

The Role of Engineering Doctoral Students' Future Goals on Perceived Task Usefulness

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Introduction

This research paper explores how engineering doctoral students' experiences influence development and utilization of future time perspective towards degree completion.

Engineering doctoral programs serve to generate innovative engineers motivated to solve global problems. However, engineering graduate programs are plagued by high attrition rates and low minority enrollment.¹ These problems limit the creation of diverse role models and solutions in engineering. Despite these persistent problems, few studies have sought to understand how engineering doctoral students' (EDS) experiences foster development of affective traits such as motivation and identity. For example, education studies have shown the positive influence of motivation on undergraduate student development of learning strategies and persistence through their degree programs.^{2,3} Previous work in engineering has shown how undergraduate student perceptions of the future and goal-setting processes can positively or negatively influence the development self-regulated learning^{4,5} and persistence on problem-solving tasks.^{6,7}

The purpose of this study is to explain how affective traits influence EDS pursuit of doctoral-level careers in engineering. To begin addressing the paucity of literature in graduate education related to student attitudes, we address the following research question:

How do engineering doctoral students' perceptions of the future influence the ways in which they approach graduate-level tasks?

To answer the above research question we also address two sub-questions:

1. How do engineering doctoral students define their future?
2. How do engineering doctoral students relate their future selves with present tasks?

Background

The nature of our study takes an interpretive, qualitative approach as to capture how EDS utilize their perceptions of the future to navigate their graduate experiences. An interpretive research approach allows a student-driven model of goal-setting processes to emerge. A student-driven model accounts for the student perspective of the future and how EDS approach tasks related to that future. This student-driven model limits any preconceptions of these processes. The end goal of this study is to create effective graduate program cultures and policies that incorporate and foster EDS' goal-setting processes. Since a small number of participants are utilized to understand the EDS experience, the methods of an interpretative approach require an accounting of rich detail from each participant. For this interpretative approach, the research question evolves from both the researchers and participants to help the researchers grasp 'how' a phenomenon is experienced by the EDS.⁸ Thus, it is important to answer our research questions

through the meticulous examination of a few participants' experiences. We provide a brief overview of our theoretical background, which is appropriate for this student-driven, interpretative approach.

Future Time Perspective

Future time perspective (FTP), a theoretical framework of motivation, is defined as:

“The degree to which and the way in which the chronological future is integrated into the present life-space of an individual through a motivational goal-setting process.”^{3(p114)}

FTP was used as a lens to interpret how EDS' future-oriented motivations influence actions toward degree completion. Specifically, this motivation framework can be broken down into the following constructs: perceived instrumentality, speed, distance, and connectedness.^{2,4} *Perceived instrumentality* refers to whether students perceive a task as useful for their emerging future identity. For example, an EDS may view submitting a conference paper as useful toward their future goal of attaining a job in industry. The perceived rate of the future approaching is referred to as *speed*. For the same EDS, the deadline for a conference submission may seem to be slowly approaching when six months away from the deadline, but as that date moves closer, the future seems to approach more rapidly and the pressures of the deadline can increase. *Distance* refers to how far into the future students can project themselves or their goals. An EDS who can see themselves as a tenured professor in the future has more distance, or a far future, than a student who can only project themselves to the near future of graduation. Finally, *connectedness* is whether an individual views the present and future as connected. A student may be able to set goals in the future but may not see how the tasks they are performing now (e.g., writing literature reviews) are connected to their future goals (e.g., starting up an engineering company).

Perceived instrumentality (PI) can be further split into *endogenous* and *exogenous perceived instrumentality*. Tasks are perceived as having endogenous PI if a participant sees them as useful towards their emerging identity, or future self. For example, a doctoral student whose future goal is to become a research professor provides critical journal paper reviews because the doctoral student wants to be highly regarded within their field. Exogenous PI describes tasks perceived as required but not directly useful to an emerging identity. An example of an exogenous PI task for the same doctoral student would be leading undergraduate laboratory tours because it was required by their advisor and is not perceived as related to their emerging identity as a research professor.

Methods

For this study, we sought to understand how EDS' graduate experiences influence their perceptions and interpretations of the future. To explore EDS experiences, we used an interpretative phenomenological analytical (IPA) approach, a data analysis tool that helps us describe “how people make sense of their major life experiences.”^{9(p1)} An IPA approach establishes a detailed account of an experience defined by the participant's own terms. IPA is

described in-depth as a methodology in social sciences,⁹ such as health psychology¹⁰ and nursing research,¹¹ and previously in engineering education research.¹² Here, we outline our adaptation of IPA to address the research question, “How do EDS’ perceptions of the future influence the ways in which they approach graduate-level tasks?”

Participants

EDS from a western land grant institution were recruited for interviews. Due to a low response to email solicitations, five EDS were recruited through face-to-face solicitations. Student recruitment was completed while considering purposive homogeneous sampling. Purposive homogeneous sampling in an IPA means selecting participants “on the basis that they can grant us access to a particular perspective on the phenomena under study.”^{9(p49)} For example, the participants of this study were all at similar timepoints of enrollment and from international backgrounds. However, due to the smaller size of the graduate population from which we sampled, the ability to obtain a homogenous sample was limited. In particular, the participants varied in their doctoral degree milestones completed and engineering disciplines in which they were enrolled. As all of the students attended the same institution, this ensured a degree of homogeneity in experience as they all faced the same institutional benchmarks for degree completion. Mark (pseudonyms are used for all participants) is a Ph.D. candidate in his final year of his mining engineering program. Katie is a Ph.D. candidate in her environmental engineering program. Umar, John, and George are all in the middle of their mechanical engineering doctoral programs and do not know when they will reach candidacy. Table 1 indicates each participant’s number of years in their Ph.D. program, their engineering discipline, and their specified future goal from the interview.

Table 1

Description of Participants

<u>Pseudonym</u>	<u>Years in Program</u>	<u>Engineering Discipline</u>	<u>Specified Future Goal</u>
Mark	2 (Candidate)	Mining	Lecturing professor
Katie	2.5 (Candidate)	Environmental	Science journalist
John	1.5	Mechanical	Research in academia
Umar	2	Mechanical	Research in industry
George	2.5	Mechanical	Research, not academia

Interview protocol

As an IPA is phenomenological nature, we developed a semi-structured interview protocol to reflect rich details of the participants’ experiences. A semi-structured interview encourages open-ended discussion through follow-up questions to elicit the full account of the participants’ experiences. The protocol focused on three main categories: future goals, perceived usefulness of tasks, and connectedness of the future with the present. We developed the interview protocol questions from Major et al.¹³ that explored similar future-oriented concepts and problem-solving

approaches among engineering undergraduates. For each of the three categories, a few main questions guided discussion with the participants. Examples include the following items:

1. What are your goals for the future?
2. How does getting a Ph.D. benefit you?
3. How do your future goals affect how you approach your research?

Most of the adapted questions were reworded to reflect the graduate experience, such as replacing “engineering degree program” with “Ph.D.”. Additionally, previous questions related to engineering problem solving were refocused to align with the EDS experience. As little work has been done in this area, the authors deemed it necessary to explicitly focus on the perceived graduate experience, rather than leveraging persistent conversations about graduate education that are often built heavily on myth¹ and stereotypes.¹⁴

Data analysis

The analytical process for an IPA requires becoming familiar with the participants and then engaging in three annotative processes. To become familiar with each participant’s voice and story, the analysts listen to each audio recording and read each transcripts multiple times before conducting the annotative processes. The annotative processes include descriptive, linguistic, and conceptual steps.⁹ The descriptive annotation pass consists of noting key terms the participants said and is analogous to “a singular sporting event compris[ing] a set of micro-events where the play-by-play commentator highlights the significant events.”^{12(p4)} The linguistic annotation pass consists of noting how participants use language while talking about their experience. For example, “pronoun use, pauses, laughter, functional aspects of language, repetition, tone, degree of fluency ... [and use of] metaphors”^{9(p88)} are all highlighted as part of the linguistic pass. The final annotation pass is conceptual and seeks to make sense of the data by connecting the descriptive and linguistic annotations. After the conceptual annotations, additional codes are developed based on interpretations made from the codes in the context of our framework. For example, the code “future goal” was created from John’s interview when he states “Yes, I want to get my Ph.D.” because he describes his desire to get his degree. The codes were then collapsed into categories and further into themes. These themes are then compared to existing conversations in FTP theory to understand how this theory manifests and influences action during engineering students’ doctoral studies.

Positionality

We documented the positionality of the research team during the data collection and data analysis processes to record our interpretations of participant voices.⁹ Positionality has also been referred to as dynamic bracketing in IPA literature. Positionality in IPA argues that the subjectivity of the researcher cannot be removed from data collection and analysis.⁹ As such, positionality is used to set aside the researcher’s bias or interpretive stance when collecting and initially analyzing data from a participant. When interpretations of the data are made, the researcher then brings back in their existing knowledge to connect conversations to theory and previous results.

As themes emerged through analysis, we evaluated our personal experiences and interpretative lenses to keep a focus on the participants. The analysts' lenses are then reintegrated when themes are created in data analysis. The positionality of the research team in this study includes engineering, education, and psychology backgrounds. The principal investigators (Adam Kirn and Cheryl Cass) both had negative engineering graduate experiences that motivated them to pursue formal training in engineering education. Kirn worked on research involving FTP and problem solving in undergraduate engineering students. Cheryl Cass worked on research involving identity in high school and undergraduate STEM environments. In addition, the primary data analyst, Marissa Tsugawa-Nieves, received a mechanical engineering degree at the data collection institution and is familiar with its mechanical engineering graduate program. The secondary analyst, Heather Perkins, is in a psychology doctorate program at another land grant institution in the southeast and is familiar with STEM identity constructs. Blanca Miller completed a master's degree in education and is completing an engineering degree. The final researcher on this study, Jessica Chestnut, is working on her dual undergraduate degree in materials science and engineering and chemistry with a minor in statistics. By outlining our theoretical positions in the background section and previous experiences, we aim to highlight the experiences that have influenced our interpretive stance.

Methodological quality

The theoretical underpinnings of an IPA require different quality assurance methods because the analysis focuses on the subjectivity of participants' lived experiences, or their perceptions, rather than the reported "truth."¹⁵ In particular, an IPA expands on how one perceives and talks about experiences rather than focusing on the description.¹⁶ Thus, methods used to evaluate qualitative work, such as transferability and trustworthiness, misalign philosophically with IPA. In lieu of these methods, we used the interpretive quality framework developed by Walther, Sochacka, and Kellam.¹⁷ This framework accounts for the human aspects of conducting research within a community (participants, researchers, and readers) and aligns with an IPA design as it intends to capture the voices of the participants' and researchers' interpretations.

We adopted the five validation processes from the quality framework: theoretical, procedural, communicative, and pragmatic validity and process reliability.¹⁷ Theoretical validation, "the most fundamental aspect of managing quality in interpretive research,"^(p641) considers how the "social reality under investigation"^(p641) fits with theory generated. Theoretical validation suggests that the study needs an emergent design^(p642) or natural setting,^(p642) where a purposeful sample is used to capture the student experience. Procedural validation refers to the selection of appropriate strategies "to mitigate threats to overall validation"^(p644) and is specific to the research. The communicative validation process establishes the community of interpretation,^(p645) or receiving multiple perspectives of the interpretations. Pragmatic validation refers to the fit of theoretical constructs with the social reality and the endurance of the theory developed in the study within the field. Finally, process reliability refers to the "necessary conditions for developing overall validation through strategies aimed at making the research process as independent from random influences as possible."^(p641) Each validation process includes considerations for *making the data* and *handling the data*.¹⁷ Table 2 summarizes how we applied

each validation process to this study where the *making the data* and *handling the data* is described for each process.

The word “conclusion” is avoided in this study because it alludes to completion as the IPA methodology traditionally calls for a triple-hermeneutic cycle.⁹ The triple-hermeneutic cycle refers to the number of interpretation passes on the data. The triple-hermeneutic cycle begins with the participants’ interpretations of their lived experience. The second cycle is the analyst’s interpretation of the participants’ lived experience. The final cycle requires the readers to develop their own interpretations of the researchers’ reported interpretation of the participants’ lived experience. Thus, the analysis of this study is considered an ongoing process through the readers. Note that we present our findings to reflect the first two hermeneutic passes of the IPA process. We first describe the participants’ experiences in their terms within each sub-theme, completing the first hermeneutic of an IPA. We then present our interpretations of the participants’ experiences in terms of established, relevant theoretical frameworks.

Table 2

Application of the Quality Framework for this Study

<u>Process</u>	<u>Making the Data</u>	<u>Handling the data</u>
Theoretical	Engineering doctoral students are an appropriate population to sample from that reflect the design of the study.	Inductive analysis was used and opposite cases were presented to fully capture the complexity of EDS’ reality.
Procedural	To ensure meaning in the transcripts, follow-up questions were sent to participants during familiarization of the data.	A systematic and documented process was used while analyzing the data. Additionally, positionality was documented for interpretative awareness.
Communicative	Communications are open between the analyst’s interpretation and the participants to receive confirmation of the interpretation.	The participants’ words were used in the development of an abstract concept and avoided technical terms.
Pragmatic	The researchers theorized how the theoretical frameworks applies to the engineering graduate student’s reality.	The results from the data were related back to the theoretical frameworks for comparison.
Process Reliability	The audio recording and transcript are checked for accuracy prior to analysis.	Analyses were reviewed by other team members to ensure sound interpretations.

Findings and discussion: Prioritizing the present or the future

“I think your future goals and research goals are very close to each other. If you’re working towards your research goal, I guess you’re working towards your future goals as well.” - George

George (mechanical engineering Ph.D. student) reveals an insight about how EDS choose to prioritize the present or the future. For George, he believes that what he does in his present is what he will be doing in his future, thus he chooses to prioritize the present. He does not define his future career and perceives graduate-level tasks as obstacles to overcome now, as shown later in this section. George’s quote defines the emergent theme we present in this paper: “prioritizing the present or the future.” We break down this theme into two sub-themes: “salient past experiences help craft future goals” and “graduate-level tasks are useful toward present or future identities.” These sub-themes help answer the two sub-research questions, and when examined together, highlight the main theme to answer the guiding research question.

Salient past experiences help craft future goals

“I was lucky to be posted to a mine. I was doing mechanical stuff, kind of maintenance. I did some research into what mining is about... [and] I discovered my inspiration to switch to mining because... I realized [mine] ventilation [is] more related to safety. Mechanics is also safety..., but with ventilation it’s in the air. The safety aspect of my research is very important to me... The safety aspect of it kind of gives you more fulfillment, I make sure I get my work done.” - Mark

Salient past experiences craft EDS future goals as demonstrated by Mark (mining engineering, Ph.D. candidate) in the above quote. These salient past experiences emerged in the interview when we asked the participants why they decided to pursue an engineering doctorate. For Mark, the experience in a mine after completing his undergraduate mechanical engineering degree was his motivation to define his future goal in mining.

Similarly, Katie (environmental engineering, Ph.D. candidate) recalls multiple salient past experiences that played a role in developing her future goal. Katie describes one of her salient experiences:

“When I was young, the water in the river was so clean and people can even drink the water directly and swim there, but recently it's so terrible. It's smelly, and doesn't look so good, and looks so dirty. Terrible taste so- it's so serious. Yea, this has happened just in my life.” - Katie

She describes the transformation of the river in her hometown with vivid details which indicates the salience and impact of this past experience. Another past experience includes discovering the limitation of information about the environment— regarding climate change and water

pollution— released to the public. Mark’s and Katie’s parallel past experiences illuminated perceived problems in society, which helped them craft future goals that work toward solving those problems. Mark aspires to become a lecturing professor to inspire students to be innovative in mine safety while Katie hopes to inform the public about environmental issues through science journalism.

John (mechanical engineering, Ph.D. student) does not share a particular past experience directly relating to the development of his future goal. Additionally, he thought little about his future goals prior to the interview as he reacts surprised when we asked the first interview question (What are your future goals?) and responds, “I haven’t seen that far... I don’t know.” He pauses, indicating that he is thinking about his answer in the moment. He then roughly outlines why he wants to pursue his doctorate by alluding to his past experiences in his home country. He states:

“Why I want to pursue my Ph.D. is like, I want to gather knowledge about my field of interest [which] is energy and my country is suffering from energy crisis. I want to contribute a little to my country, to harness energy from different sources.” - John

He does not provide the details of his past experience in his country and its energy crisis, but he roughly crafts a future goal around this alluded past experience. Throughout the interview, we ask John probing questions that help him explore his future. John vaguely defines his future goal as a researcher, most likely in academia, as he says industrial research and development careers are not prominent in his home country.

Umar (mechanical engineering, Ph.D. student) shares a dissatisfying salient past experience as opposed to posing problems to solve. He states:

“The whole cumulative [doctoral] program [is] helping a lot for understanding purpose [in life] and all this stuff. It does. If I was not here and doing my Ph.D., I would be doing some jobs like cleaning filters. Everyday I would feel like my [job] is not doing any good to anyone. I am just cleaning filters, and earning money, that’s it. It doesn’t have any lifelong, or any long-term effect, it’s just that.” - Umar

Even though Umar uses hypothetical language (e.g., “if” and “would”), he is referring to if he continued to work in his previous industry experience prior to attending graduate school. As such, working in industry after receiving his engineering degree “just cleaning filters and earning money” did not fulfill Umar. He did not see the “long-term effect” of “not doing any good to anyone,” which was his motivation to find something more purposeful in life. In his case, pursuing a graduate degree would help evoke purpose in his life. Umar vaguely defines his future goal as doing research in industry, not in academia, so he can “do a lot of work in [his] research [that] can be helpful to other people.” Umar utilizes his frustrating past experience to work towards a rough future he perceives as “helpful to other people.”

In contrast, George presents a salient past experience that defined what he cannot do, therefore limiting his future goals. Before George decided to pursue a doctoral degree, he taught “basic engineering courses like engineering drawings [and] thermodynamics” at a private college. However, he discovered that teaching was not for him. He states:

“I think I’m not a good teacher. I can’t really teach... I had to do TA-ing and back then (pause) where I came from, I did some teaching. That’s how I *knew* I don’t think I like teaching a lot... I don’t feel like I can share my knowledge very systematically or in a proper order so that others can perceive them... I’m not very organized.” - George

George hesitantly talks about his teaching experience and focuses on the negative aspects, which indicates his stress and discomfort with teaching. When we asked George what he wants to do in his future, he broadly answers that he wants to do research, but not in academia because he cannot teach. He utilizes this unpleasant salient past experience to limit future goals (e.g., research in academia).

Salient past experiences are one component of the goal setting process that help participants craft their future careers. For Mark and Katie, these experiences assisted crafting their future goals of solving particular societal problems. John alludes to his life in his home country as a salient past experience which helped him craft his future goal of solving global energy. Umar shares his frustrating experience in industry as “not doing any good to anyone” which pushed him to vaguely define a future that helps others. George recalls an unpleasant past experience that he perceives as a limitation of his future goals. These different salient past experiences were utilized to define, or limit, future goals.

The clarity, or lack thereof, of EDS’ future selves is similar to the idea of distance discussed in previous FTP literature. Here we observe that students’ perceptions of temporal distance are dictated by past experiences. Traditionally, FTP only considers present and future experiences without explicit consideration of the role of the past in developing student perceptions of these timepoints.³ While previous work using FTP in engineering has shown that the construct of distance has held,^{6,13} it has also been noted that engineering students do not elicit similar motivations and attitudes when compared to non-engineering peers.⁴ As such, the role of the past in EDS FTP is not surprising and can be related to a cognitive process called episodic future thinking. Episodic future thinking is defined as the ability to imagine oneself in a future based on similar past events.^{18–20} Mark, Katie, and Umar suggest that they have this ability to project themselves into a future similar to a particular past experience. John takes time during the interview to develop his future self which originates from his past experiences. On the contrary, George seems to have this ability working in the opposite direction where he utilizes his past experience to exclude futures similar to his past.

Graduate-level tasks are useful towards research

“As an engineering student, yes, it’s always interesting to solve engineering problems.” - George

The participants perceive tasks as useful toward present or future identities. George demonstrates that a graduate-level task, solving engineering problems, is useful toward his present identity “as an engineering student”. George associates this task with being an engineering student and not much as a researcher, as he further states, “[I solve engineering problems] right now, to get good grades.” Thus, George perceives engineering problems as a task useful for his present identity as a student in engineering classes.

Similarly, both Umar and John perceive reading journal articles as a task useful toward their present identity as an EDS. Particularly, John understands that he “has to read journals” as it helps “for the research” related to his thesis. On the contrary, he reveals that he reads unrelated science magazines as “that’s where innovative ideas are” that can be useful toward his future identity as an energy researcher. Umar similarly views reading journal articles as useful toward his present identity as an EDS. However, he differs from John in that he retrospectively reflects on how reading journal articles in the past helped him approach reading journals in the present. He states:

“When I started reading paper[s], I used to go through it very fast. My idea was just grasp the results and that's all... I didn't follow the whole idea of the [paper]... [My advisor] wanted me to see that all these things are not very difficult. All the [big] equations we see are actually very small, simple equations... Now when I see some very difficult equation, I know that it's not difficult. Inherently it's very simple. This is the learning I had because this helps me a lot now.” - Umar

Even though Umar knows he learned how to approach reading journal papers with difficult content, he does not talk about how his skill can be applied to, or is useful for, his future identity as a researcher. He constrains this task to his present identity as an EDS.

Katie differentiates between which tasks are useful toward her doctoral research and align with her present identity as an EDS. For example, we asked her if she thinks the required coursework is useful toward her research, and she states:

“Not enough! It's more about basics, but not enough. You still need to read more, the newest paper... Recently I'm searching [for] more classes here, like R Studio and Matlab and, if possible, Python. I just hope I could learn more about that one, the software. It would help to solve the problem. But for the basic classes in the major, I think I have already taken enough.” - Katie

She does not find her coursework useful anymore as she perceives them as “basic”. To compensate for the “basic” courses, she actively searches for outside resources that will help her gain the knowledge she needs to conduct her present research. She also perceives reading “the newest paper” in her field is a useful task for her present research. Even though we ask her about her current research, she does not refer these tasks are connected to her future identity as a science journalist.

In contrast, Mark finds use for the graduate-level tasks he does in the present toward his future self. For example, Mark perceives the required summer internships as a useful task toward his future identity as a lecturing professor. He states:

“Normally we have books we teach from. The books are written to complement [and] reflect what is being done in the field, but some of these books are still old, and sometimes things might be done the same way, others might be improved... Once you [graduate] and you’re a lecturer, you cannot relate what is in the book to real life. [You need to] be able to give real life examples for the kids to understand. That’s why [an industry experience before lecturing] is important to me.” - Mark

Because he knows the difference between “the books” and “real life”, he sees usefulness in having an industry experience. He directly connects this graduate-level task to his future when he continues, “In view of that, I’ve been doing some internships. I’ve had a couple of internships. I think it’s enough to help me lecture, but to get out in that field more is going to be helpful.” Mark perceived he will not have enough industry experience, which led to him to plan a more immediate future goal in industry. He is able to directly find usefulness in his graduate-level tasks to his future because he put a lot of thought into defining his future self.

For this study, the five participants displayed different conceptualizations of task value. Note that each participant was not asked about how tasks directly relate to their defined futures, but rather how they valued the tasks they were performing. Mark is the only participant who directly connects the graduate-level tasks he performs to his future self, connecting his future with his present. For example, he connects course-based tasks with his emerging identity (future self) as a professor which aligns with Nelson et al’s⁴ definition of endogenous perceived instrumentality (PI). Despite having future goals, Katie, John, and Umar approach graduate-level tasks as useful toward doing their research in the present. George does not have an emerging future identity and constrains problem solving in courses to his present identity as a student. Despite explicit prompting of the valuing of present tasks for future selves, these four students discussed the value of tasks for the present, thus removing the explicit consideration of time. The removal of time from value more closely aligns with utility value conversations from the Expectancy-Value literature.²¹ Through removal of the consideration of time in task value, these students may also be indicating that they have shorter temporal distances than what has been seen in undergraduate engineering students in previous studies.^{6,13} This shortening of temporal distance may be that Katie, John, and Umar all noted multiple future selves that they wanted to pursue or avoid. Having multiple future selves may divide students’ attention and time to craft more detailed and deep perceptions of the future, thus limiting the number of ways students could find the perceived instrumentality of present tasks. When taken in tandem with previous findings, the limited futures of graduate students and their limited conceptualizations of endogenous PI may serve to limit student persistence⁷ and learning⁴ during engineering tasks.

Overview of findings

FTP literature supports that goal setting plays an important role in motivation to persist and find usefulness in an academic program.³ In particular, each participant defined a future self or future

goal around a salient past experience with varying degrees of clarity. Participants then perceive different levels of usefulness, or perceived instrumentality, in the graduate-level tasks in their programs towards present or future identities. Table 3 summarizes these sub-themes with a description and how they apply to the participants. The intersection of these two findings defines the overarching theme of “prioritizing the present or the future”. Mark prioritizes his future. He has a clear definition of his future self and finds usefulness in the graduate-level tasks toward his future. Katie, John, Umar, and George prioritize the present.

Implications for Practice

Implications of this study include rethinking graduate advising techniques to consider future goals as motivation to approach graduate-level tasks. In current graduate culture, assigned graduate-level tasks are pushed by advisors to meet project deadlines. As these tasks are generally related to the advisor’s research projects, EDS may not find usefulness in the tasks which hinder development of skills necessary for their desired future careers. Engineering graduate advisors should give serious consideration to their EDS’ future goals to tailor graduate-level tasks. By connecting EDS future goals with graduate-level tasks, EDS will be motivated to pursue the tasks and develop skills.

Table 3

Summary of Emergent Sub-Themes

Sub-Theme	Description	Participant Context
Salient Past Experiences Help Craft Future Goals	Participants describe unique past experiences that inspired them to imagine, or define, their future selves within that context.	Mark, Katie, and John had past experiences unveiling social issues which helped them define relevant future selves. For example, Umar had an experience where he was not helping people. He described this experience as “just cleaning filters” and “making money.” This motivated him to roughly define a future self that helps people. In contrary, George’s past experience defined what he does not want to do in the future. Specifically, he explains how he did not perform well as a teacher, which deterred his future as a

Graduate-Level Tasks are Useful Towards Present or Future Identities	Participants perceive assigned tasks as useful to complete for either the present as an EDS or the future as their defined future self.	faculty. Mark is able to see how his graduate-level tasks, such as internships, are helping him for his defined future. John, Umar, Katie, and George perceive their tasks as working towards their present research.
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Additionally, graduate advisors should avoid pushing their EDS into a future which the advisors envision for their EDS. This pressure is true when the advisors' imagined future for their EDS do not align with the EDS' defined future. The misalignment of future selves creates a tension in finding usefulness, or possibly congruence, in assigned graduate-level tasks. For example, Umar explains how he knows his advisor has plans for his future. Umar states:

“I think he has a plan. He's not happy the way I'm going with this plan, because I think he has a plan for me in academia, but I have only one journal, how can I be in academia? It's impossible. I don't have any interest in that. I think he has a plan for me, he hasn't shared.” - Umar

However, Umar made it clear that he does not have interest in pursuing a career in academia. He further explains how he approaches an assigned task towards a future in academia:

“He's [his advisor] telling me, ‘You have to do this, you have to do that for that.’ Maybe. He told me to write a CV now, I told him, ‘What the hell?’ I have still two years. Why do I [have to] write a CV?” - Umar

Umar resists writing his CV because he perceives it as a task to obtain an academic position and unnecessary for the future Umar wants in industry. Even though writing a CV is a small task, the implications of resistance to working on larger, incongruent tasks could lead to the exclusion or attrition of EDS. These findings are reflected in undergraduate motivation studies, such as FTP^{4-7,13} and identity-based motivation,²²⁻²⁴ that indicate when there is an incongruence in present tasks with future selves, students are not motivated.

Limitations and future work

Our study considers one point in time of the participants' engineering graduate experience, which is a limitation. To understand how EDS' FTPs develop over time, a longitudinal study is necessary where participants are invited to participate in follow-up interviews. These follow-up interviews could help explicate the development or stagnation of EDS' FTP over the progression of an engineering doctoral program.

This study is a part of a larger study to grasp identities and motivations of EDS. Future work on this particular study of FTP on EDS includes the development of FTP survey items based on our findings. The developed items will then be used in an instrument from the larger study to sample EDS nationwide. These data will then be used to develop identity and motivation profiles of EDS to further our understanding of EDS. Also, the task utility findings indicate that separation of motivation theory into future *or* present oriented constructs may not be appropriate for EDS, and alternate ways of combining these theories need to be explored. This work, however, provides initial insight into EDS' need to develop future selves or perspectives that are integrated into all aspects of their engineering graduate experience.

Summary

This research explored how five EDS experiences influenced their future oriented motivations, or future time perspectives, at a western land grant institution. The participants were interviewed regarding their future goals and graduate-level tasks. It was found that participants use salient past experiences to craft future goals, which answers the first sub-research question. The participants with more defined future goals were able to perceive usefulness in graduate-level tasks towards their future goals, which answers the second sub-research question of how EDS connect their future and present. Connecting these two answers, shows how EDS decide to prioritize the present or the future as an approach to pursue graduate-level tasks.

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