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Exploring Engineering Students' Perspectives of Instructors' Test Beliefs and Behaviors: A Secondary Data Analysis by Current Undergraduate Engineering Students

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Introduction

Instructors' or teachers' belief research is one of the key components in efforts to improve teaching and learning in engineering education research. Documented works have widely shown that beliefs shaped instructors' behaviors and practices in the classroom [1], [2], though nesting, conflicts, and tension between beliefs and practices do exist [3]. Although such research is abundant, research on how engineering students perceive instructors' beliefs and behaviors is scarce. It is important to explore this side of the research domain because learning and teaching are interactive activities that involve a community [4], [5], and centering student voices in the dynamic between students and instructors is crucial in advancing a student/learner-centered philosophy and efforts in engineering learning and teaching [5]. In our study, we engage with student perception research by having current engineering students conduct secondary data analysis on an existing data set on instructors' beliefs on test usage in fundamental engineering courses. The process involves having the undergraduate researchers, Alshanti and Thu, 1) reflect and make explicit their positionalities and 2) code the existing data set to understand how their positionalities as current engineering students shape how they analyze the data.

Motivation

Education literature on student perceptions of teachers or instructors' behaviors and teaching practices is abundant, with the focus on various facets and contexts of such research. Such research is important as student perceptions of their teachers' behaviors can shape learning outcomes [6], [7]. Many of the studies have specific targets in terms of understanding the behaviors and teaching practices. For instance, studies that date back decades have explored and tested hypotheses on secondary student perceptions of instructors' control behaviors and power in the classroom. [8] argued that a constructivist perspective on learning should involve exploring "student perceptions of their teachers' behaviors within the context of classroom activities and expectations" (pg. 426), and studied students' perceptions of teacher control behaviors. Students may perceive teacher's behavior, even with the intention to regulate the classrooms, as controlling, though they cautioned that their study did not have data to show relationships between such perceptions and the students' learning outcomes. Another study focused on student perceptions of teachers' confirmation of the students in classrooms, and such perceptions can shape student outcomes and perceptions of teacher's power in the classrooms [9], [10]. Other contexts and facets of student perceptions include biases [11], [12], teacher humor and classroom climate [13], use of social media in teaching [14], and teaching effectiveness, which large part of the research focuses on teaching evaluations [15], [16], [17].

Although research on student perceptions of instructors' or teachers' behaviors is abundant and has shown to be capable of shaping student outcomes, scholarship on student perceptions of instructors' teaching beliefs or intentions is generally scarce in engineering education. From the motivation perspective, especially motivation to learn, understanding perceptions of beliefs or intentions can be important in shaping learning. In the Situated Expectancy Value Theory (SEVT) by [18], one of the subjective task values that students use, along with their expectancy of success, to make achievement-related choices/tasks is utility value. Utility value means how one perceives the importance of the choices/tasks toward future goals [18]. However, such future goals may not have direct relevance to the future goals, such as taking a math course to prepare for being an engineer. Abundant research has argued that interventions on students' perceived utility value of their choices/tasks can improve their subsequent motivations [19]. Although much of this research is on how useful the content is to the individual student achievement-related choices/tasks, we argue that exposing students to the instructors' intention and beliefs behind their course decisions is a manifestation of informing students of the utility values behind the decisions to motivate students to choose to work on these tasks [20]. In addition, many have argued that assessments should be transparent for students as part of equity arguments, and understanding student perceptions of instructors' intentions and beliefs on their teaching practices is, we argue, a form of transparency [21], [22].

The majority of research on student perceptions of instructors' teaching behaviors and practices research discussed prior involve surveying the students in the course taught by the instructor. Our study contributes to this domain of research by providing a unique perspective on student perception of instructors' beliefs on teaching practices by having current engineering students research an existing data set of instructors' beliefs on using tests in fundamental engineering courses. We decided on the undergraduate researchers' angle because research has shown that undergraduate researchers can provide more authentic interpretations of the data because they engage with their own lived experiences in the process [23]. In addition, because they are currently engineering students, they are bringing in fresh and current perspectives to analyze these instructors' beliefs on test usage. These are in tandem with the benefits undergraduate researchers obtain through engaging in undergraduate research, such as improvement in cognitive and personal skills, learning research skills, and working on communication skills [24], [25].

As research discussed that undergraduate researchers could engage in their lived experiences for more authentic interpretations of data, we engaged our lived experiences, especially both undergraduate researchers, through the writing of positionality statements. Positionality statements have been a growing phenomenon in engineering education research as part of the efforts to uncover researchers' preconceived notions that can shape how they conduct their research [26]. By reflecting on their positionalities, Alshanti and Thu as undergraduate researchers engage their lived experiences as engineering students to interpret instructors' beliefs and behaviors on test usage. This becomes the foundation of this work that contributes uniquely to the scholarship on student perception of instructors' teaching beliefs and behavior. Considering these setups, we answered the following research questions in this study:

RQ1: What are the positionalities of two current engineering students who are working on analyzing instructors' beliefs and behaviors on test usage as undergraduate researchers?

RQ2: What are the findings that emerged in the analysis of the dataset by these two undergraduate researchers?

Methods

We engaged in secondary data analysis in this study. Both Alshanti and Thu were new researchers who engaged in the existing data collected from Chew's dissertation work, and this is consistent with how existing researchers define secondary data analysis [27], [28]. Researchers in engineering education have argued for secondary data analysis as a large amount of data has been collected in the field, and many research questions could be answered with these existing data [27]. However, secondary data analysis does have its challenges, and [29] pointed out one key challenge is “doing justice” to the participants’ narratives from these data. We addressed this by making sure our findings were described in “thick descriptions” as recommended by [29], and this was based on [29] work in interpretive analysis. Both Alshanti and Thu had not performed qualitative data analysis prior to this paper, hence the process of analyzing the existing data was also a growth experience for them to develop their research skills, concurrently with the importance of undergraduate research [25]. Figure 1 illustrates our secondary data analysis process, showing the interaction among the three authors, with Alshanti and Thu learning about conducting education research with guidance from Chew.

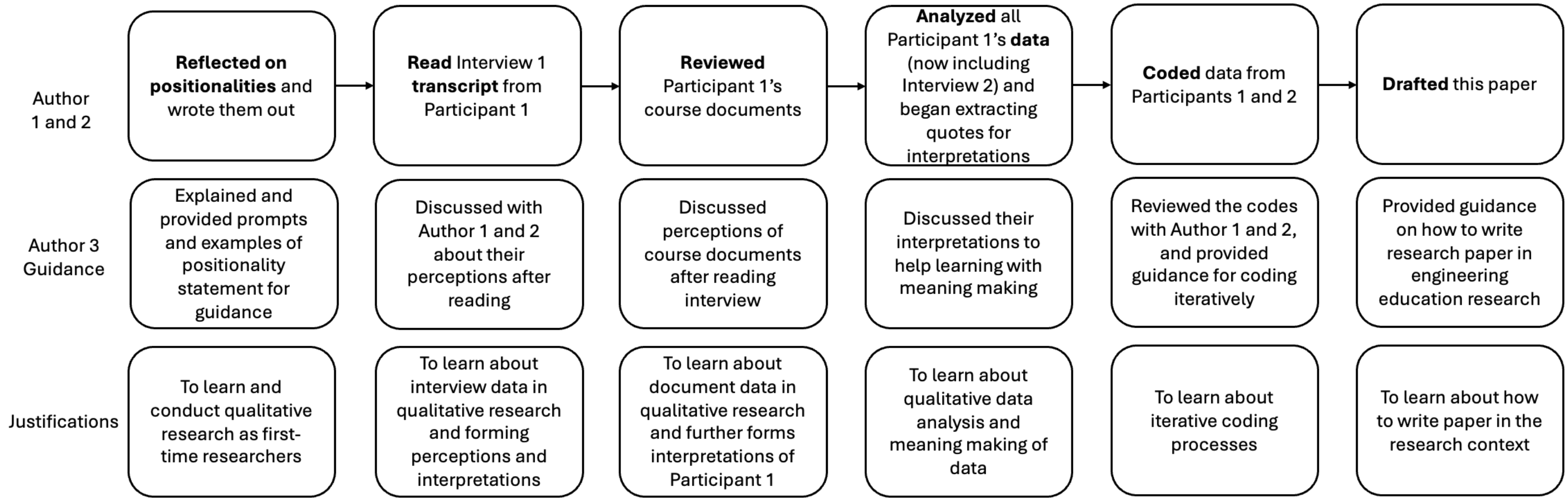
The existing data were collected from Chew’s dissertation study, which was a multi-case study of seven cases (participants), with two interviews and course documents (syllabi and exams) collected from each participant. This multi-case study answered research questions about these instructors’ beliefs and behaviors on test usage in their fundamental engineering courses. In addition, Chew also collected institutional and departmental documents as part of the data as this is consistent with the need to use multiple sources of data to answer research questions in case study methodology [30].

For this specific study, we analyzed data for participants 1D1 and 1D7, because 1) Alshanti and Thu were new undergraduate researchers who were learning about education research and 2) focusing on data from two participants (two interviews and course documents) provided sufficient time for Alshanti and Thu to analyze the data deeply, consistent with the need of detailed analysis as part of qualitative analysis [31].

Positionality Statements of Kai Jun Chew (Advisor)

I am an assistant professor in a first-year engineering program at a teaching-focused institution, who is also a mechanical engineer by training and an education researcher. My identities of being an immigrant, Asian man, and a queer person have shaped my research agenda, particularly from a more critical and caring perspective. For this research, my goal was to provide guidance to Alshanti and Thu on learning how to conduct qualitative research and a learning experience working as undergraduate researchers. In addition to providing the data, which came with my positionalities from the past, I was also transparent with Alshanti and Thu on the data sources and how I interpreted them for my dissertation. In short, Alshanti and Thu conducted the secondary data analysis on the data with some of my positionalities in mind, but I made sure to remind them to take ownership of how they analyzed the data and shaped their interpretations based on their own positionalities.

Figure 1: The secondary data analysis process that guided this research.



Findings
To answer RQ1 and RQ2, this section is organized based on Alshanti and Thu. The presentation of the positionality statements answers RQ1, while the analysis answers RQ2. These sections were drafted by the authors themselves.

Maya Alshanti: Positionality Statement
As a 20-year-old Jordanian/Filipino international student, having spent most of my life in the Middle East before moving to the U.S. in 2022, my unique cultural background deeply influences how I approached data analysis, particularly in test design. My experiences have made me attuned to the nuances of inclusivity, equity, and support in academic environments.

Being an international student has exposed me to challenges like fewer opportunities and limited financial and structural support, shaping my lens on the inclusivity of educational systems. I've observed a recurrent dissonance between the intentions of some engineering professors and the realities of their course designs. While many claimed to support students, their rigid structures—such as strict deadlines and inflexible course policies—often told a different story. This inconsistency between belief and practice is a pattern I frequently uncovered in my data analysis, especially when examining the disconnect between what educators professed about student support and how they implemented those beliefs in practice.

For instance, my professors might advocate for "grade redemption" but fail to integrate it in a meaningful way. Similarly, while they often expressed concern for students' well-being, policies like rigid submission deadlines and accelerated course pacing suggested otherwise. As an international student, I saw how these inflexible systems intensified student burnout and impaired learning, especially for those unfamiliar with the academic culture and even language making it harder to navigate.

This awareness extends to my approach to test design analysis. I evaluated exams not just on their content but also on the external stressors they imposed, such as strict time limits, lack of supportive resources like formula sheets, and the overwhelming volume of coursework. Flexible testing environments, like the no time limit structure in one of my classes, accommodated different working paces and promoted a more equitable learning experience. Flexible testing environments, like the no-time limit structure in one of my classes, accommodated different working paces and promoted a more equitable learning experience. On the other hand, courses that emphasized memorization over application often created unnecessary anxiety, obstructing genuine understanding.

In summary, my background and experiences compelled me to examine whether educational systems truly catered to the diverse needs of students. As someone navigating both academic and cultural unfamiliarity, I am committed to ensuring that test environments are inclusive, supportive, and conducive to optimal performance for all students.

Alshanti: Analysis
My portion of the study examined the effectiveness of testing and highlighted the contradictions between what professors express as their beliefs versus what they actually implement in practice. ID1 frequently expressed frustration about academic dishonesty, stating, *"The only thing we talk*

about is how to prevent students from cheating." This quote reveals a possible frustration that may hint at a pattern in academia: professors, in their efforts to prevent cheating, may sometimes prioritize measures that make it easier for them to manage rather than focusing on other important factors such as student learning and understanding. Another example supporting this belief is reflected in his statement: *"Another consideration when choosing assessments is knowing that, during final exam time, for instance, you won't have a GTA to assist with grading."* This quote highlights how instructors could possibly prioritize logistical convenience, such as the availability of grading assistance, over more impactful measures of student learning and comprehension. By selecting assessment methods based on factors like ease of grading, professors may unintentionally prioritize their workload management over the depth of assessment that accurately reflects student learning. Small remarks like *"the solutions are all out there and students use them"* reflect a possible preoccupation with cheating prevention, adding to the suggestion that instructors may be more focused on limiting academic dishonesty than on enhancing the quality of their teaching, assessments, or exam rigor. While part of my findings indicates a focus on preventing cheating, much of the emphasis appears to also be place on valuing the problem-solving process and progression over simply obtaining the correct final answer.

Through various statements and grading practices, ID1 promoted an understanding-driven assessment style that possibly nurtured student learning, comprehension, and growth in a manner distinct from traditional academic grading systems. This focus on process rather than outcome may hint at an educational philosophy that values the underlying mechanics of problem-solving as fundamental to mastering engineering principles. For example, ID1 awarded substantial credit for showing the correct method, even if the answer was incorrect, which indicates a strong emphasis on students' ability to grasp and apply concepts:*"If you show me the process that you have done, and you do the right process and doing the problem. I will give you 90% of the credit irregardless of if you get the right answer or not."* Additionally, ID1's grading system was flexible, allowing for student redemption. According to ID1, poor performance on an initial test could be offset by improvement on subsequent assessments. This flexibility might encourage continuous learning, as students were not penalized heavily for early mistakes and instead are given the opportunity to demonstrate growth over the course of the semester: *"I make the course so that hey, you flunk the first test, you can still do well in the course because I have a whole system to forgive, if you do poorly on one test…"*

ID1's teaching methods also emphasized the application of fundamental principles over memorization. *"...they do have the time constraint. And so they really need to know what they're doing to be able to do it…I don't want them to memorize equations and throw them on the test..."* While this approach was intended to promote problem-solving skills, it might also suggest a tension: the professor's imposition of time constraints might inadvertently pressure students to prioritize speed over in-depth reasoning. This could possibly lead some students to fall back on memorization strategies to manage the limited time, which contrasts with ID1's stated goal of discouraging rote memorization.

ID1's teaching approach presented a contradiction in his stated emphasis on process and problem-solving over simply reaching for the correct final answer. He claimed to prioritize students' understanding of the process, yet his instruction involved structured examples where students were encouraged to "*mimic what I do and how I think.*" While he posted complete solution sets for all quizzes and tests, this mimicking approach might unintentionally undermine his goal of fostering independent problem-solving skills. By focusing on the exact replication of his methods, students might be led to prioritize memorization over genuine exploration, which seems at odds with his stated commitment to valuing the process and problem-solving skills essential in engineering.

ID7 also reinforced the practice of understanding over memorizing. For instance, ID7 noted that students often perceived success as a matter of memorizing solutions rather than genuinely understanding them. To address this, ID7 incorporated more conceptual questions into assessments, stating, *"students really perceive it as how well they can memorize a homework problem, as opposed to really understanding that so that's why I try to incorporate more concept questions into there."*

She further emphasized this by requiring students to individually explain their solutions in group problem-solving exercises: *"they [students] had to have a solution for each problem that was usually one problem per person, they could work together to solve it, but each person had to explain a problem to me…they still had to be able to come up and explain their solution…"* Another quote: *"...you need to understand the process or it's not going to go well."* further underscores the educator's focus on process-oriented learning, emphasizing that comprehension of the underlying methodology is critical for academic success.

Returning to the topic of cheating, ID7 appeared to prioritize multiple methods of prevention to maintain academic integrity. For example, ID7 started off by recognizing the ease with which students could access pre-existing solutions for homework assignments and acknowledged, *"the solutions are all out there and students use them…custom new homework assignments, that are not mentioned through Wiley plus which is difficult when you have large sections to be able to actually do that."* She then expressed her concerns, stating that, *"But the main issue or concern with taking the service courses online is the ability to cheat… it's difficult to implement those rules without some sort of proctor…"* This highlighted the challenges of enforcing academic integrity in a virtual environment, where traditional monitoring methods are inherently limited. Her attention to detail was further emphasized when she remarked, *"I knew that they work together ahead of time because I knew they sat near each other for previous tests when you're actually in person..."* This demonstrated ID7's proactive approach to deterring misconduct during in-person assessments by closely observing seating arrangements and student behavior, using these cues to uphold individual accountability.

Overall, the findings revealed a nuanced perspective on professors' approaches to assessment, highlighting both their commitment to fostering learning and the practical compromises they made. ID1 and ID7 consistently emphasized the importance of understanding the process and applying concepts over rote memorization or simply obtaining correct answers. However, these pedagogical ideals were often juxtaposed with practical considerations, as professors prioritized strategies that streamlined grading and limited opportunities for academic dishonesty, such as proctoring tests, customizing assignments, and designing assessments that are harder to cheat on. While these methods reflected efforts to maintain academic integrity, they sometimes prioritized logistical convenience over deeper pedagogical objectives. This tension became evident in the potential contradiction in instructional strategies: while promoting understanding and discouraging memorization, practices such as structured examples and complete solution sets may inadvertently encourage students to mimic methods rather than engage in independent problem-solving. Additionally, time constraints on assessments may push students toward surface-level strategies, conflicting with professors' goals of fostering deep comprehension. Ultimately, these findings underscored the delicate balance between upholding academic integrity, managing practical constraints, and fostering meaningful learning experiences, with ID1 and ID7 exemplifying the challenges and strengths of assessment practices in higher education.

Alshanti: Discussion

The landscape of engineering education places a significant emphasis on assessments as a way to evaluate student learning. However, the effectiveness of tests in promoting genuine understanding has been a topic of ongoing debate [32]. While traditional assessments, such as exams and quizzes, are commonly used to measure student knowledge, there is growing concern about their ability to accurately reflect a student's true grasp of the material [33], [34]. Professors are faced with the challenge of designing assessments that not only measure a student’s ability to recall information but also encourage deeper cognitive engagement and problem-solving skills. At the same time, concerns about academic dishonesty and the logistics of grading can influence the design and implementation of assessments, which can lead to practices that prioritize convenience or integrity over fostering true comprehension [35].

Based on my findings, both ID1 and ID7 have expressed concerns about academic integrity, with ID1 frequently referencing the ease with which students can access pre-existing solutions, and ID7 acknowledging the difficulty of preventing cheating, particularly in online courses. This concern appeared to lead them to design assessments that prioritize integrity, such as customized homework assignments and monitoring student behavior during in-person exams [36], [37]. While this is an important issue, this might divert professors' attention toward creating cheat-proof exams or courses, rather than focusing on improving and enhancing the course structure for students.

Lastly, I found that there can be tendency among professors to focus on convenience when designing assessments. Lastly, I found that there can be a tendency among professors to focus on convenience when designing assessments. My findings suggest that the logistics of grading, especially during peak periods like final exams, can influence the types of assessments professors choose to administer [35]. For example, without the assistance of a GTA (graduate teaching assistant), professors may opt for assessments that are easier to grade, such as multiple-choice exams or assignments with clear-cut answers, instead of more time-consuming but potentially more meaningful forms of evaluation, like essays or project-based assessments.

My findings overall highlight a misalignment of priorities among faculty. This excessive focus on preventing dishonesty can overshadow efforts to address more impactful aspects of education, such as refining course content, developing innovative teaching strategies, and creating a more enriching learning experience for students [33], [34].. Instead, faculty should also balance in emphasizing improving test design and preparation strategies, which can be more effective and beneficial to students [35]. Research indicates that inadequate preparation can be a significant driver of cheating. As Paulhus notes, *"If they [students] have poor cognitive skills or simply haven't prepared because of low conscientiousness, then out of desperation they're more likely to cheat"* [38]. By prioritizing a well-structured syllabus and thoughtfully designed course content, professors can enhance students' understanding of key concepts and problem-solving skills, ensuring their success in exams. When students are equipped with the tools and knowledge they need to succeed, they are more likely to feel confident in their abilities and less likely to resort to cheating.

Harry Thu: Positionality Statement
As an international student from Myanmar studying in the United States, my experiences and background have significantly shaped my approach to analyzing instructor beliefs and actions. Coming from a culture that places a strong emphasis on academic achievement, I tend to focus on the decisions instructors make on their pedagogical approach, and how it benefits students. My experiences in small educational institutions, where classes were rarely larger than 30, contrast with the setting of this study, where instructors often manage hundreds of students with the support of teaching assistants. I recognize that this difference may affect how instructors approach course and test design. Understanding my personal and cultural background, I try to remain mindful and understanding of the circumstances within specific institutional constraints and contexts and ensure that my interpretations are grounded in the data.

Thu: Analysis
Over the course of my analysis, the first instructor, identified as ID1, exhibited a structured approach to course design and student expectations. He taught a heat transfer course to third-year undergraduate students for over 20 years. From the interviews, ID1 identified himself as someone with decades of both industry and educational experience, where *[he] worked in industry, started companies [and worked in] consulting.* They described their core approach to course design: "*But you gotta do what the faculty says. Demand that, I do not back down. And so that's what you know some students react to, they want to go off and do whatever they want to do. Now you don't do that my course. Do what I tell you to do. Because that is engineering."* This perspective underscores ID1's emphasis on structured learning paths that align closely with industry expectations, which can be implied based on his comment about the industry.

Expanding on course policy, ID1 explained that "*...I don't pick up many homework and students get to basically copy whatever they want from the Internet*." He clarified that since students may be inclined to copy homework answers, collecting these assignments may not be representative of students' understanding. This sentiment is also further reflected in ID1's policy on quizzes, where *[he doesn't] care for those [as] they don't count that much in their practice for the tests, and so, if the students cheat on the quizzes they're going to flunk the test. You need to practice how you're going to do it, so I'm not going to try to monitor those or anything.*

These policies tie into how ID1 appeared to structure and utilize his tests, with a belief that students still retained learning and test-taking habits from high school, where "*…there's a lot of problems in high school, when they come to come to university like this, you need to, in essence, have a shock and start all over again and okay, this is education yeah it's not memorizing things. It's like learning at a higher level."* ID1 also mentioned that he designed their exams as an intervention for students not studying properly to the level they wanted. In essence, the course was designed to promote and improve study habits with careful guidance.

This approach of careful guidance was further reflected in how ID1 structured their class notes. He provided an outline of notes for students to fill in during class, which included how a problem should be solved from start to finish. ID1 explained how this was supposed to serve as a guide for students to solve homework problems and prepare for exams. ID1 reinforced this approach: "*You mimic what I do and how I do it and how I think. I tried to make very clear exactly what that is.*"

From my findings, it can be summarized that ID1 believed that some students may still have habits from high school that the habits were not deemed to be appropriate for success in their course or engineering. His test structure acted as an intervention for those cheating on homework and quizzes, and his notes acted as a guide to succeed in his assignments and exams.

The other instructor analyzed for this paper, identified as ID7, contrasts heavily with ID1. She had been teaching for around a decade and came from a kinesiology and biomedical background. ID7 primarily taught Intro to Biomedical Engineering and Dynamics at the institution. In her Intro to Biomedical Engineering course, ID7 used a unique approach to course design that focused on content acquisition, literature searches, and experimental design. The course was designed to be open-ended and included intermittent deliverables throughout the course. Details that stood out were deliverables that included creating a video explaining a medical device for a K-5 audience and redesigning pediatric medical devices for approved FDA labeling. ID7 tried to incorporate these open-ended and creative elements into the heavily structured Dynamics course.

A primary motivation on their teaching style was their belief that "*...the students individually could contribute, and they have some like certain level of competence or expertise that will make a well-rounded team in general and the idea that they're not still smooching off the teammates."* ID7 explained that students must learn to work well in teams to emulate industry but still must have a core competency of basic concepts and how to apply them.

ID7 still understood the importance of exams, and how "*we use tests to really understand students [on an] individual level, because the [homework] solutions are out there everywhere. They all work together in the homework so it's really hard to understand [...] In that aspect, I think. Because you can actually isolate an individual and see if they can do it [on exams]."* However, ID7 recognized that engineering exams favored pattern recognition and memorization, without a focus on conceptual understanding. To address this, she included more *[conceptual questions] as opposed to running through the numbers, because just running through the numbers and [getting the right answer], you can't see it. They might have gotten there the wrong way.*

To summarize, ID7 recognized the value of exams for assessing individual competency while also preparing students to collaborate effectively in teams, aligning with industry standards. To move beyond pattern recognition and rote formula application, ID7 incorporated conceptual questions into exams. Additionally, they used open-ended, creative assignments to foster applied knowledge and teamwork skills.

Comparing ID1 and ID7, both instructors recognized the importance of exams in engineering education, and how exams helped assess the core competency of engineering students. ID1 emphasized a structured learning process while ID7 integrates collaborative work and promotes conceptual understanding. These contrasting methods reflect differing views on the expectations for engineering students.

Thu: Discussion

Based on my findings, ID1 appeared to favor a learning approach that pushed students to mimic and follow their steps in problem-solving. This differed from ID7, who preferred a more student-centered approach that promoted collaborative work. From the perspective of a current undergraduate engineering student, both instructional approaches have merit depending on the context of the course. For advanced theoretical engineering topics, ID1's method of step-by-step problem-solving instruction may be particularly effective when students encounter the material for the first time and lack prior knowledge. ID7's approach may be more suitable for courses that focus on technical applications and simulate real-world scenarios, where critical thinking and teamwork are essential.

Existing literature highlights the benefits of a student-centered learning approach. In Maryellen Weimer's *Learner Centered Teaching* (2013), it is posited that classrooms in higher-education are instructor-centered and can hinder student learning and growth [39]. She recommends instructors create alternative approaches to foster student-centered classrooms. Weimer claims that students in higher education are more anxious and hesitant rather than self-motivated and confident. To address this, she claims that instructors should seek to guide students on their learning journey rather than viewing them as vessels to be filled with knowledge (Weimer, 2013).

ID7 explained her approach to course design for their Intro to Biomedical Engineering course, which included an interactive assignment that focused on conceptual understanding. Building on the argument of courses integrating student interaction, an experiment ran in an upper-level course in developmental biology saw students achieve higher learning results and conceptual understanding when incorporating increased student participation and frequent assessment of understanding [40]. The course was originally structured as three 50-minute classes with 4 exams that made up 80% of a student's grade. Lectures did not include any interactive activities, and students rarely participated. By reducing lecture time and introducing interactive features such as collaborative work and in-class formative assessments, the latter course saw increased student performance and participation (Knight & Wood, 2005).

ID1's teaching philosophy aligns closely with direct instruction, an instructional method based on a structured learning environment that emphasizes clear, explicit teaching [41]. This method is effective for engineering education as students learn quicker when receiving direct instruction (Ruutmann & Kipper, 2011). ID1's approach required students to replicate their step-by-step problem-solving methods, enabling them to be applied to assignments and examinations. This approach is particularly effective in helping students learn complex problem-solving processes in a structured and time-efficient manner.

The contrasting teaching philosophies of ID1 and ID7 show the diverse approaches that exist in engineering education. To an engineering student, both approaches address different aspects of the learning process, from understanding theory to technical application. ID1's structured instruction facilitates the core understanding of complex topics, and ID7's collaborative style prepares students to navigate real-world scenarios.

Overall Discussions

We engaged in this research to explore the current undergraduate engineering students' perceptions of instructors' teaching beliefs through research. As previously noted, undergraduate students tend to bring authentic interpretations of data as they bring in their personal experiences in such interpretations [23], [42]. Reflecting on the findings, we as a research team has found that both Alshanti and Thu have 1) engaged authentically in interpreting the existing data set through their positionalities, and 2) this is demonstrated by the discovery of new potential themes as compared to Chew's last analysis.

Both Alshanti and Thu analyzed their data while engaging with their positionalities. Alshanti described their positionalities were shaped by their lackluster experiences with some of the engineering instructors in their courses, and this led to her realization that she interpreted the data by exploring the possible contradictions of beliefs within the instructor participants. Thu, on the other hand, described their focus on academic integrity was based on their upbringing in a different educational and cultural context. Thu's findings reflect this by emphasizing the instructors' course structure, and how preventing cheating tends to shape the participants' course structures. As posited by [42], positionalities are important component of research as acknowledging and engaging them while conducting data analysis can provide transparency on how the researchers arrive to certain claims or conclusions in their analysis. Alshanti and Thu showed transparency by explaining why their findings emerged from the analysis as they reviewed the data in multiple iterations, consistent with how positionalities are crucial element in giving readers contexts on the analysis outcomes.

Alshanti and Thu also discovered new potential themes while working on this research. These themes are new relative to Chew's findings from previous analysis (blinded for review). We argued that this was because of the different positionalities that shaped our analysis as previously described. Chew was a graduate student when they analyzed the data, and Chew's positionalities of experiencing heavy testing in their engineering courses prompted them to focus on beliefs that could explain the heavy usage of tests and exams in engineering courses. Alshanti and Thu both brought in their unique and authentic interpretations based on their positionalities as undergraduate engineering students who are currently experiencing their learning in engineering courses [23]. These different positionalities at different points in time led to different interpretations that emerged while analyzing the data, possibly explaining the discoveries of new potential themes from the secondary data analysis.

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