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Work-in-Progress: Student Learning and Pedagogical Beliefs and Student-Instructor Power Dynamics: An Exploration for the Associations of both Concepts

Victoria Minette Belveal, Embry–Riddle Aeronautical University, Daytona Beach
Riley Sharp, Embry-Riddle Aeronautical University - Daytona Beach
Kai Jun Chew, Embry-Riddle Aeronautical University - Daytona Beach

Kai Jun "KJ" Chew is an assistant professor in the Engineering Fundamentals department at Embry-Riddle Aeronautical University. He is passionate about teaching and research, and he strives to produce knowledge that informs better teaching. His research intersects assessment and evaluation, motivation, and power dynamics. His research goal is to promote improve engineering teaching with these research intersections.

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Introduction

Exploration of student learning and pedagogical beliefs can be an important contribution to engineering education research from the perspective of student-instructor power dynamics. Student-instructor power dynamics can be defined as a reflection of the dynamics existing in society and contexts [1]. The dynamics can shift depending on the backgrounds of students and instructors (some instructors may have less power if their students are not accustomed to seeing people from minoritized communities as engineering instructors) [2], [3]. Still, research has shown that instructors tend to have more power in this dynamic, with students rarely been engaged to co-create the learning environments they are a part of [4], [5], [6], [7]. By understanding student learning and pedagogical beliefs, such knowledge has the potential to open up conversations between students and instructors in the form of negotiations [8]. This can be through providing information about how students perceive learning and pedagogies to the instructors, who could use the information to further engage students in co-creating the learning environments.

To begin contributing to such exploration, this ongoing pilot study strives to provide a lay of the land in terms of uncovering students learning and pedagogical beliefs, alongside with their perceptions of power dynamics in the engineering learning environments they have participated in. We propose to answer the research questions: 1) *What are engineering student learning and pedagogical beliefs in a private, teaching-focused university* and 2) *What are these students' perceptions of power dynamics between them and their instructor?* This work-in-progress paper details the underlying motivation, method, and preliminary findings. The topic aligns with one of the Equity, Culture, and Social Justice (ECSJ) pillars that acknowledges engineering classrooms as terrains of struggle and site of possibility. Our works focus on exploring the possibility of enhancing learner-centered and humanizing pedagogy by researching the idea of managing power dynamics between students and instructors, with the goals of uplifting students with minoritized backgrounds in engineering to persist in engineering

Literature Review

Engineering education consistently sees challenges related to student retention in engineering programs caused by poor teaching and ineffective pedagogy, especially with disengaged professors and poor teaching [9] and gatekeeping courses [10], [11], [12]. Environments like these are at the expense of learning. The engineering education field has called for learner-centered pedagogies to address these issues. Learner centered pedagogies focus on active learning and reflection, with the use of student's previous knowledge and background to engage them in learning [13], [14]. Similarly, humanizing pedagogy is also explored in previous studies. This pedagogy allows the students to be whole individuals that have lived outside of the classroom [15], [16]. It also allows engineering professors to create trust in the

classroom and recognize their diverse student population within the classroom [17]. These pedagogies have been used in engineering education, but rarely and with moderate success [16]. All in all, the challenge of student departure in engineering has partly been addressed with learner-centered and humanizing pedagogies, with limited success.

Power dynamics become another crucial component in the efforts to engage with learner-centered pedagogies to address engineering retention issue. In such pedagogy, power sharing, meaning managing power dynamics by the instructor with their students, can facilitate and enhance pedagogical approaches implemented based on learner-centered philosophies [8], [18]. This perspective specifically stems from the humanizing pedagogy perspective [17], [19]. In short, exploring student-instructor power dynamics as a research topic can present potential to enhance effectiveness of learner-centered classroom approaches, such as active learning. However, research has shown power is still favorable toward instructors [4], [5], [6]. When these power dynamics are challenged, it can allow for a more inclusive and engaging environment that that sets the students up for success. One important component to shift power dynamics is negotiations, and by understanding students learning and pedagogical beliefs, instructors can engage students to negotiate to shift power dynamics [20], [21]. However, both power dynamics and student learning and pedagogical beliefs are understudied, and expanding our knowledge of these constructs can help with using power dynamics to address poor teaching.

Literature has shown a wide range of manifestations of power sharing in the classroom. Some have provided complete sharing with the students, engaging students to co-write the course syllabus [8]. However, some other examples of sharing involve negotiations between students and instructors, such as compromise where the instructors and students meet halfway, such as individual negotiation of accepting late work in the classroom, or discussing academic integrity violations [21]. These are some examples of how to manage power dynamics through negotiations, and understanding student learning and pedagogical beliefs can empower both instructors and students to engage in such negotiations.

Current literature in engineering education has scarcity of knowledge in terms of the intersections among student learning and pedagogical beliefs, power dynamics, and negotiations. There have been research on student beliefs on smartness and intelligence, but not much in the learning and pedagogical beliefs realm, presenting a research gap [22], [23]. In addition, research on power dynamics tends to focus on the dynamics themselves, but have not explored how negotiations can shape these dynamics [6], [24]. Hence, this pilot study is the beginning step to explore knowledge that address these research gaps.

Method

We designed a survey study to answer the research questions as surveys are useful in for exploratory study to provide the overview of social thoughts among a population (engineering students in a private, teaching-focused institution) [25]. Such overview can be useful in determining the next steps in further researching the topic, considering that survey research has a

disadvantage of not capable of establishing cause-and-effect of phenomena [25]. It must be noted that this is a pilot study to attempt testing a survey, where the outcome of this study will inform design for a bigger study to explore power dynamics, negotiations, and student learning and pedagogical beliefs.

Our survey consists of three parts: 1) Demographic information to understand the respondents background for context in analyzing the data, 2) an adapted instrument from [26] about learning and pedagogical beliefs, and 3) some questions about their perceptions of power dynamics in their classrooms. For demographic information, we inquired the students about their race, gender, major, and degree to understand the makeup of our respondents. For the adapted instrument, the original use of the [26] instrument was with teachers, but adapting it for students can prove to be an interesting as a way to explore students' learning and pedagogical beliefs.

We did not modify substantially the language of the instrument to ensure the validity of the except for two questions where it asked "If I do not tell students exactly what to do, nothing worthwhile will be achieved" and "Old-fashioned learning by rote is the most effective way to learn part of the subject that I teach". To adapt this for the students, we modified the language to frame it from the student perspective: "If a teacher does not tell students exactly what to do, nothing worthwhile will be achieved." As for the other question, we modified it to "Old-fashioned learning by rote is the most effective way to learn part of the subject that I learn".

As for the power dynamics questions, there are created based on existing literature [8], [21]. The power-dynamics-related questions are inspired by the literature on power dynamics, such as seating distance [8] and describing their perception of power dynamics [1], [27]. Appendix A shows the survey instrument for learning and pedagogical beliefs and power dynamics. We recruited engineering students in a private teaching-focused institution for this pilot. The sampling focuses on engineering students of all years and majors. Recruitment involves flyers and emails to faculty members for survey dissemination. The process has been approved by the Institutional Review Board (IRB) of the university.

We are performing descriptive analysis on the learning beliefs data, following the guidelines by [26] to understand respondents' learning and teaching beliefs, while we will perform qualitative coding with the open-ended questions related to power dynamics. Considering that this is an exploratory study, outcome of the analysis will provide a view of how students perceive these constructs, with the information being used for future studies.

Preliminary Results

In this paper we present the preliminary analysis from the student responses to the learning and pedagogical belief survey in Figure 1. In this ongoing pilot, 9 students responded to the survey. We are aware of the low sampling size. However, since this is a pilot study to explore the lay of the land in terms of how students would respond to such survey, we will make note of observations that stand out instead of making claims based on the limited sample size.

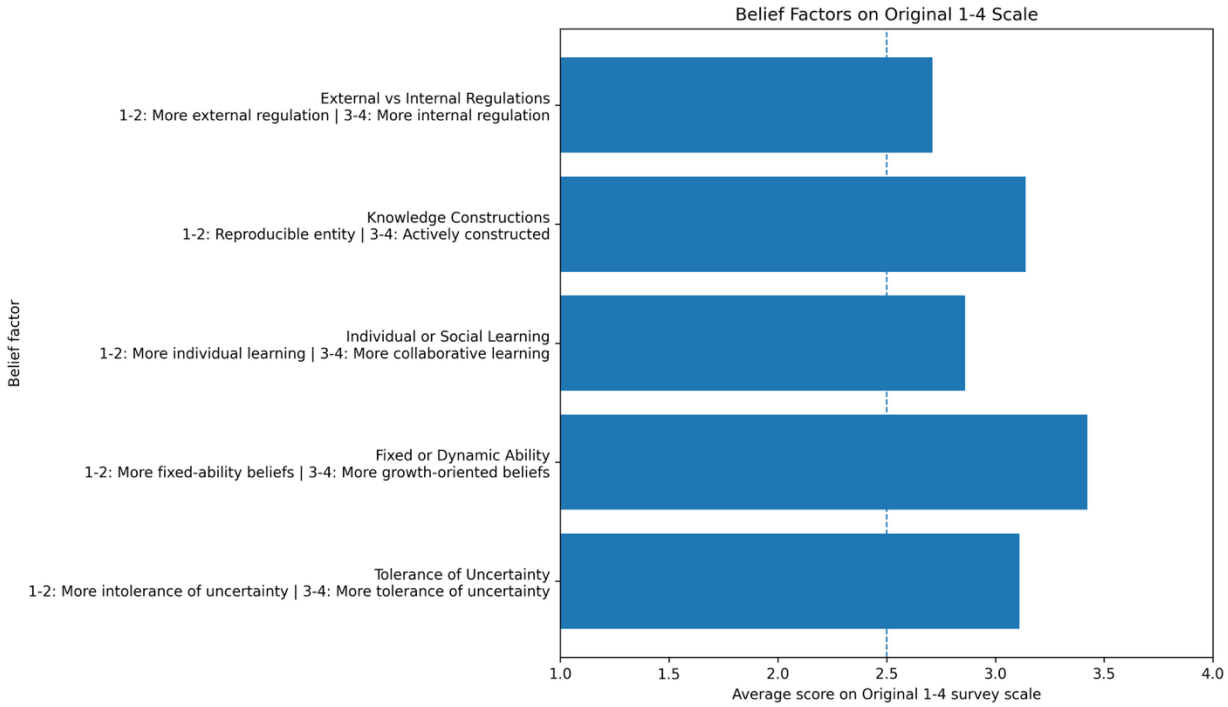

Figure 1: The average score based on the five factors of the learning and teaching belief survey.

There appears to be two distinct patterns with the data. First, the respondents appeared to rate the factors of fixed and dynamic ability items the relatively highest in aggregate. The respondents rated four out of five of the fixed and dynamic ability the highest among all 21 items. These items are shown below with the mean (Table 1).

Table 1: The means for the items for the fixed and dynamic ability factor.

Factor 4: Fixed Ability	Dynamic Ability	Mean
Some students cannot be expected to make much progress	All students should be challenged to perform, even if they find this difficult	3.44
A student's low achievement is often caused by the student's limited ability	A student's low achievement often has a cause that can be helped	3.44
Bright students were already bright when they entered school	The school's task is to help students to become brighter	3.44
Low achievers remain low achievers, no matter what the teacher does	Low achievers can make progress when the teacher manages to help them in the right way	3.44
Smart students will always do well	Smart students became smart (partly) because of a positive environment	3.33

Another observation is that the items in the external and internal regulations are rated relatively lower as compared to items in the other factors, with the aggregate factor mean being the lowest among the five factors. Table 2 presents the means of these items.

Table 2: The means for the items for the external vs internal regulation factor.

Factor 1: External Regulation	Internal Regulation	Mean
School is compulsory for students, thus you can expect motivation problems	Students lose their motivation in school if everything is presented in a predigested way	2.44
In general students are not able to work on their own	Basically students are perfectly capable of working on their own	3.00
If a teacher does not tell students exactly what to do, nothing worthwhile will be achieved	I think students achieve better results when they have a certain amount of freedom in how they work	3.00
It is the teacher's responsibility to evaluate the students' learning achievements	If students do not learn to evaluate their learning achievements, they have only learned half the lesson	2.56
Learning will be most successful when an expert (teacher) is in charge	Learning will be more successful as the students themselves take the initiative	2.56

It must be noted that these are observations, not claims. In the paper that details the design of this survey, the authors argued that most teachers appeared to rate the items close to process-oriented view of learning [26]. In our data so far, we are seeing similar trend, though more data are needed to make this claim.

Future Work

As this study is ongoing, data collection will continue in Fall 2026 when students return for the new academic year to expand the sample size. In addition, the study may include a qualitative component where semi-structured interviews may be included to further understand the responses on learning and teaching beliefs and power dynamics.

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Appendix A

Learning and teaching beliefs survey adapted from [26]. The respondent will rate each statement pairing with a Likert scale below:

(1) I quite agree with the statement on the left.
(2) I agree somewhat more with the statement on the left than I do with the one on the right.
(3) I agree somewhat more with the statement on the right than I do with the one on the left.
(4) I quite agree with the statement on the right.

Traditional	Process-orientated
Factor 1: External Regulation	**Internal Regulation**
School is compulsory for students, thus you can expect motivation problems	Students lose their motivation in school if everything is presented in a predigested way
In general students are not able to work on their own	Basically students are perfectly capable of working on their own
If I do not tell students exactly what to do, nothing worthwhile will be achieved	I think students achieve better results when they have a certain amount of freedom in how they work
It is the teacher’s responsibility to evaluate the students’ learning achievements	If students do not learn to evaluate their learning achievements, they have only learned half the lesson
Learning will be most successful when an expert (teacher) is in charge	Learning will be more successful as the students themselves take the initiative
Factor 2: Knowledge as Reproducible Entity	**Knowledge as Actively Constructed**
One can assist student learning the most by precisely formulating the tasks	One can assist student learning the most by stimulating the students to search for answers
It is important that students know definitions by heart, they should be able to say them in their sleep	Students should understand the reasoning behind definitions; in that way they will always be able to derive the definition
It is important that students are kept informed about facts and have a thorough knowledge of them	It is important that students learn to think on their own and to pass their own judgment
Old-fashioned learning by rote is the most effective way to learn part of the subject that I teach	Utilizing knowledge is not learned by memorizing lists and rules
Factor 3: Individual Learning	**Social Learning**

When students cooperate, they often learn the wrong things from each other	Students learn a lot by explaining things to each other
When students discuss the subject matter together, they will not be any wiser in the long run	When students discuss together, they learn to handle different points of view and acquire deeper insight
Students learn best when they work individually on the subject matter	Students learn a lot from each other when they work together on the subject matter
Cooperating is too distracting. Learning is done best alone	Students learn more by cooperating than they do when working on their own
Factor 4: Fixed Ability	**Dynamic Ability**
Some students cannot be expected to make much progress	All students should be challenged to perform, even if they find this difficult
A student's low achievement is often caused by the student's limited ability	A student's low achievement often has a cause that can be helped
Bright students were already bright when they entered school	The school's task is to help students to become brighter
Low achievers remain low achievers, no matter what the teacher does	Low achievers can make progress when the teacher manages to help them in the right way
Smart students will always do well	Smart students became smart (partly) because of a positive environment
Factor 5: Intolerance of Uncertainty	**Tolerance of Uncertainty**
It is better not to confront students with problems they cannot understand	In school it is all right to also confront students with real-life problems that do not have solutions
Students should only be given tasks at school that they are able to handle	Students must be allowed to try things. They should be allowed to stub their toes
Students should learn to behave themselves at school and to comply with rules of behavior	Showing respect for each other does not mean that you have to accept everything

The following are the power-dynamics-related open-ended questions.

1. Describe where you sit in the classroom in relation to your instructor.
2. Describe how comfortable you are reaching out to your instructor to ask questions in class or outside of class.
    a. Explain the reasons behind your responses above.
3. How consistent are your thoughts about learning and teaching with your instructors' teaching approaches?
4. In an ideal scenario, what kind of power relationships are desirable between students and instructors to help with your learning?