknowledgement of societal conditions, it also requires critical reflexivity of one's own personal perspective and perception [24]. When engineers fail to account for their own perspective and values in relation to others, they diminish the value of place-based knowledge of local communities [15]. Further inhibiting the ability of an engineer to design with cultural cognizance is confirmation bias, where designers already have an idea of the solution in mind and then use that solution to validate or steer their decisions throughout the design process [25]. Confirmation bias has been observed negatively impacting the reasoning and analysis of engineering students [26]. These negative impacts of confirmation bias have led scholars to argue for the integration of positionality, or how one exists in the world due to identity and experience, within an engineering curriculum [27].

In addition to positionality, Contextual Engineering defines three levels of perception, awareness, attestation, and assimilation, to help students conceptualize how perspectives can impact their approach to designing technical solutions and solving problems [28]. Engineers begin with an awareness of a technical need and move to an attestation stage as they begin to understand the societal conditions of the need. Assimilation is seeking to understand the value of a technology from the user population's perspective and, therefore, requires deep and continuous engagement with both societal conditions and one's own positionality. Designing from an assimilated perspective positions engineers to incorporate place-based capabilities, beliefs, and values and is therefore crucial for challenging conditions of colonialism and power dynamics [23].

Background

Aspects of STT such as societal conditions and positionality are commonly taught in humanities and social science courses but can be challenging to integrate directly within engineering curriculum [27]. Teaching students about societal conditions and the importance of perspective requires a critical pedagogy, as these non-technical elements require new approaches devoid of technological deterministic influences. In this section, we explore how the ZK note-taking method is well positioned to integrate within experiential learning opportunities and serve as a critical pedagogy to aid in students' ability to think socio-technically.

“Zettelkasten” translates from German to English as “Slip-box”, or a storage area where individual note cards may be placed and collected. The ZK note-taking method was originally developed by the Sociologist Niklas Luhmann, who used it to organize his thoughts and develop novel ideas. At its core, the ZK note-taking method is a way of thinking. It is a system of organization meant to help scholars and researchers absorb information and create their own knowledge [29]. There are three critical characteristics – Non-hierarchical, bottom-up, regularly reflexive to the method that position it well to be integrated within engineering course work and improve engagement with STT.

1) Non-hierarchical:

When adding notes to his slip-box, Luhmann's only rule was that the note he was adding had to be related in some manner to the note he was placing it behind. Because of this, Luhmann's slip-box was *not* organized in a hierarchical manner based upon folders and sub-topics, but in a non-hierarchical manner based on relations [30]. Students can be encouraged to apply this relational approach to the societal information they make notes from, helping foster the idea that non-technical information can also be complex and highly interconnected.

2) Bottom-up:

A beneficial result of Luhmann's non-hierarchical system was its ability to build themes and larger topics from the bottom up. By linking multiple notes together in creative ways, Luhmann allowed ideas and assertions to emerge from his readings rather than to be deduced from his own thinking. This is very similar to inductive coding in thematic analysis, where themes are developed from the data rather than being prescribed [31]. When students use notes taken directly from participant interviews or their own observations of societal conditions to construct ideas, they are encouraged to use the community members' perspectives to construct knowledge rather than their own. Although not completely shifting students towards an assimilative perspective, bottom-up approaches can reduce confirmation bias as well as ensure better stakeholder engagement and correct needs assessments [32].

3) Regularly Reflexive:

Luhmann centered his method around the idea that notes would be consistently moved around and linked with other notes. The simple act of reviewing old notes and searching for new connections meant that Luhmann was constantly using new knowledge to reflect upon and reshape notes. As students learn more about a community, their perspectives or interpretations can change. By encouraging them to continuously review old notes and re-think meanings, they are more likely to achieve assimilated perspectives and deep understandings of community dynamics. Taken together, these characteristics of the ZK method mimic theories present within social science fields but in a more approachable manner for engineering.

The relative success of Luhmann and the systematic nature of his ZK method has led many scholars and researchers to begin experimenting with its capabilities. Most commonly used as a personal knowledge management (PKM) system, the ZK method allows users to organize a wide variety of information and reflect upon ideas in a systematic and constructive manner [33][34]. The ZK method can also be used in a digital manner to avoid cluttering. Software such as Obsidian (<https://obsidian.md>) has been used by researchers to help develop ideas and achieve deeper understandings of concepts [35]. Obsidian is free to download and allows users to create notes, use hyperlinks to connect those notes, and add tags and index words to their notes in a digital format. The ZK method itself has also been used in educational settings to foster knowledge retention and critical thinking among students. Malashenko [36] integrated the ZK method into a learning model for students and found that those who used the ZK method had an enhanced learning experience and displayed a stronger understanding of material.

Although the ZK method is typically used for taking notes on academic literature and learning about new subjects, its characteristics also allow it to also be used to take notes on interview transcripts. Making sense of social, economic, cultural, and political information based on the primary sources of local perspectives may be considered akin to learning about a new subject or field. With this relationship in mind, the ZK method is positioned well as a critical pedagogy for fostering engagement with STT among engineering students.

Methodology

To analyze practical implementations of the ZK method in engineering for societal understanding, we carried out two trial activities where engineering students used the method to take notes on interview transcripts. The interviews for both trials were conducted within the case study of an engineering system design for a small rural community in Honduras in partnership with a Non-governmental Organization (NGO). Researchers from the Contextual Engineering Group (CERG) began working with the NGO in 2022 based on the NGO's desire to implement an infrastructure system with the community. The case study interviews are a part of a larger co-design research that utilizes asset-based community development methods to increase community level decision-making power. In the summer of 2024, semi-structured interviews were conducted with Institutional Review Board approval where residents of the community were asked about their opinions and perspectives on the implementation of a water system within the community. Sixteen of these interviews, including a final design meeting carried out with the entire community, were then anonymized, transcribed, and placed into the Obsidian software. See Appendix A for the general interview guide and information about anonymized interview data access.

The first type of STT engagement with this data occurred during the Summer of 2025 and involved a group of three engineering undergraduate students and one high school research assistant. Group members were first taught the basics of the ZK note-taking method and how to apply it to the interview transcripts. The ZK method uses three primary types of notes:

Literature, fleeting, and permanent [37] each of which are defined as follows:

1. Literature Notes - Notes that are tied directly to something somebody said (a community member in an interview, a political figure in a meeting, etc.)
2. Fleeting Notes - Notes that come from your own observation or experience (witnessed people collecting or using water, learned something new about the community's election process)
3. Permanent Notes - More coherent thoughts or assertions about the community (your own opinion) that draw from multiple fleeting and literature notes

Figure 2 illustrates one of the graphics used to explain how reading through transcripts would generate these notes. The blue circle labeled "Miguel" represents a community member whose transcript is being read. The grey circles surrounding it are examples of literature notes that were made while reading the transcript and therefore link directly to the original transcript. Due to the nature of the activity, group members did not engage with fleeting notes because they were not there in-person to observe the phenomenon.

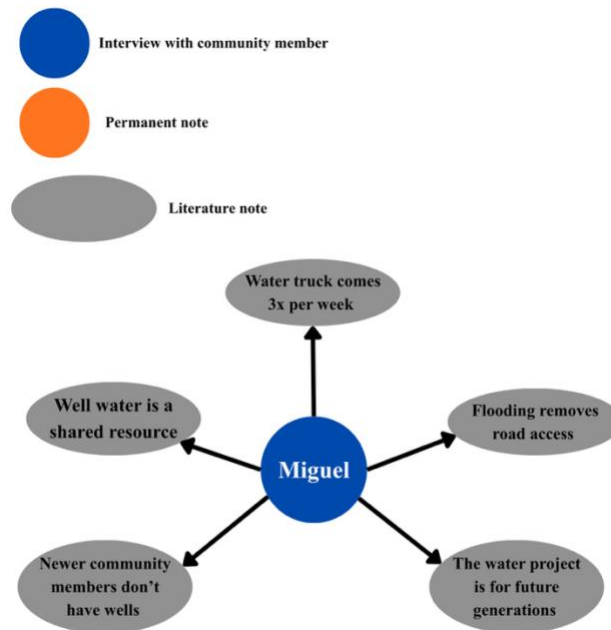


Figure 2. Example literature note.

In Figure 3, the orange circle is a permanent note surrounded by a collection of literature notes that support the assertion “Wells can be divisive”. The literature notes in Figure 3 may come from different interviews or sources, but are all linked together through the permanent note. Since the group members had no prior exposure to this case-study, these notes and connections served to track their understanding of the community and project as they read through interviews.



Figure 3. Example of making permanent notes

After reading through 4-5 interview transcripts, the group members would complete a short reflection meant to assess their current understanding of the case and allow for a chance to review their notes and current perspectives. These reflection questions were meant to simulate what a researcher or engineer might do after a typical day of field work and interviews. The reflection questions as follows:

- What are the main topics that you see emerging? Are there any patterns you are starting to see?
- What questions do you still have? What topics still aren't clear to you?
- What are you going to look out for in the next couple interviews to help you answer these questions?

Upon completing all 16 transcripts and two reflections, the group members worked individually to complete the Contextual Engineering predictive tool, a set of 41 questions about a variety of local conditions that range from the way people interact and the processes they employ in decision-making to the accessibility of education and public services [Witmer, 2020]. For example, “Do residents practice behaviors, social habits, politics, etc. that they overtly attribute to spiritual beliefs?” could be answered with a score between 1 and 5, where 1 means this is not present and never occurs and 5 means this is prevalent and occurs often. After completing the questions individually, the group members then worked as a group to compare their answers and come up with a collaborative final scoresheet. It is important to note that many of these questions were designed to be answered after visiting the site and directly observing the client community. Students were encouraged to answer the questions as best as they could and use their notes to provide support for their scores. Although the tool has been shown to be most helpful on site [28], students were encouraged to think deeply about their notes and how they relate to various societal conditions prevalent within communities.

The second trial occurred within a multidisciplinary course centered on understanding context in technical interventions. The class consisted of 63 students, half of which were in engineering degree programs. Roughly 80% of the class consisted of Freshman, Sophomore, and Junior level students and the remaining 20% were senior and graduate level students. The course uses collaborative pedagogies inspired by Friere and critical pedagogy. This includes many activities followed by course dialogue with no clear right or wrong answer. A short sub-unit of the course curriculum introduced the ZK method as part of a larger unit focused on the three levels of perception, discussed earlier. This introduction was followed by a similar set of activities to the first trial, consisting of reading, reflecting, reading, and overall analysis. For a majority of students, this was their first time hearing about the ZK method and being exposed to the Obsidian software (See Appendix B figure 1&2). Therefore, the first class was dedicated to teaching students about the ZK method, installing the Obsidian software, and using an example transcript to display the note-taking process. In the second class, students received half an hour to start reading through interviews and 10 minutes to complete their reflection questions. This allowed time for each student to read through 2-3 interviews while taking notes. In the third class, students received an additional 30 minutes to continue reading through interviews and making notes. They then they were placed into groups of 3-5 and worked together to fill out the Contextual Engineering predictive tool.

To assess how students were engaging with the in-class activity, they were asked a series of short free-response questions throughout the duration of the activity. The questions were as follows:

- *After the first interview transcript:* Based on the interviews you read and took notes on today, what progress do you think you made towards achieving an assimilative perspective?

- *After the second/third interview transcript:* Did you make any permanent notes today? If so, how do you think your perspective of the community changed based on these notes?
- *After completing the predictive tool:* How did it feel attempting to answer the predictive tool questions yourself?

Responses to these questions were then coded thematically to identify how students were engaging with both the activity itself and the ZK method of note-taking (see Appendix C). Student responses in addition to likert-scale survey questions asked in an optional end-of-semester feedback activity form the basis of our results.

Results and Discussion

Our results from a large classroom unit and in-depth, summer research activity are divided into three parts. First, the student feedback and survey responses are used to show how the ZK method acted as a critical pedagogy to help facilitate STT among students. In the second part, we outline experiential outcomes among students who engaged in the in-class activity and how these resulted in increased understandings of STT and Contextual Engineering. In the third part, we highlight the final design assertions of the summer research group to show how a more long-term engagement with the ZK method and activity results in the integration of non-technical information into technical design.

1) ZK as critical pedagogy to facilitate STT:

Thematic coding of student responses revealed that using the ZK method to take notes on interviews encouraged them to engage with STT in five key ways (Table 1). The ZK method specifically fostered these new ways of thinking by encouraging students to approach the qualitative information they were reading more methodically and engage in critical thought about how community members' responses were interconnected with each other and the water project.

Table 1 - Student engagement with STT as a result of the ZK method

STT Engagement	Description
Making connections	Students making connections between ideas
Technological Determinism	Students re-thinking the value and importance of a new technology
Positionality/Bias	Students recognizing their own bias and background in relation to the interviews/project
Place-based knowledge/perspective	Students valuing community members opinions in relation to the project, or engaging with local knowledge/ways of doing
Contextual Listening	Students thinking more deeply about the concepts and ideas presented in the interviews

Figure 4 illustrates student responses to the question “On a scale of 1-5, how helpful was the Zettelkasten note-taking process at improving your understanding of the interviews and context?” For this question, 81% of students responded with a rating of 3 or higher, indicating that a majority of students found the ZK note-taking strategy beneficial for their understanding of the interview transcripts.

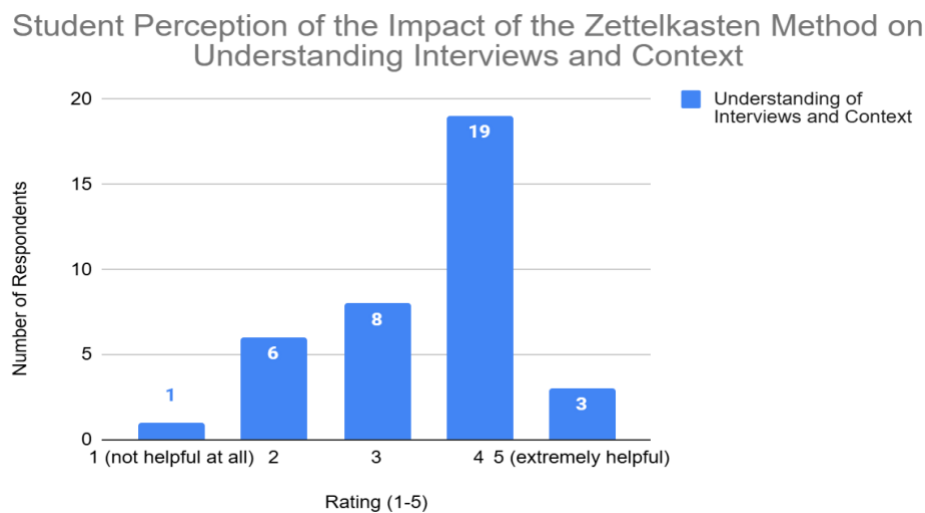


Figure 4. Student perception of ZK method on understanding context

Student open-ended responses further substantiate these survey results by directly attributing the note-taking process to improved understanding of societal context and cultural influences pertaining to the community. In the selected response below, the ZK note-taking method facilitated STT among one student. For a more comprehensive overview of the coding process and student responses, see Appendix D.

“I took notes comparing different perspectives, especially noticing how both individuals supported the idea of collective progress but were hesitant if they felt the burden would not be equally shared. These reflections helped me better understand the social and cultural dynamics influencing decision-making within the community.”

2) Experiential Engagement:

Beyond taking notes and employing the ZK method, students also engaged in several experiential components as a part of the in-class activity such as reading through interviews conducted with real community members, reflecting on their own perspectives, and attempting to answer a set of contextual questions about the community based on their current understandings. Our results from student free-response feedback and survey questions indicated that students engaged with the activity on an experiential level in three key ways (Table 2).

Table 2 - Experiential engagement observed among students

Experiential Engagement	Description
Real-world experience	Students putting themselves in the shoes of the engineers on site, feeling like they are the ones working on this project
Social Challenge	Students struggling with real-world challenges like managing multiple perspectives, and attempting to come up with solutions
Exposure	Students being exposed to community perspectives and thoughts they normally would not have access to in a classroom setting

Despite this activity being carried out in a classroom setting, students displayed a deep engagement with crucial components of experiential education. Here, we highlight one student who engaged with the real-world experience component while attempting to fill out the Contextual Engineering predictive tool.

“While answering the (predictive tool) questions, I felt like I was the contextual engineer who analyzes the conditions and context of the community as well as their problem in water or contextual fingerprints in the area of cultural, mechanic, education, political, and economic.”

Figure 5 indicates students’ responses to the question “On a scale of 1-5, how much do you think the activities we carried out in class (reading through interviews, taking notes, filling out the predictive tool in groups) added to your understanding of Contextual Engineering?” Of the 33 respondents, 67% of the respondents answered with a 4 or 5, indicating this process aided their understanding. We note that none of the respondents rated this question with a 1, leading us to believe that all respondents increased their understanding of Contextual Engineering from using this process.

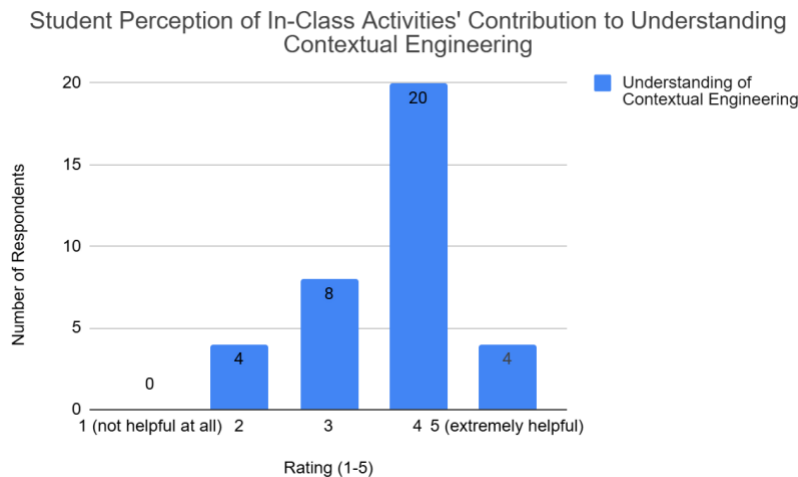


Figure 5. Survey perception of contextual engineering

We correlate this increased understanding of Contextual Engineering with the ability of the activity to expose students to community member perspectives and place-based ways of thinking that they would normally not receive access to. In this selected response, we see a student using community member perspectives to push back against their own pre-determined biases and assumptions in relation to the water project.

“The community may or may not want new infrastructure because they seem content with the wells at each person's house. It also seems developed which changes my original perspective thinking they may need a new water source”

3) Non-technical Integration:

While students who carried out the ZK method and activities in class were only able to review 2-3 interviews, the summer research assistants completed all 16 transcripts. After completing all interviews and reflections, the research group made one final design assertion. They concluded:

“The water system isn't beneficial to the community because there are not enough communal needs for a water project and the cost of water is viewed as a negative among residents.”

Their proposed alternative solution was:

“Since there are only 9 families without wells, we believe the community could work together to dig wells for these families. This is because people mention having the materials and tools necessary to build wells and community members have said they are willing to help build these wells.”

While this specific solution is dependent upon the case study used for this activity it is still a well-informed and personalized design that accounts for the needs and capabilities of the community. Concluding that a water system is not beneficial echoes other students' findings who carried out the activity in class and suggests that in both trials students were finding ways to integrate social information into their own engineering context. If implemented with different case studies or as part of engineering design courses, with long-term goals and design outcomes, the ZK method might assist engineering students with incorporating non-technical factors more consistently into their final designs.

Conclusion, Limitations, and Future work

Our results show that the ZK method is a critical pedagogy capable of being used to facilitate deeper engagement with STT among engineering students. It is important to note some limitations that were identified throughout the activity trials. First, using the ZK method as critical pedagogy requires student engagement with a form of note-taking that may not suit the learning styles of all students. The majority of students in the classroom appeared to enjoy this style of taking notes (Appendix B figure 3), but some found the open-ended nature of a non-

hierarchical organization system to directly conflict with how they learn. Additionally, some students had problems downloading the software and felt overwhelmed by the interface.

The nature of reading through already-completed interviews does not allow for direct engagement with residents of the community like other experiential opportunities provide. Students were not able to ask follow-up questions to residents or respond to them in a dynamic and natural manner, an important skill which was not covered by this activity. This limitation highlights the crucial point that the ZK method and experiential activity presented in this paper do not serve as a stand-in for real community engagement. Additionally, the interviews presented to the students were not conducted with the predictive tool questions in mind, causing them to feel disconnected from the questions students had to answer in their groups. This is a potential cause for students feeling overwhelmed and limited in their ability to faithfully answer the predictive tool questions given their limited exposure to the community. In the future, additional case-studies are necessary that implement the ZK method as a part of experiential activities to assess the applicability of ZK as critical pedagogy in engineering courses.

Lastly, the course in which these activities were carried out was focused on engineering applications but was not a technical or required engineering course. The upfront time commitment required to teach students how to use the ZK note-taking method (approximately a 1.5 hour class period) may be a barrier to its implementation in more rigorous engineering courses. Additionally, reading through interviews and taking notes is a time-consuming process and is most likely better suited as a homework assignment than as an in-class activity. Although we do not see this pedagogy being implemented within strictly technical courses, there is a place for it among engineering capstone and design courses that focus on broader and human-centered outcomes. The variability of the method could allow it to be used for individual student design projects, where students are taught the method and then allowed to use it to scope their design projects and make assertions.

The importance of STT among engineers cannot be understated. These capabilities are highly valued in industry and consulting settings and therefore deserve integration within standard engineering curriculum. In direct response to calls for deeper and more meaningful engagement with STT within engineering curriculum, this paper presents the ZK note-taking method as a critical pedagogy for achieving this. Through a multi-faceted approach involving experiential activities alongside the ZK note-taking method as critical pedagogy, we highlight a useful and accessible tool for other engineering educators to foster deeper engagement with STT among their engineering students.

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Appendix A: Semi-structured Interview Guide

Concept	Specific Concepts	Example Questions/Script
Relational building	Introduction	• Introductory script & consent • Time for questions, clarification of presence and relation to NGO
	Demographics	• Role in relation to Dos Caminos (DC) • Economic standing/security: where do you work, what do you do? I see we're at a store; do you own it? Tell me about your restaurant, etc. • Time spent in the community • Connections w/in the community (family, friends)
	Closing	• Anything else you want to ask me? • Understanding my goals and relationship - want do you want out of this process? • Invitation to focus group or community meeting to continue discussion
Community Values	Strengths	• What do you like about living in DC? What is special compared to LS (neighboring community) • Why did you move to DC? How has DC been different from your previous community?
	Priorities & Goals	• What would you like to see change in DC? • Extreme/dream: If you had a magic wand, if you were in charge, if money was no object...etc. • Think about DC in 5/10 years, what do you picture?
	Qualities	• What is important for a newcomer like me to know about DC? • How has DC changed over the years? • Education levels: Where are kid(s) of various age now? How many people work in your household? How often?
Community power structures	Priorities	• For (priority listed earlier) how would you go about doing that? • Do you feel others care about X in the community? Why or why not?
	Existing power structures	• How is the Patronato (local government) chosen? How often? • Tell me what that is like? Do a lot of people want to be on the Patronato? How do you decide if someone is a good fit? • How well does current leadership know/care about listed priority? • Why are you on (power structure or board within community)?

	Community decision-making	• How do people make decisions within the community? • I noticed (recent infrastructure or community level project), can you tell me about that? Who decided to work on it? • How often do you talk about X within the community? Can you tell me about the last community meeting on Y?
Work w/ outside organizations	Presence/relation	• Have you worked with H&H (partner NGO)? How? Why or why not? • Before H&H came, have you worked with other organizations, government groups, churches, etc? • It was great to meet you at X event earlier. Do you attend those often? Was today representative of the ones you've attended? Why or why not?
	Success of interactions	• What is different about H&H for other org.? What is similar? • Of those differences, what have you liked better? Would you work with X again?
Water	Source	• Where do you get your water? For what purpose(s)? • Is water always available through each source? Tell story about when or why not?
	Demand	• Size of household • How often do you refill your pila? If water is bought, how many botellions per week? General daily schedule for chores/cleaning
	Maintenance	• How often do you need to replace X (filter, pump, etc.)? • Can you show me how you do that (clean filter, adjust pump, access water)?
	Quality	• Why do you buy water for drinking? • How is the water source? How long has it been (insert concerns discussed)? Why do you think that is? • Stomach sickness

For additional information on interviews, including anonymized data, please contact Emily Lawson-Bulten, 3rd author, emilyjl3@illinois.edu

Appendix B: Survey Data Collected From Multidisciplinary Course

Was This Your First Time Hearing Of The Zettelkasten Method?

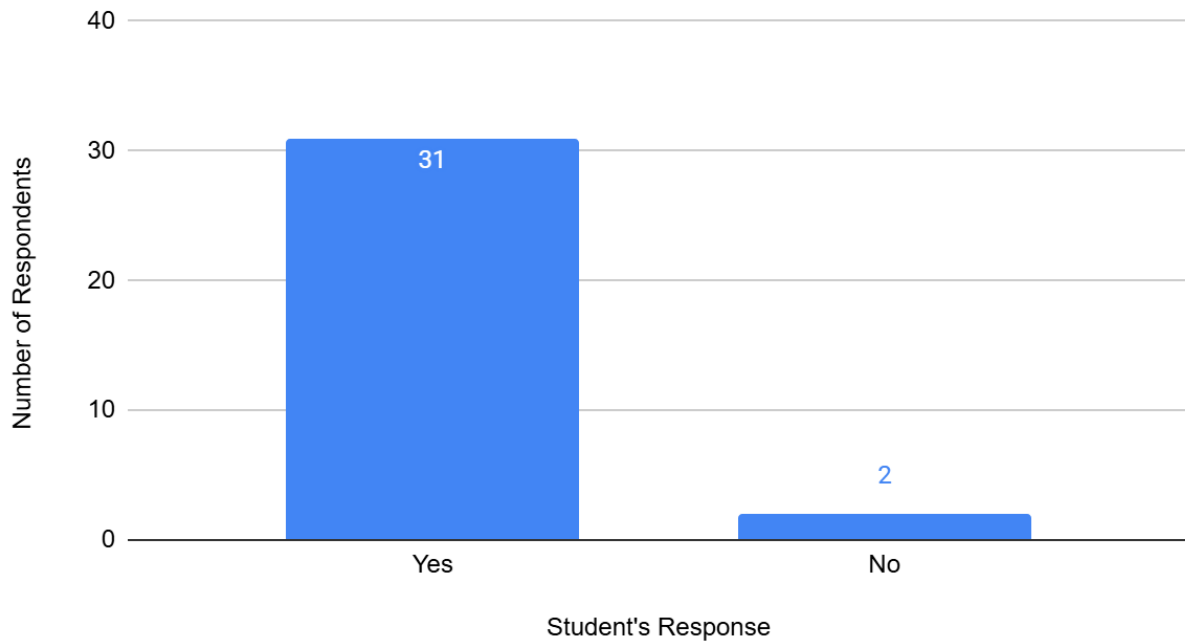


Figure B.1.

Was This Your First Time Using The Obsidian Software?

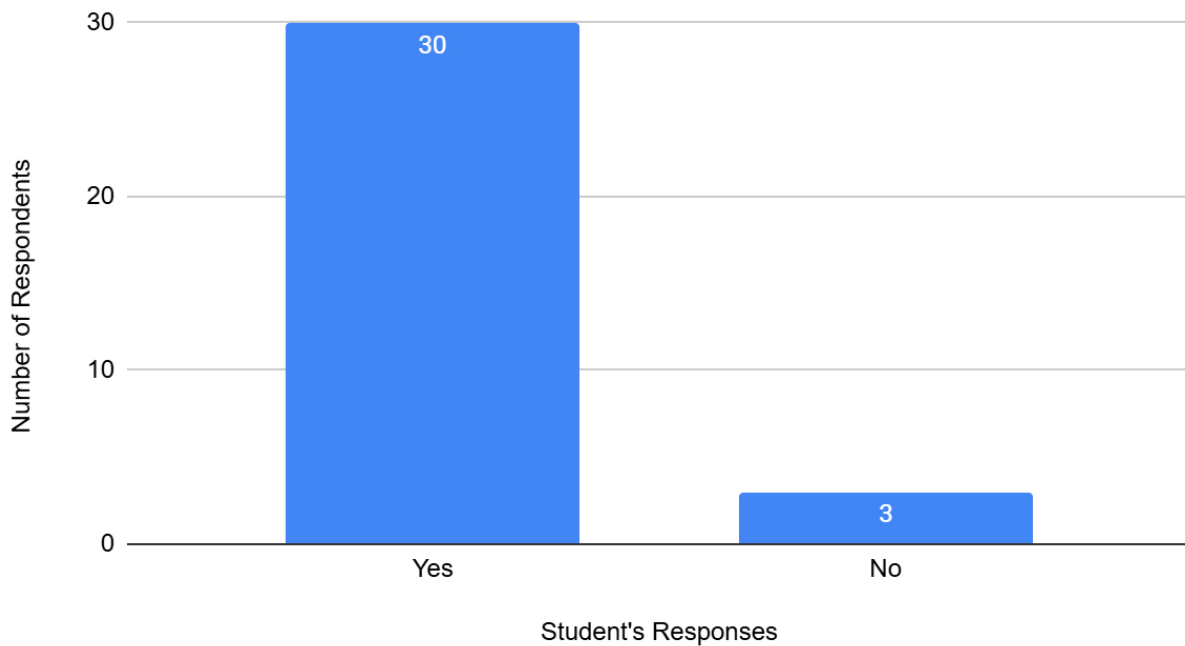


Figure B.2.

Student Ratings of Ease of Understanding for Note-Taking and Interview Analysis

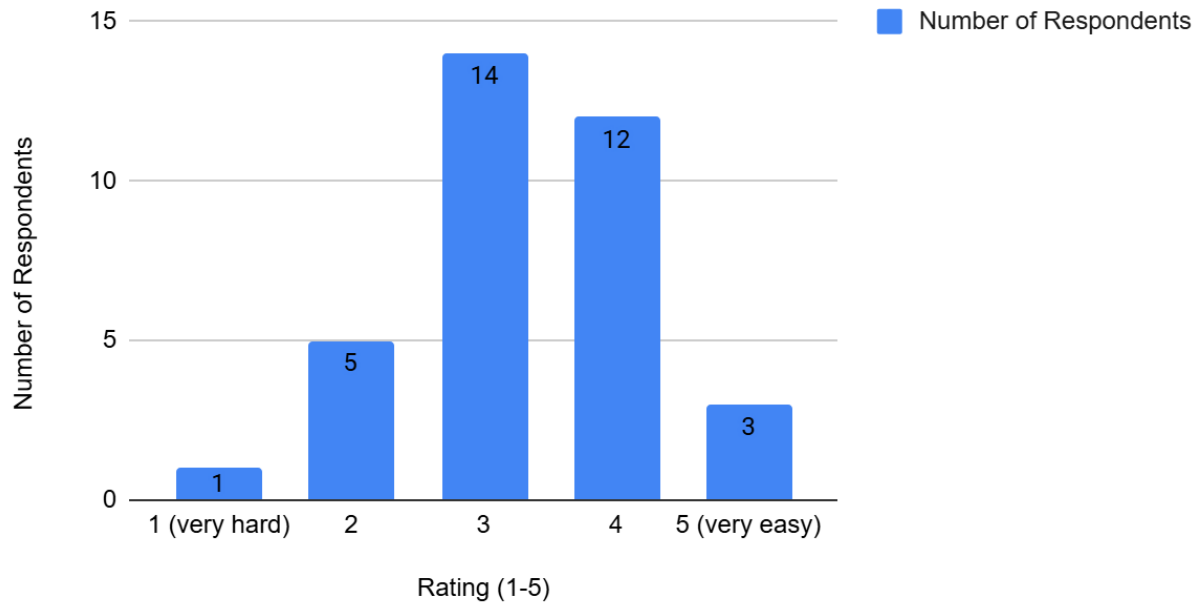


Figure B.3.

Student Perception of In-Class Activities' Contribution to Understanding Contextual Engineering

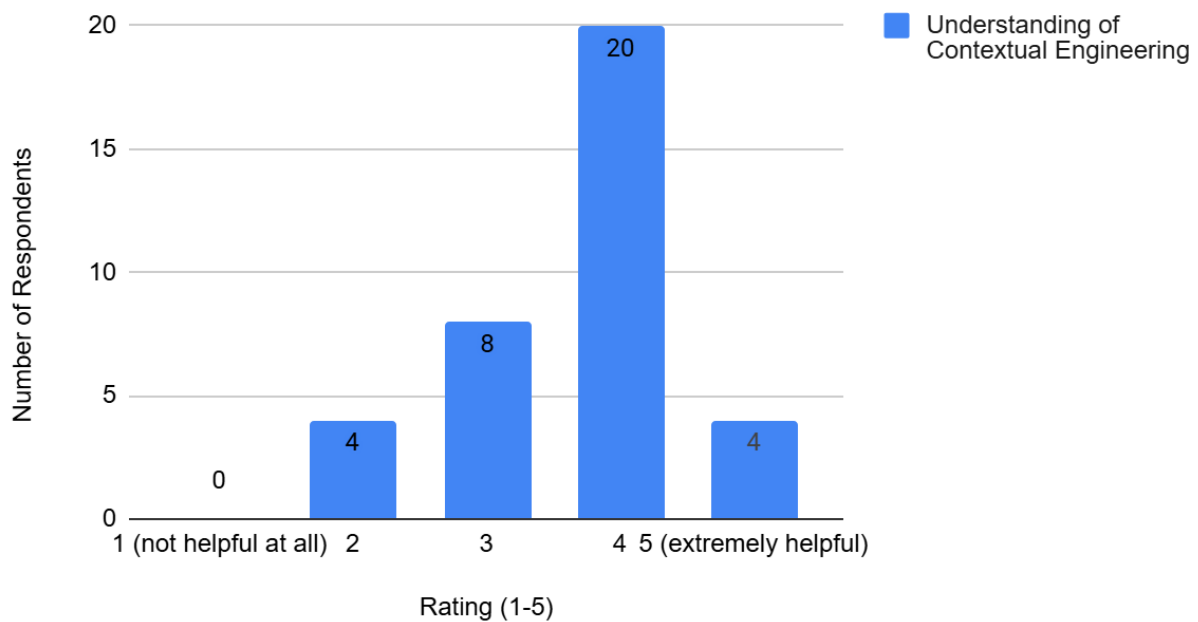


Figure B.4.

Student Perception of the Impact of the Zettelkasten Method on Understanding Interviews and Context

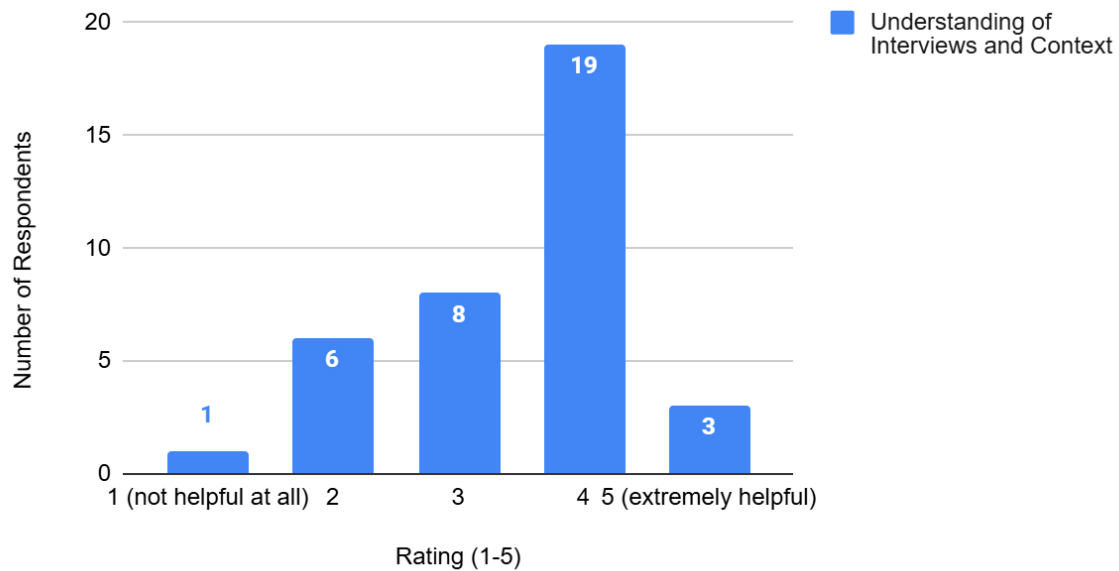


Figure B.5.

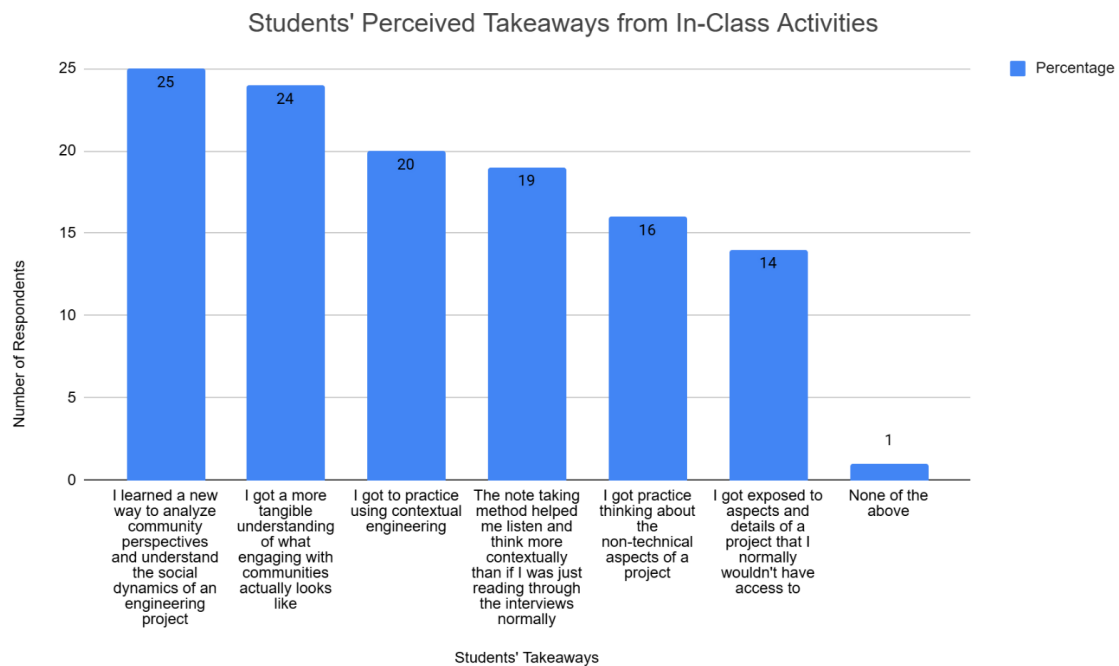


Figure B.6.

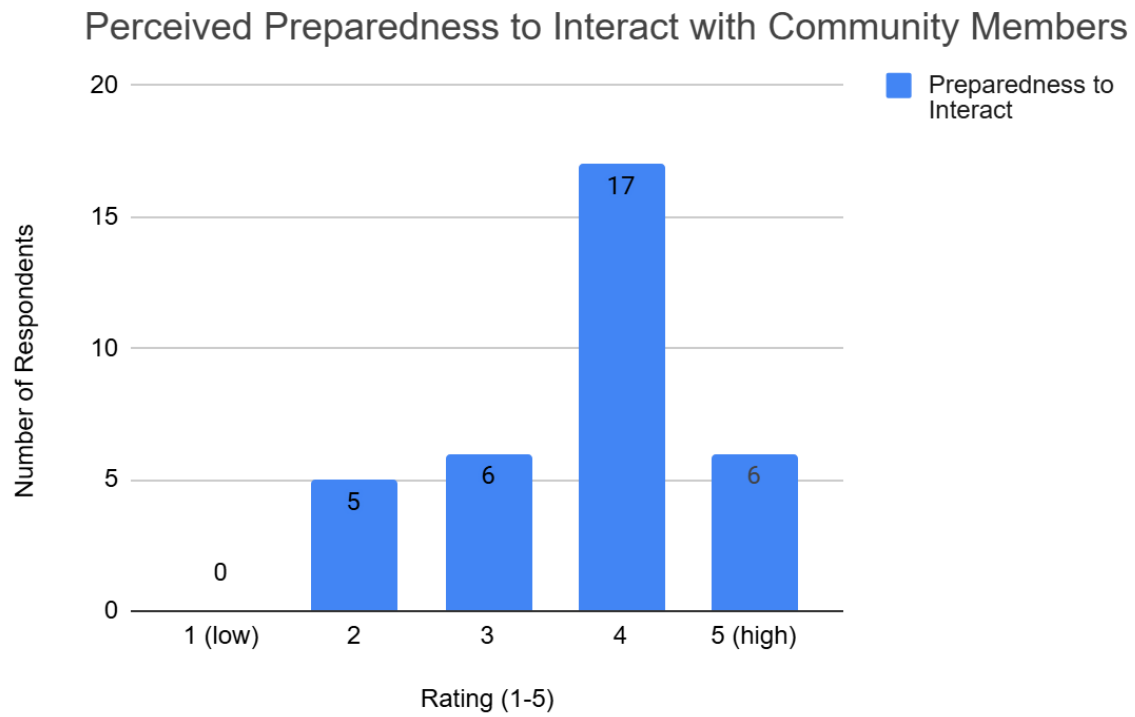


Figure B.7.

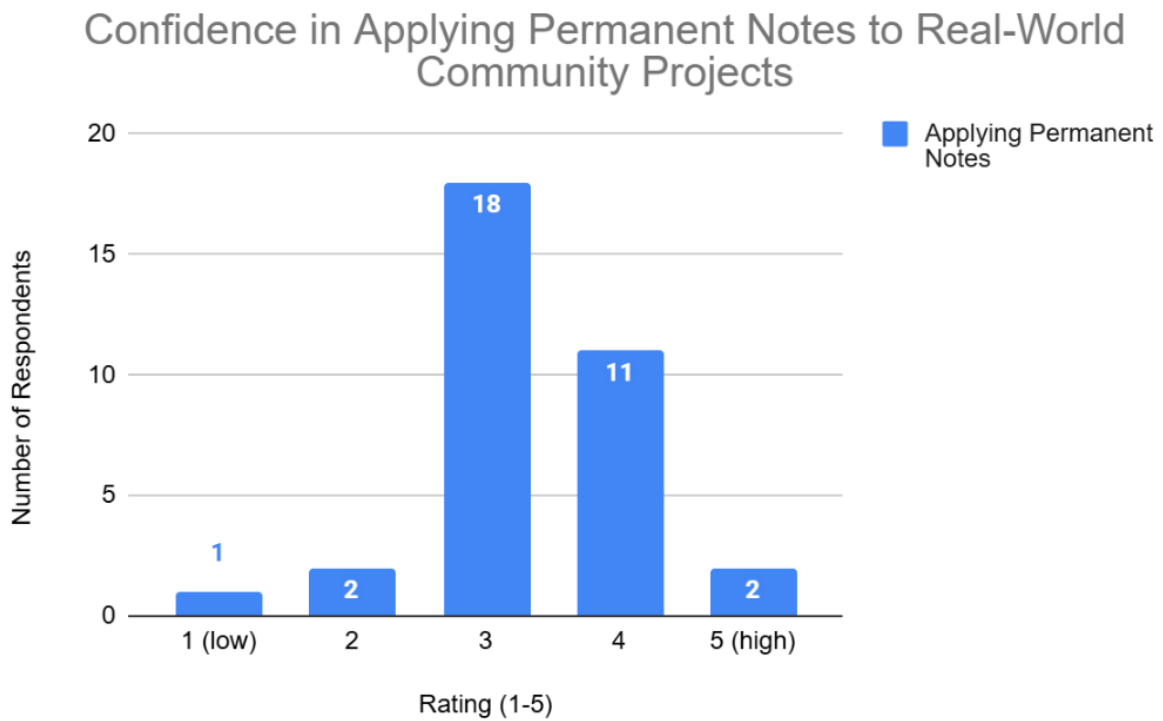


Figure B.8.

Appendix C: Thematic Coding

Coding of student responses was done with the following questions in mind:

1. In what ways did students engage with aspects of Contextual Engineering as a result of the in-class activity?
2. What indicators of an experiential learning opportunity can be seen among students from the in-class activity?

Table 1: Codes and frequencies for engagement with Contextual Engineering as a result of the ZK method

Code	Description	Example	Frequency
Making connections	Students making connections between ideas	"connect ideas between different sections of the interview, identifying which ideas are recurring themes over the course of the interview"	16
Technological Determinism	Students re-thinking the value and importance of a new technology	"DC may or may not want new infrastructure because they seem content with the wells at each person's house"	6
Positionality/Bias	Students recognizing their own bias and background in relation to the interviews/project	"Learning to view experiences from multiple standpoints rather than just my own eye and lens"	7
Place-based knowledge/perspective	Students valuing community members opinions in relation to the project, or engaging with local knowledge/ways of doing	"each community member holds a very important role"	17
Contextual Listening	Students thinking more deeply about the concepts and ideas presented in the interviews	"Digging deeper into something I would have previously just read over and made a lot more assumptions"	8

Table 2: Codes and frequencies for engagement with experiential learning

Code	Description	Example	Frequency
Real-world experience	Students putting themselves in the shoes of the engineers on site, feeling like they are the ones working on this project	"I felt like I was the one interacting and analyzing Jamie (the person I was making notes on)"	9

Social Challenge	Students struggling with real-world challenges like managing multiple perspectives, and trying to come up with solutions	"learned about the deepness needed to really connect with members of a community"	8
Exposure	Students being exposed to community perspectives and thoughts they normally would not have access to	"by reading through some of the interviews, I could see different perspectives of the different people on the project."	14

We correlated other experiential components of the activity with their outcomes on student engagement with STT and contextual Engineering:

- Reading through multiple interviews helped students see different perspectives on the same problem, aiding in their ability to see the community as a non-homogeneous population with sometimes conflicting ideas
- The questions on the predictive tool were challenging for students to fill out since the interviews they read only offered a small piece of the overall nature of the community. The act of attempting to fill out these questions give this limited insight caused many students to recognize the value of direct observation and listening in understanding societal conditions and achieving assimilated viewpoints. This helped students realize that ZK method is not a conclusive means for achieving an assimilated perspective
- Giving students a tangible case-study to reflect upon allowed the course instructors to identify technologically deterministic mindsets and push students to reconsider their own perceptions and biases

Coding of student responses was also done in an attempt to discern what aspects of the activity students engaged with. The following question guided our coding:

1. What specific aspects of the in-class activity helped facilitate STT among students?

Code	Description	Example	Frequency
ZK method	Note-taking/Obsidian software/Making connections	"By documenting the individual notes, I could see patterns more clearly than I would have if I simply read the document"	31
Interviews	Reading through interviews	The interviews I read today helped me realize that each community member holds a very important role."	21
Reflections	Reflecting on interviews		0
Predictive tool	Answering predictive tool questions	"While answering the (predictive tool) questions, I felt like I was the contextual engineer who analyzes the	6

		conditions and context of the community as well as their problem in water or contextual fingerprints in the area of cultural, mechanic, education, political, and economic.”	
STT	Students displaying an awareness of social, cultural, political, economic, and environmental factors amidst the technical design process	"The couple values the water project, but they also understood why some community members resist it - the small population size, existing wells, and economic concerns about who would pay for shared infrastructure"	12

**Note that students did complete a set of reflection questions after each interview, however those responses were not coded so there are no codes associated with that aspect of the activity.

Appendix D: Student Open-ended Response Data

Responses to the question “Based on the interviews you read and took notes on today, what progress do you think you made towards achieving an assimilative perspective?” which was asked after the first day of instruction with the class activity

I feel I made progress toward an assimilative perspective by starting to connect different aspects from the interview into a more complete understanding of the project's context.

It allowed me to connect ideas between different sections of the interview, identifying which ideas are recurring themes over the course of the interview. It also gave me a more visual understanding of how each idea connects to the others.

Talking with the locals definitely helps with gathering more opinions and the context needed to determine whether the proposed water project should be built. This is positive progress.

I feel I've made much more progress in understanding how the assimilation perspective is formed. Taking notes the way I did in Obsidian made me realize that assimilation happens when you take the perspectives of multiple stakeholders in a situation and consider how those stakeholders might think about another and interact with another based on information that you collected on them. Specifically, this information has to come from them, this is the literature notes. You then have to interpret these with fleeting notes to develop a perspective, and Obsidian allowed me to see this process in clear view.

I think I made some early progress towards assimilation, but it would take a lot more time and effort into note-taking to get there. Seeing the perspectives of two different community members and making connections between them helped me gain a deeper understanding of how they viewed C&C and the water project.

from the interview I have found that the patronato has community meetings and allows the people to decide if they want to go on with the project or give suggestions. from the Jaime interview I learned that many people in the community have a well of their own. In addition, the community thinks the project will require a lot of funding that the community cannot get. The topic of the project also caused some disagreements among the community. Lastly, the community does not use their wells for drinking.

Without further ado: I think considering the stakeholder perspective on the water project helped me understand an assimilative perspective. Jorge talked about how the water project might not be necessary, and that there were "problems" in the community that needed to be "solved" before acknowledging the water project as a "super optimal" way forward. The community needed to be bigger, more representation in the community meetings, and people not being willing to pay themselves for water being an example.

I have made progress toward achieving an assimilative perspective by collecting data and gaining perspective through analyzing the interviews that were conducted.

I think being able to take notes helps the brain remember more and helps towards achieving an assimilative perspective. It allows you to reflect and be more mindful.

Based on the interview, significant progress was made toward an assimilative perspective by moving beyond the surface-level reason of cost. The interviewer learned that the community's decision was fundamentally driven by a desire to avoid the social "responsibility" and potential for conflict that a collective system would create. This deeper understanding revealed their true priorities, such as a community center, and the value they place on the independence and predictability of their existing individual wells.

I do think I made progress toward an assimilative perspective, but it would definitely be very difficult for me to reach simply because I do not have that much exposure to other communities. Maybe not harder, but it would take more time and require me to live live with them.

Based off the interviews we analyzed today, I feel that I made progress to assimilation since I learned about the deepness needed to really connect with members of a community and I also learned that lots of dialogue and discussion is needed to understand their cultures and values, and arguably most important of all, their needs.

I think reviewing the interview did definitely help with assimilation. I was beginning to mentally humanize a member of the community, with their style of speech, their opinions, their experiences, etc.. And I didn't even go through too much of the interview. I definitely think that if I were to go through much more of the interview, as well as more interviews, I would be able to read into subtext of Dos Caminos society, thereby helping with assimilation. But that would require a LOT of time spent on analysis. Still a really nice exercise.

I started to understand the residents' concerns and why they were hesitant to move forward with the project

I think there was some progress that was made, however I do think there is a large scale of confusion among the population. Many individuals do not go to the meetings for various reasons, which I think is limiting the progress that can be made.

I made progress towards achieving an assimilative perspective by helping me understand common themes and problems that are brought up by members of the community.

I think I got a better understanding of what the community wants and what is important to them, but I still don't quite understand the underlying motivations. I am probably near attestation right now.

From this interview, I learned to better understand the community's point of view. Jaime explained that the water project was not rejected because people didn't want it, but because it would cost too much and be hard to maintain. Many people already have their own wells, so they don't see the project as necessary right now. I also realized that being responsible and paying for shared projects is a big concern for the community. This helped me see that real progress comes from listening to what people actually need and making sure projects fit their situation.

I feel like the interview helped me to understand a situation from another person's perspective better. Each person has their own idea and way of tackling a problem and, with these interviews I feel like I could better understand them. This was especially evident with Chris and Jaime. I think this activity definitely helped me become closer to achieving an assimilative perspective.

I honestly don't know if I achieved significant progress to an assimilative perspective. I do not normally think like this. My mind is very chaotic and never shuts off so I need to sort and file away my thoughts to not get overwhelmed, the exact opposite of the non-hierarchical Zettelkasten method. This 'freeform' notetaking method is such a drastic change from the way I usually think that I would probably need to do more notetaking in this manner before I could conclusively say if this helped me progress towards an assimilative perspective. To quote my favorite short story, "There is as yet insufficient data for a meaningful answer".

I think I made progress because I understood the values and priorities that people have in the community. By documenting the individual notes, I could see patterns more clearly than I would have if I simply read the document. I think this is an extremely useful tool that I will use in the future.

I think I learned from the interviews how to ask questions that give good insights into understanding community perspectives and context. This will help me achieve an assimilative perspective because I can ask better questions to others that I interact with to better understand their perspective.

Jaime is still in awareness phase, he doesn't know the specifics of why the community does what they do.

While I don't think it is possible to achieve an assimilative perspective with the information I have gotten, given I had very little prior knowledge of the community and its structure in DC and more so gained some level of awareness of the issues in DC. However to build my perception to the level of assimilation would likely require spending time with the community to gain a firsthand understanding of the community. These interviews are primary sources but still perceived and organized through the lens of a "Interviewer."

I felt like I was the one interacting and analyzing Jamie (the person I was making notes on). I also realized something new that maybe the interviewer could have had personal biases while asking the questions. It is a great tool I hope to use in the future.

The progress I made towards achieving an assimilative perspective was achieved by critically examining the different perspectives and raising comprehensive questions. Assimilation from the model of the contextual levels of perception is derived from deep understanding, high input from the community, and incorporates place-based capabilities, beliefs, and values. If I only analyzed the interview with Chris, I would never be able to identify the feels and perceptions that have been going on among the community members.

It was interesting seeing actual thoughts from the interviewees and their unfiltered opinions. It definitely made me understand assimilation a little more, and how it looks from the perspective of the one being assimilated, even if they don't know it.

I've made progress towards an assimilative perspective by learning about the community's perspectives through the patronatos.

The interviews I read today helped me realize that each community member holds a very important role. Even those who do not participate frequently have an impact on those around them by changing the outcomes of decisions. These roles are all so different and it's necessary to see each perspective clearly and without bias to become more assimilated. Going through these note-taking techniques also helped me understand how everything is intertwined and overall how complex things can become when trying to account for everyone's views. This is not a bad thing whatsoever and it can help shift from attestation to assimilation.

I think based on the two interviews I read and took notes today, I think I made progress about idea of approaching into the community, going from the awareness to possibly the integration. By taking notes I learned although in the same team or community, the solution differs and thinking process differs. For example, at Jamie, while at the meeting with C&C some people agreed and some people didn't agree upon whether should the project be needed and there are available resources for the community. It is because not only due to the cost, most people already have wells and they also don't have much land to build the project. In addition, in Jamie's perspective, while he uses water for chores, chores like cleaning, showers things like that, he doesn't use it for drinking water maybe because it's not that steady, clean or safe water.

I think I was dabbling somewhere between awareness and attestation. Without actually visiting the community it is hard to know my perceptions and assumptions to be able to distinguish them from other stakeholders, but this was an interesting way of engaging with information and being able to connect ideas to each other. For example taking ideas from two different people to form an overall perspective.

Learning to view experiences from multiple standpoints rather than just my own eye and lens. Listening secondhand to individuals talking about their backgrounds and values and how their community works helped me connect their perspectives to my own understanding.

I think that taking notes allows us to better understand the information and further interpret our findings. As the notes become more cohesive, are perspective assimilates towards those being interviewed. I made progress towards an assimilative perspective because my knowledge of the water project has grown.

--Based on the interview that I worked on today, I have been able to gain a deeper, more detailed understanding of the community's viewpoints, priorities, and constraints:

- The couple values the water project, but they also understood why some community members resist it - the small population size, existing wells, and economic concerns about who would pay for shared infrastructure.
- Their responses hint on a consideration of collective responsibility and a desire for unity while also revealing dependence on outside organizations like C&C for support and decision-making.
- Sandra's emphasis on education and opportunities for children shows how aid is valued not just in material value but also in the cultural/educational value.

By listening closely to how their perspective on such elements, I managed to learn how cultural context, local participation, and communication shape whether projects succeed or fail.—

I think I have made good progress achieving the assimilative perspective as I was able to get the opinions and perspective of someone like Samatha, who has lived in DC. I was able to know how many people have their own wells in Honduras, but many still need to buy botellones as the water is not good for drinking and cooking. She also likes the current members of the patronato.

Working directly with input from a community member, rather than just hearing about it and paraphrasing in class, was definitely helpful in making progress towards an assimilative perspective. The interviews provide a deeper understanding and can allow for the incorporation of the beliefs and values of the community, which is a key step in moving from awareness and attestation to assimilation.

It made me look at what was said through multiple perspectives and clarify every thing that was said. Digging deeper into something I would have previously just read over and made a lot more assumptions really makes me grow with my perspective.

I can't tell since I only happen to get to one and spent the most time trying to understand the platform

None. I have no idea how these interviews relate to anything. This is not a case study we have dealt with before, so these few scraps of information don't really provide any kind of context for what's going on.

I think I have gotten some insight into the community members' feelings and community structure. Though I am in no way assimilated, however, I'm progressing through the levels of perception

I believe that though much more progress is required, I have taken the initial steps in the right direction to achieve that perspective.

I think I've made some progress towards understanding the structure of the community and how past projects have benefitted them, but I'm not super close to developing an assimilative understanding just yet. Since we didn't have a lot of time today, I was just starting to gain a sense of the community at the beginning of the interview and their general values and culture. I think if I had actually been on the ground, also conducting these interviews and taking notes on top of that, I would've come pretty close to assimilation after reviewing the interviews and taking notes on them - the note taking process is very insightful for getting a sense of base values within the community

I think I made good progress towards disregarding my own experience. I had very few opinionated thoughts based on my own experience while reading Samantha's testimony. Subconscious bias may have still played a part in the way I took notes, but overall, I think I definitely reached the stage of attestation and made progress towards understanding the situation from Samantha's point of view.

Although I disliked the note-taking style, I do think that reading the interviews and getting community perspectives helps create a deeper understanding. Over time, I believe this will help me achieve assimilation with the community.

I made progress toward an assimilative perspective by understanding how Jaime's community values practicality, responsibility, which helped me see development choices from their local viewpoint rather than my own assumptions.

I took notes comparing different perspectives, especially noticing how both individuals supported the idea of collective progress but were hesitant if they felt the burden would not be equally shared. These reflections helped me better understand the social and cultural dynamics influencing decision-making within the community. I will upload the interviews and my completed notes for review.

Based on the interviews I read, I learned that it is important to keep in mind community context while working on international projects. For example, the rejection of the water project was not resistance, but a response towards the financial burden of the community. This helped me understand the project in their perspective and needs.

Through today's interviews, I learned to understand community perspectives instead of judging from my own view. Listening to Jaime helped me see how priorities like street lights or a community center can matter more than a

water project. This made me more aware of cultural and practical differences—an important step toward an assimilative perspective.

I make a conclusion of the people's words, arranging them together to find connections, which provides me with a new perspective to consider their interview.

--understand the aspects from the local

jaime 's community don;t need the water project

they already have good wells, they don;t have enough money to maintain—

I think that by reading through some of the interviews, I could see different perspectives of the different people on the project. This helps me become more informed on different viewpoints and positionalities that would help in making future decisions.

I think that I got a perspective of one of the elders of the community, whose perspective was from the point of view of the community, and not just from the Patronato. I think that I was able to see into the daily lives of the regular community members, and they all have similar feelings about the project, which differs from the Patronato.

Student response to the question “Did you make any permanent notes today? If so, how do you think your perspective of the community changed based on these notes?” which was asked after the second class period containing the activity

I now view the community as being smaller than I previously thought. I noticed this because the residents believed the community needs to be larger to make it worth starting a water project, especially given the limited resources. I also noticed the residents don't seem strained by water scarcity. It doesn't bother them that if they don't have a well, they have to buy the water.

Yes, I noted that the community seems not to prioritize the water project. I thought that there was a big need for the water project but my perspective changed after the interviews, and I know now that it's not a priority to most people.

I made a permanent note about how the community views the water project and why. Collectively, it seems that the community initially liked the water project that was proposed by the C&C. However they only liked the idea of the project because they didn't realize they had to pay for it. So when it was revealed that the community would have to pay for the water project, most people didn't support it anymore. However it wasn't only because they had to pay for it. The community is more than happy to pay for projects like streetlights, which is commonly regarded as necessary. They don't want to pay for the water system because they already have their own water wells. Since they have their own water sources, they would rather prioritize other projects.

No, I didn't. However, if I did, I would probably make it on the facts that most of the community has their own wells, with good quality and reliable supply, and that the community has a much more pressing need in their lack of streetlights. This definitely changes my perspective because it helps me understand why the project seems so unnecessary to them, since they would rather spend that money on a streetlight project that would benefit a much larger proportion of the community.

The community thinks having street lighting is their top priority.

People in the community don't like how they will have monthly payments with the water system

From these permanent notes I think the community is not necessarily worried about the financial burden of monthly bills but the fact that majority of DC has their own wells that they can use for free. The community does not seem as enthusiastic about the water system as they are the street lighting. From the interviews, when the people were asked what they thought the community's main priority was they all said street lighting first. When they were asked if the

water project was necessary they had a very middle ground response. They acknowledged that it will help, but not everyone needs it. This is what makes me think they are less enthusiastic about the water system than the street lighting.—

I made the permanent note that the main concern for the community was economic. My perspective on the community changed due to some members still being willing to contribute to a project regardless of having a well. This says that the economic concern isn't greatest for everyone in the community.

I did not because I did not finish Samantha's interview. It was interesting to read the change in perspective that the water project isn't as needed as other things such as lights and education for children.

No.

As I read through the interview between Jorge and Sandra, I noticed that they are not really in need of water system. They stated that they are more in need of the convenience such as street lights. This changed my perspective of the community pretty significantly since I also thought they are desperately in need of the water system.

Yes, I think the perspective of the community changed to be more worried about not having a water project than anything else because they view it as a major waste of money.

Yes, I made permanent notes about what the community feels its needs are and my perspective has changed because I now have a better understanding of what the people want and expect.

Yes, I made a permanent note talking about how the community is tight-knit, but lacks physical infrastructure to harness that. It made me view the community as capable of building the water pump and maintaining it, if not for the fact that they have many other issues that they would like to address first. However, other community members are probably ok with the water pump, as it does not necessarily *worsen* other community topics that are being addressed.

I did not get to that, but what my plan was to talk about the feelings towards C&C, some positive and some negative

I did make permanent notes today. I think my perspective of the community changed based on these notes because I visually recognized a similarity that the interviewees had, which was an openness to new ideas. They had thoughtful insight into their community and I have a stronger sense of confidence in hearing first-hand witness experiences that resulted in effective, self-reliant change.

The biggest thing I noticed was a lack of responsibility and authority of the government and people in power. Additionally, Jaime seemed willing to change and improvement.

--Yes, I made some permanent notes today, and I think they really changed how I see the community.

Before, I thought people might've turned down the water project because they didn't care or didn't understand how helpful it could be. But after listening closely and writing things down, I see that they actually do understand, they just have their own reasons. They think about cost, responsibility, and whether everyone will actually follow through. It's not that they're against change; they just don't want to take on something that could cause problems later.

The notes helped me notice how much people value independence and being able to take care of their own homes. Jaime seemed proud that most families already have wells and that their water is good. I also started to see how much trust matters, they believe in C&C because they showed up when others didn't.

Overall, I feel like I understand the community better now. They seem careful and practical, and they want projects that fit their reality, not just something that sounds nice from the outside.—

My perspective of the community changed as I realized that people have really different priorities and ideas of what's fair. Through my interviews, I saw that things like having a private well shape how someone views a shared project, and that trust and communication play a big role in whether people get involved. I started seeing the community not as one group but as a bunch of individuals with different motivations, all connected through local institutions.

I made one about how a lot of people seem almost more interested in a nighttime lighting program than the water project. I am honestly unsure where I'd go forward if I was put into this position myself. Would I try and pivot? I don't know. I need more data before I can provide a good answer to that question.

I did not make any permanent notes today because I still do not understand the dynamic and sense of community they have. Sometimes it seems strong and tight nit but at other times seems harsh.

I didn't make any permanent notes yet, because I only finished one interview. I want to cross-check my information a bit more before making a permanent note.

I did make some permanent notes. I think that my perspective changed because I connected multiple ideas that help me understand the context in the community and their needs.

I didn't make any permanent notes today but I noticed that the cost to make the project is an issue, so maybe I could make that into a permanent note. Also that people didn't want to pay the bills for the project. I'll need to look at other interviews to make a better permanent note that is more accurate.

I made 1. "The community is divided over this new source of water." - I think that my notes have only raised more questions on why there is this disconnect as many members of the community buy water, yet are unwilling to pay for a water project.

I made a permanent note on my understanding of what Chris says about DC taking long to make decisions which emphasizes the fact that DC may or may not want new infrastructure because they seem content with the wells at each person's house. It also seems developed which changes my original perspective thinking they may need a new water source

I made some permanent notes on similarities I found between different interviews. My perspective of the community definitely changed through these notes because it appears that this water project isn't even wanted by the community among other priorities, like electricity and lighting, as many members of the community already have a well.

The community is content with the water they have for cleaning and miscellaneous use, and want more community representation within meetings.

Based on these notes I learned to immerse myself into the community matter and be more observant with the communication process. Especially while making the notes on the score chart, it helped me re-evaluate the scenario in more keen manner. I was able to make a permanent note on it.

A permanent note I created today said "the DC community places a large value on shared responsibility". I think this note gives perspective to why members are more reluctant to implement the water system when it comes to paying or maintaining the system.

No I didn't make any permanent notes but I made progress towards making some, or I think I could have. My biggest takeaway is the dynamic of the relationship between community members and C&C. It seems the community has a low cultural identity since they aren't on the same page about the needs of the community and many don't attend meetings. Most people agree the water project isn't a priority because they have their own wells.

I did not make any permanent notes today.

My initial thought about the responsibility of the community was they didn't try to pay for the water because its expensive. However, now I realized not only the cost and price but there are also feelings of responsibility and burden contributed although the people with the wells have to pay more price than the community water.

I didn't make any permanent notes today, but hearing from more people helped me think differently about how decisions are made within the community. Even without writing notes, I noticed how much people care about responsibility and fairness when it comes to new projects.

I only made one permanent note about money in the community. Didn't get far enough to see a huge impact from it but I could see them as being helpful anchor points for past points and new points as I start to notice patterns

Yes, I did make some permanent notes on Jaime's interview. I've learned that the community has different perceptions of "fairness", and we need to figure out what those perspectives are in order to be the most fair to the most people.

I did not make any permanent notes today, as I was focused on understanding the context of the interviews and how/why they were being conducted. If I had made permanent notes, I think they would have changed my perspective of the community by understanding their current struggles more in depth and aligning my perspective to match their interests. This change in perspective would allow me to consider how the water project may impact the community.

--Some of my notes are: The agreement made in the meeting is not inclusive of all stakeholders and as such led to the subsequent dissent towards the project, A sophisticated water project at DC under any scale would be unnecessary, as its cons would overwhelm its benefits.

My impression of the community is that their use of wells and the lack of resources and will to cooperate renders the water project as unrequired.—

No, I did not make any permanent notes today.

The community has different priorities than water, but was not able to express these because they were never given the option to choose their form of aid, and so agreed to the water project.

I made a couple, however not much changed, the interview I read today was similar to the one prior. But I did get to note how despite his access to LS water, he still needed to buy water to consume. This makes things a bit different, even people with access to water already can benefit greatly from the new pump.

I did not make any permanent notes yet

I did make some permanent notes today on two interviews, and it changed my perspective of the community into a view of do they really need this project or are we're just telling ourselves that they need it.

No, I did not make any permanent notes.

I have not made any yet

Not yet, but I am starting to connect some themes and shared worried among the community.

No permanent notes were made

I did not make any permanent notes today because I only got through one interview, but the literature notes I made today have shown me that the perspectives of people in the community on the water project are probably more

nuanced and complicated than I could get from the one person in the interview I was reading. I'm really curious to know more about how the community operates and how it approaches the inequality between people who have wells and are buying botellones to supply their drinking water vs. people who depend on LS for their water supply.

No, but I think after the reflection I can put my ideas together of the notes I took. Especially about the community and if they do or don't want to do this project.

Yes, I made notes about how many people already have their own wells and how much they care about responsibility and payments. Try to connect some idea together. My view of the community changed because I see they are not against new projects, but they just want to make sure everyone is responsible and that the project is realistic for their situation.

Reading the interviews helped me see how the DC community is about big decisions. They think about long-term responsibility, not just short-term change. It made me view them as a group that really values unity and practical progress.

I did not make any permanent notes today, but I feel like they will become useful when I finish all the interviews.

We have to consider and find a way to get most of the people's idea in a community if we want to build some project, like water project.

Yes, I was able to understand the overall consideration of larger amount of residents towards the project and organizations.

No

I made one permanent note mentioning how the community will have to bear a lot of responsibility for the water system if it is installed. My notes made me think that some people may not fully understand that the maintenance and continued operation of the proposed system falls on them and not some outside organization.

I didn't

Student responses to the question "How did it feel attempting to answer the predictive tool questions yourself?" after the third day of class instruction with the activity

Difficult. A lot of looking back and forth. Also, a lot of predictions had to be made.

Some questions were difficult to answer since we were using evidence from only a couple of interviews. However, I feel like it did make me aware of all the areas where I lacked sufficient understanding of the community. This would help guide the kinds of questions I ask in future interviews if I were actually involved in the project.

It was fun since I had to infer a lot about the way they lived, given I could only read 4 interviews. Some I felt were not answerable given the limited information in each interview.

Using a predictive tool can only do so much with answering these questions. I feel like it would be good utilizing contextual thinking to answer to the best of my abilities. Though it may not be 100% accurate, I think that the predictive tool can still be helpful.

It was very hard because we only had a very small number of short interviews, and the interviews only focused on the water project, so much of the context outside of that was not available.

it was really hard since all we had to go off of were the 3 interviews. I'd rather have had at least a bit more background on the community.

It was extremely hard to answer most of these questions because I obviously wasn't there in the town. Understandably, most of the questions are meant for people who are actually living among the community so I wasn't able to get a good idea of specific things. These things are questions like "is there upholstery" or "what is the average age." However some of these questions really made me use my brain and think really hard about how the people of DC live.

It often felt like the information was too limited to make an inference, especially about things like upholstered furniture and community leaders' ages. On the other hand, it felt satisfying to be able to make a clever inference from an unrelated piece of knowledge, like inferring that they have mostly paved roads based on the fact that Jaime owns a motorcycle shop.

it was difficult to answer some questions with the little amount of information we were given. In addition to not being able to see the community and be there personally adds to the difficulty.

It was cool. I think it enlightened me on how I have to make a ton of assumptions to move forward since I'm not doing a site visit and I don't know the actual state of living for this community

It was hard with limited information about the community. Since we were not present in the community and weren't able to observe it, a lot of the information was not available to us.

I felt very limited by only getting to read the interviews and not see the community. The interviews were focused on the opinions of the water project. I was only able to get other information by people expressing other wants/needs instead.

I think answering those questions only by myself is really hard, since I'm not able to notice all the details in the interviews. Combining our group's opinion helps a lot on answering the questions.

Overwhelming and had involving discussions with group members for a lot of questions.

Easy but some of the information was just not in the interviews

It was definitely a challenge for me and my group since for many questions, we felt that we simply didn't know enough about the community and we had to infer a lot of things. I feel if we were there in person, or we had some visuals, we would definitely get a better image of the situation.

It was nice piecing together a fuller picture of the community based on fragmented information. It helped us understand the minutiae that we otherwise would not have taken into account.

very difficult with only 3 interviews to work with; would be far easier to get concrete answers if we were on-site

It was a bit hard because I only got to 2 interviews. There was some questions that I did not feel like were mentioned very well in the text. However I think I understood it for the most part

It was challenging because I had to make a lot of assumptions.

It was difficult to answer all the questions without knowing the community that well. It probably would have been easier if I was actually in the community.

I thought that this was a pretty fun activity because although I made notes on each interview, these questions made me go through each interview and analyze it in greater details since each question was so detailed.

I felt like it was really hard and a bit confusing. We had to use condensed information and had to use extrapolation at times to come up with the most reasonable answer. It really forced me to think critically, but I like the rationale and differing perspectives my groupmates offered.

Some of the questions were easy, others functionally impossible. How the hell am I going to guess the level of alcoholism without being there? If it's anything like Colombia, probably on the high side but you can't just call that with the information we're given in the interviews. People also disagree on things, which the tool fortunately appears to plan around (people disagreeing tends to be part of the parameters for judging a score).

It felt overwhelming since I did not have adequate information to answer many questions. I fought a lot with my team members about the index.

It was difficult because we hardly had any information to base our answers on and we weren't there. We couldn't answer most questions because a lot of them weren't mentioned in any of the interviews.

Some questions we couldn't figure out directly from the interviews and we had to infer about some things. Also, on religion the interviews didn't really talk about it but maybe it's something the community doesn't want to bring up, but we aren't too sure.

Difficult given the massive amount of missing context and information. Many of these questions would be difficult or impossible to answer confidently without visiting the community.

Not awesome. The interviews were helpful for a few of the questions but otherwise did not provide anything useful. I inferred what I could based on past lectures or presentations, but am not really confident in most of my evaluations. I wasn't able to finish all of the questions either, as I kept rereading the interviews hoping I'd find something I could make a guess off of.

Many of the questions couldn't be answered with the questions since we aren't physically in the community but it gives us a chance to think about the things that normally wouldn't be thought of.

It's more difficult when you aren't present for the interviews yourself, because you can't see much of the context behind the interviews which helps answer some of the predictive questions. You also have no control of the interview questions, which leaves many of the predictive questions impossible to answer with confidence.

It was a bit difficult to use my own thoughts to form answers about the questions because I was given limited information about a community I knew nothing about, outside of 4 interviews of community locals. There wasn't a lot of information to go off of from the interviews, and a majority of the questions had to be inferred or labeled as unknown because of a lack of information.

It was a tedious job to mark the score one by one and write the reasoning behind it, but overall, this question's metrics helped me a lot in categorizing things in a more objective manner. I have also identified the key aspect of the community by investigating the fact that community members want a more engaging system from this program.

Especially taking farmers and other community members into account gave me a much fresher perspective, since their purpose and needs for electricity and infrastructure are totally different. I found that there's a possibility that the normal residents and the farming residents may have different interest understanding on visiting technology because their life experience and infrastructure is quite different.

I felt very uncertain attempting to answer the predictive tool questions myself. The interviews barely covered how they community members are actually living, and focused more on the water system and what they prefer in terms of that.

It's difficult. There are so many questions which we can't answer just based off of the interviews alone. These are the kinds of questions that you would need to visit the place on your own to be able to answer.

This process was difficult due to lack of content and the interviews were not centered around these questions. For this reason lots of things had to be assumed and ultimately predicted from the information we were given. This process would hopefully be much easier once immersed within the community itself and seeing it on a deeper level.

While answering the predictive tool questions, I was confused by some of the questions such as about spiritual beliefs or cultural beliefs and their behavior association. Still, with my group teammate, Zain, we could answer the questions well enough. While answering the questions, I felt like I was the contextual engineer who analyzes the conditions and context of the community as well as their problem in water or contextual fingerprints in the area of cultural, mechanic, education, political, and economic.

It was very hard since I was thinking about how I should answer the question and if it was fully correct or not. Which made me think of how other groups of people, when coming into a community, would tend to this without getting more people's thoughts on it. This is why I'm very grateful for my group, since thinking over the questions with them made it easy to answer and think. Yes, it was really difficult to answer these questions by myself.

Very difficult especially for things that required observation of physical features like age or infrastructure, and with interviews so focused on water there weren't a lot of other topics touched on

It took a lot of back-and-forth research and looking through my notes, but I feel semi-confident that my answers reflect the information given in the interviews.

It was difficult to answer the predictive tool questions ourselves because it felt that a lot of critical information was missing. Our group was able to collaborate using our knowledge of different interviews to come to a consensus about certain questions; however, there were still many we had to make inferences. Overall, we were more confident on specific questions that had been mentioned in the interview, but more interviews would be helpful in answering questions about the community.

I felt there were many questions whose themes did not appear in the interviews.

it was a little bit stressful, but overall it was fun to do. I think I go to learn more about the community this way.

It was harder than I imagined. The limited information from the interviews made it difficult to agree on a direct answer to most of the questions - we did our best to not make any big assumptions and only work around what we read from the interviews. Being there or having access to interviews with other members of the community would have made this task easier.

It felt and was objectively quite hard. Not only did I myself not know very many of these, but together as a team we were still confused. It is very difficult to try and connect everything and be accurate.

A lot of stuff isn't mentioned during the interviews so it was a little hard.

Even though we read the interviews it felt like we were guessing on a lot of questions because there wasn't a lot of information but overall it wasn't hard to answer the questions.

It felt pretty hard to make an assumption. We were making the ranking with the number for all the questions and later did the justification in case of different ideas.

I didn't fully understand the community's structure and living conditions. A lot of the questions ask for information that doesn't really come up in the interviews, given the context of well building. Things like home infrastructure and spiritual beliefs didn't show up in the interviews I read. I had to make many inferences and have low confidence in my answers.

It was a fun and interactive activity, allowing me to discuss with my teammates the various similar (and different) inferences we had after reading the interviews.

It felt alright, there was a lot of information we didn't know because of how few interviews we had and how they were conducted. Since the interviews were conducted primarily to assess the popularity of the water project, we didn't get to learn about a lot of factors like culture, infrastructure, or education, so many of the slots on the predictive tool we had to leave blank. This demonstrates how engineers who focus solely on the technical aspect and not on understanding the community as a whole will have severe knowledge gaps when it comes to the context of the community, which can negatively impact the project.

It was hard especially when there were things not explicitly stated. Going back in the interviews help and trying to make inferences on what was or was not said.

It felt a bit challenging but thoughtful. Some questions didn't have direct answers, so we had to infer based on interview details and patterns in the community, and for some questions that are too hard to figure out, we will just basically say not mentioned. It encouraged reflection and helped connect evidence from notes to broader community understanding.

For many of the questions, there was no information available, so we either had to infer or Google, which felt a little disingenuous to the actual state of the community.

It was really hard to answer some of the questions asked by the predictive tool so I had to make inferences about the data given.

Not too hard but part of the question I can't answer because I am an international student. I need to follow with my teammate for these questions

It is easy for using the notes made before to find clues to answer the question on the predictive tool, it make me feel not so stressful when attempting it.

It's a good way to evaluate the condition of the village

I was sometimes very confused, as many of the questions just didn't seem to have an answer that I could find. I think this was due to the small amount of interviews and resources that I had to answer the questions, which ultimately led to few answerable questions.

It was very hard because some were about the inner thinking of residents or some aspects of their lives that we had no idea about.