

# Meta-Analysis of Student-Researchers' Learning Journeys Through a Reflective Practice

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**Abstract**—This Full Innovative Practice Paper explores an intervention in which undergraduate engineering students participating in engineering education research (EER) conduct a meta-analysis of their own learning journeys through a unique reflection process that engages qualitative education research methods and engineering design principles. This work expands on our previous research on factors that impact engineering students' learning journeys, including but not limited to gendered learning experiences, the influence of external and internal narratives on engineering students' identities, and conforming and non-confirming motivations and behaviors that affect engineering students' learning journeys. While our previous work allowed engineering undergraduate scholars to cultivate a deep understanding of the qualitative research paradigm's intricacies and reflect on other engineering students' learning paths, this innovative practice invites them into a space of continuous – albeit informal – reflection on their own learning trajectories. Specifically, we have designed and implemented an innovative practice that allows for EER students' metacognitive development as they learn about themselves through reflection on the learning of others in their education research and by integrating this process with engineering design practices – a more habitual paradigm for engineering undergraduates. The following prompts guide the EER students' engagement with this intervention: What are the EER students' motivations to engage in this innovative practice's reflective activities? How has the engagement in this innovative practice influenced their perspectives on their learning journeys? What are the EER students' emergent sense-making narratives about themselves resulting from participation in this reflective contemplation? This paper describes the process and artifacts resulting from this design-based qualitative meta-analytic practice that range from art-based representations to storytelling to mind maps. As is evident in the artifacts produced and further explored in this paper, the EER students' engagement in this innovation had and continues to have a profound, lasting positive impact on their learning journeys as engineers and undergraduate education researchers.

**Index Terms**—learning journey, identity development, metacognitive development, qualitative research paradigm, design-based practices

## I. INTRODUCTION

Understanding one's identity is an important aspect of a researcher's sense-making of their personal growth, biases, and positionality as those pertain to their scholarship. Muhammad et al. (2015) define identity as “a complex, multi-layered, and dynamic phenomenon that is both fluid and situational, yet

retaining core characteristics” [1]. The identity of a researcher is dynamic and evolving, influenced by ascribed characteristics (e.g., race, gender) and achieved characteristics (e.g., education, job, social position) [1]. Nash (2024) further differentiates between a researcher's identity and positionality, explaining that “positionality directly incorporates ideas of power and privilege and seeks to describe the researcher's identity” through the intersectionality between one's background and related actions [2]. Understanding a researcher's positionality through the lens of exploring their identity allows them to gauge the effect of their identities on “knowledge construction and research use, and [...] their impact [on] the goals of the research itself” [1]. As Britzman (1991) explains, the process of research and scholarship (inherent in becoming a teacher in the context of Britzman's study) involves more than “applying decontextualized skills or of mirroring predetermined images; it is a time when one's past, present, and future are set in dynamic tension” [3], suggesting that scholars must navigate and address their own biases, blind spots, and assumptions, as well as their life stories, to improve and maintain the quality of their research while also making sense of their own identities.

Employing an autoethnographical lens for understanding educators' professional journeys, Starr (2010) argues that “through the interrogation of one's identity and the locations and interactions pivotal in the formation of identity, the result is increased consciousness” [4] and, what Hickey and Austin (2007) call, “conscientising of social positioning” [5]. Starr further explains that “taking such a position generates more authentic knowledge” of “personal educational experiences, core beliefs, and ideologies” [6] and “how that personal knowledge informs educational philosophy and pedagogical practice” [4][6]. One seeks to make sense of one's life by reflecting on the past in the present to plan one's future.

A number of frameworks, processes, and associated practices have been developed recently to support one's (own) reflective processes to allow for a deeper understanding of one's (own) life experiences and how those experiences shape one's (own) identity. For example, Kajfez et al. (2021) use a “fully integrated mixed method approach [that] combin[ed] closed-ended and open-ended survey items to explore student-[scholars]' identity on a survey and during an interview” and

determined the “importance of considering student[-scholar]’s conceptualization of the identity that is being measured” [7]. In his interpretation of curriculum and curricular design, Schubert (1986) describes a process of development and sharing of autobiographical accounts “with others who strive for similar understanding.” He further highlights that through this process “the curriculum becomes a reconceiving of one’s own perspective on life, ... [and] a social process whereby individuals come to [a] greater understanding of themselves, others and the world through mutual reconceptualization” [8], suggesting that a mutual exchange of one’s reflective practices and their outcomes (i.e., autobiographical accounts in this case) may support individuals in their identity sense-making. The importance of leveraging reflective practices in engineering education is further emphasized by Epstein and Zastavker (2017) in their exploration of engineering students’ “uneasy stories” within the context of two courses on critical reflection. They argue that “reflective practice is based on the premise that tacit knowledge is embedded in practice and is generated through the process of reflecting on and in practice (or action) [9]. They further emphasize the need for centering self-authoring through self-reflection in engineering education stating that “the project of unearthing, interrogating, and sharing uneasy stories is a rewarding but messy one that requires iteration across a lifetime” so that one can engineer one’s own life [9]. Similarly, Venkatesh and Zastavker in their adoption of contemplative practice, including contemplative reflection [10]-[13], leverage Carper’s framework integrating personal and professional ways of knowing [14] as well as cognitive ways of being with those that are affective and embodied [15].

To date, the scholarship that focuses on reflective practice in engineering education (including reflexivity, critical reflection, contemplative reflection, etc.) has focused on students as study participants engaging in reflective experiences either through their coursework (e.g., [9]-[13]) or as participants in external research (e.g., [7][9]). To our knowledge, engineering students, and specifically engineering undergraduate-scholars, have not been engaged in aspects of autobiographical or autoethnographic work exploring their own learning journeys in the same way that educators and education scholars have done (e.g., [16][17]). This Innovative Practice fills the gap by building on our previous work [18]-[21], which focused on engineering students’ – as study participants’ – learning journeys, including but not limited to gendered learning experiences and the influence of external and internal narratives on their identities. While this previous work allowed EER students to cultivate a deep understanding of the qualitative research intricacies and reflect on other engineering students’ learning paths, their participation in the project invited them into a space of continuous – albeit informal – reflection on their own learning trajectories. By creating opportunities for the EER students to formalize this reflective process and integrate it with the engineering design practices – a more habitual paradigm for engineering undergraduates – we have designed an innovative practice that allows for EER undergrad-

uate students’ metacognitive development in learning about themselves as they reflect on learning about others. This process also opens a door for defining a new framework for a meta-analytical practice that engages investigation of one’s own learning journey through a unique reflection process that integrates qualitative research methods and engineering design principles that can help scholars, including engineering undergraduates and EER students, develop an educated positionality statement.

## II. METHODS

Our work is situated at Olin College, a four-year engineering-only institution that uses project-based pedagogies throughout its curriculum. All students engage in at least six engineering design courses comprising a design stream that focuses on major themes in design thinking, involving theoretical design principles’ consideration and engineering experiments. Six engineering undergraduates, at various stages of engagement with the EER about engineering students’ learning journeys, prototype and test the impact of innovative reflective practice. The following prompts guide their engagement with this intervention: *What are the EER students’ motivations to engage in this innovative practice’s reflective activities? How has the engagement in this innovative practice influenced their perspectives on their learning journeys? What are the EER students’ emergent sense-making narratives about themselves resulting from participation in this reflective contemplation?* This paper describes the process and artifacts resulting from this design-based qualitative meta-analytic practice that range from art-based representations to storytelling to mind maps. Below we describe the diverse methods EER students use for this innovative practice. All names are pseudonymized.

**Antisana’s method:** Antisana reflects on her learning journey by creating a mind map. Kernan et al. (2017) define mind mapping as a “brainstorming technique that allows users to deconstruct complex topics by creating a graphical representation of constituent subtopics and related themes” [22]. Centering around one main topic, Antisana’s analysis branches out into subtopics, resulting in a somewhat hierarchical graphical structure. Antisana’s handwritten mind map – an intentionally kinesthetic analytical approach that allows her to reflect in an embodied way – supports her understanding of complex relationships within her learning journey integrating her various identities clearly and concisely. The description of what she depicts in her mind map uses colloquial rather than scholastic discourse providing an opportunity for her to make meaning of her mind map and further understand her learning journey with herself as a main audience.

**Priya’s method:** Priya reflects on her learning journey through a written reflective practice. She divides her narrative into two chapters that she tacitly names ‘Tae Kwon Do’ and ‘Engineering.’ To help guide her reflection, she follows the learning journey study interview protocol, imagining her own learning journey as two book chapters [18]-[21][23][24]. In each chapter, she explores how its main subject – Tae Kwon Do or Engineering – has been and continues to shape her

I am Antisana Harin, a 20-year-old female and a 3rd year student at Olin College studying Mechanical Engineering. I have been a part of the research group studying engineering students' learning journeys for four semesters. For this reflective practice, I created a mind map – one that allows me to visualize and connect parts of my identity, similar to how my thoughts connect in my mind. At the time of doing my mind map, I am in the midst of a comparative climate change study abroad program while also continuing to be a part of Olin's EER team. During this one semester away from Olin, I am exploring a different part of my selfhood and passion. This is also my first semester not taking any technical engineering courses. As I am learning about climate change, ethics, and conducting qualitative research this semester, I am also continuously questioning my identity and choices, particularly related to my career choice in engineering. My mind has been widely scattered this semester as I continuously

battle to understand how my non-engineering interests fit into my engineering ones: do these choices complement each other at all, or am I making wrong decisions, especially at a crucial stage of life where my decisions shape my engineering career? In a conversation with one of my former professors, I was invited to write down all my interests and pool them into large bubbles as a way of visualizing my learning journey. This process allowed me to reflect on aspects of my selfhood that made me happy in the past and those that make me happy now. Connecting these aspects with threads and seeing this large mapping of my past and present serves as a starting point for coming to terms with my desired future path. Through this process, I was able to connect two large parts of my identity: that of an engineer and that of a qualitative scholar. Before participating in this reflexive practice, I did not realize how intertwined these two parts of my identity are and how much they support each other. For one, I realize that the qualitative research and engineering parts of my identity complement each other, and the skills I have been learning in one are transferable to the other. For example, in qualitative research and the engineering field, there is a need to understand positionality and bias when doing work. Practicing this in both spaces has been helpful for my growth as an engineer and a scholar simultaneously. In the “New Perspectives” node in my mind map, there are several more connections I have made between these two identities. This reflective practice helped me see that I don’t need to confine myself to a strict “engineering” identity. Other aspects of my selfhood, whether technical or not, integrate seamlessly into my career as an engineer. Embracing the various facets of who I am, in fact, contributes to my aspiration of becoming a more well-rounded engineer, broadening my perspective and fostering creativity.

### *B. Priya’s Reflection*

I am Priya, an Indian-American second-year student studying Computer Engineering at Olin College, and planning to graduate a year early. I think about my learning journey in two parts. The first part is centered on Tae Kwon Do, and it’s straightforward. My mom enrolled me when I was 8, wanting me to learn self-defense, and I stayed until I got my black belt. I knew I loved it from the start, and my identity/worth as a ‘black belt’ is something I have never questioned. Even now, years after earning my black belt, that is one of the core identities I hold.

The other aspect of my learning journey, the engineering one, is far more complex. For years, I went back and forth on what I wanted to do in my future. I wanted to be a mermaid, a princess, a lawyer, a doctor, and countless other things. After COVID, I decided that a “safe” option was computer engineering. It was a reliable, growing field, it paid well, and it didn’t require years of schooling. I knew some coding, and it was interesting enough to me that I was okay doing it for the rest of my life.

I got accepted into Olin and committed to enrolling. My first memory at the college was midnight dodgeball. The teams were decided by arbitrary things like “west coast vs. east

coast.” The one I remember the most was “robotics vs. no robotics.” I walked to my place on the “no robotics” side, and, upon turning around, found well over 80% of my graduating class on the opposite side, proudly discussing what robotics team they were on, the wins their teams had, and all the cool robots they created. They were throwing around random acronyms, and I felt out of place as one of the only students in my class who had never touched a robot.

As my first semester went on, I began to worry because I wasn’t interested in any of the classes. In my second semester, I took a course in Python and loved it. I was good at it - one of my friends told me I was a “God at Python” - and I was interested in it. By my definition of belonging at Olin, i.e., liking the work you are doing and spending lots of time doing it, I finally qualified as someone who belonged. I didn’t feel like I belonged, but I could certainly act like I did.

That semester, I joined the EER team with one simple motivation - I liked the professor leading the group, and I thought it would be fun to work with her. When I heard about the various ongoing research projects, I chose the one investigating engineering students’ learning journeys. As someone who struggled to make sense of my place at Olin, I thought learning about other students’ learning journeys would help me make sense of my own. Reading the interviews and engaging with the participants’ narratives, I realized I was nowhere near an engineer based on the metrics they defined. I didn’t spend my summers at math camp, I didn’t do robotics in high school, and I definitely did not grow up dreaming of being an engineer. Studying people who were so passionate about the work they did made me feel like I was in the wrong place. They had always wanted to study engineering, and they had very clear goals for their college experience and afterward. This made me feel even less of an engineer.

For the most part, I enjoyed research more than my classes. I liked being able to step away from engineering, from everything being black and white, and allow myself to think and reflect differently. I liked that there wasn’t a right or wrong answer, and I liked that things were up to interpretation. But that’s not engineering. Your code either produces the expected output or it doesn’t. Your project either works or it doesn’t. My research teammates and I were able to read the same line from an interview and interpret it in multiple different ways, and I couldn’t do that with engineering. Research became a much-needed escape. It provided me with an opportunity to do work unrelated to engineering, and I found that to be extremely refreshing. That feeling was worrisome to me though. I looked at the amount of extra time my peers would spend on projects that they were so passionate about and compared that to my own desire to finish my work as quickly as possible. I looked at the amazing and over-scoped projects my peers would make for their classes and compared them to my very underwhelming projects. Mulling over my four semesters at Olin, I still don’t feel like an engineer. I don’t know if I will, but for now, I just feel out of place.

My motivation to engage in this activity was to be able to reflect on my engineering identity and try to understand





Fig. 2. Bridget's Visual Art

why I feel the way I do. Engaging in this practice has shown me that the people who I consider engineers have different priorities and passions than I do. They love engineering, so they want to do it in their free time. I see engineering as something that I like and as a means to an end, so I need a break from it outside of classes. After this exercise, I see that there are two ways to define the engineering degree I will receive. The first way is to call myself an engineer, to allow this degree to be a major part of my identity. The other way, the way I identify with, is saying that engineering allows me to do what I like without defining me. The issue with this interpretation is that I don't think Olin is the place to be if engineering is just what one likes or is a means to an end. With the nature of this school as one that allows for exploration through projects for people to dive deep into their passions, I feel very out of place. I don't know if I would feel otherwise if I went to a different school with a more diverse student body and more varied motivations to study engineering. For now, I have come to understand that I'm okay with why I'm studying engineering. I have also realized that this state of uncertainty, this state of being "okay for now," is temporary. I have one more year at college, and much more will unfold after I graduate. For now, I don't mind being unsure.

#### C. Bridget's Painting and Reflection

I am a 23-year-old female senior at Olin majoring in Engineering with a concentration in Industrial Design. I have been a part of the EER team studying engineering students' learning journeys for five semesters. To engage in this reflective practice, I chose to create visual art. Having contributed representational visual works for this research, I chose to further explore this practice.

I believe that visual representations of learning journeys can help the teaching and learning practices to be more inclusive. As a student with dysgraphia, a learning disability that makes transferring thoughts through writing difficult, I am a strong

believer in the power of alternatives to communication and self-expression. Visual art does not have the same connotation nor struggle for me personally, and I believe visual self-reflection tools could make reflecting and sharing learning journeys from a neurodiverse population more accessible. This hope is encapsulated in the lower left-hand corner of the painting with the misspelled word elephant, morphing into a drawing of one, tied to a pivotal moment in my learning journey when, on a spelling test in the third grade, I drew each word rather than spelling them out. I was sent to the principal for failing to comply, a symptom of the broken educational system, and a moment of realization that the world was not built for my mind. To further spotlight this idea, I drew a headset microphone on the top right of the painting as a simplified curved black line symbolizing the time I spent using voice-to-text devices to help me communicate. It is next to a paintbrush, the device I would have rather communicated through. Above the misspelled word I located an envelope that mirrors those in which my grades would come home throughout grade school, a visual element demonstrating the complex relationship I have had with grades as a system of evaluation. Other elements of the painting feature the 'neutral' world, representing what I have learned about nature and what I hope to continue to learn; the more abstract marking that fills the background of the work represents various strong emotions in my personal learning journeys. The circles represent my family - I am one of three sisters - and the squares represent the different colleges I attended.

I am extremely grateful for the skills and learnings about self-reflection that I have gained in my time with educational research, that empowers art and community. I hope as engineering education invites more neurodiverse populations into its fold, forms of communication other than writing will be engaged to support these students, including visual mark-making used for this reflection, which is a product of physically marking a surface as a form of visual art.

#### D. Vanshika's Journey Tree and Reflection

I am Vanshika Bajaj, a 20-year-old junior studying mechanical engineering at Olin College. I have been a part of the EER team studying students' learning journeys for five semesters. Below is the description of both the process and product of my engagement with this innovative practice.

Christmas trees have always reminded me of home: running around with my cousins, playing with them to get my presents under our small Christmas tree in India, our interaction with the festival being more cultural than religious. Being born and raised as a Hindu in the diverse city of Delhi, we celebrated Christmas as a holiday to exchange presents and decorate a tree with our handmade ornaments, a tradition we followed together as an extended family. When I moved to the US, I added to this tradition personalized ornaments for my friends.

When brainstorming the ways to engage with the reflection on my own learning journey after studying the learning journeys of others, I felt that making custom Christmas tree ornaments - as though gifts of reflection for myself - was

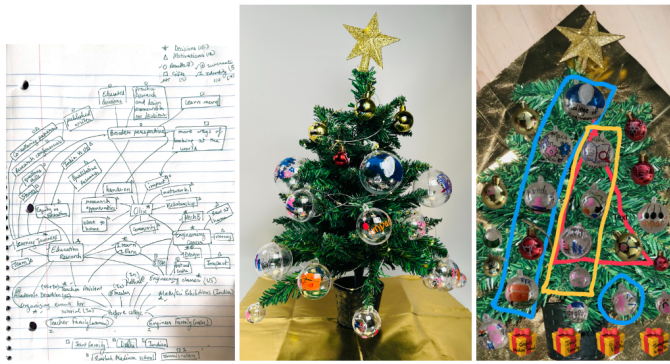


Fig. 3. Vanshika's Learning Journey Tree: An Identity Model

apropos. By placing these ornaments on the tree and viewing them from the tree's bottom to its top, I portray a narrative of who I am and why I became an EER student. The size, color, and position of the ornaments on the Christmas tree mark the key decisions (largest, transparent), motivations (medium-sized, transparent), results (small, golden), interests (small, red), identities I was born with (small, transparent), and gifts I was given (objects under the tree). The latter ornament category is the privileges my parents have provided me with: access to education, a loving family, city life, and immigration to the US. Coming from a family of teachers and engineers (circled in blue), integrating these professions into my emerging identity seemed natural to me. I gravitated towards opportunities where these fields coexist, whether assisting a professor teaching a class, running my own engineering design and education program, or researching the undergraduate engineering education experience (triangle in red).

In eighth grade, I moved to the US from India, leaving my extended family and friends behind, entering as a nuclear family into a new world, which, I soon gathered, offered many different opportunities I did not have the privilege of having in India. I had gone from a school whose definition of engineering was math tests and problem sets to a school with maker spaces and the freedom to build anything I wanted with materials and guidance provided. I quickly realized the importance of equity in engineering education. I saw my friends in India taking qualifying tests or paying extra to have access to what I got from just moving to a new country. This added to my desire to contribute to building equity in engineering for at least the communities I'm a part of. Choosing Olin for mechanical engineering was not difficult – the college engaged hands-on paradigm, focused on equity, and was close to my new home (rectangle in blue). Participating in the learning journeys study seemed natural due to the combination of my love for intricate stories and the purpose of this research: making engineering education more inclusive and equitable through analysis of rich, detailed individual undergraduate engineering students' narratives (rectangle in yellow).

While reflecting on my journey so far in college, I have realized I have spent most of my time split between engineering

and education research, which is how I want my life to continue: work as an engineer while building equity in engineering education through sharing my experiences and expanding the program I started in high school. Mapping out the results, i.e., the learnings, knowledge, wisdom, and principles I gained from these experiences, provided the validation and clarity in my decisions I was seeking as a soon-to-graduate engineer. Did I make the right decisions? Is making different choices than my more "successful" peers right for me? What even is success? What is it for me? I realized that my decisions were right for me because they aligned with my interests and priorities and that my interests, privileges, and background are different from my peers which makes me who I am. Running this exercise made me understand that due to my experience in India, where grades were everything, I only evaluated myself through quantitative measures of "success:" brand and salary. I now define success as my personal growth, maturity, diverse work experiences, relationships, and motivation – all qualitative, all stories, all critical. The surprising aspect of this innovative practice is that I did not start by seeking answers to these questions. I made a mind map based on the six emergent categories and relevant symbols, instances, and depictions on the ornaments I created. This process highlighted key aspects of my learning journey all the while making me curious about what is yet to be learned in the future and bringing forth the interests previously hidden from my conscious mind.

#### E. Mario's Reflection

I am Mario Fernandez, a 20-year-old engineering student, and I am in my third semester at college. I have been on the Learning Journeys education research team for one semester. I immigrated from Argentina to the United States at 8 months old. This is my reflection on my identity as an engineer and this past semester as a research team member.

"[Aureliano (II)] had already understood that he would never leave that room, for it was foreseen that the city of mirrors (or mirages) would be wiped out by the wind and exiled from the memory of men at the precise moment when Aureliano Babilonia would finish deciphering the parchments and that everything written on them was unrepeatable since time immemorial and forever more, because races condemned to one hundred years of solitude did not have a second opportunity on earth" [26]. In this passage at the end of Gabriel Garcia Marquez' novel *One Hundred Years of Solitude*, Aureliano reads his family's prophecy, the Buendia's story from the past 100 years, and discovers that it has all been predetermined from the beginning, even his reading the prophecy at that moment. He realizes that by reading this prophecy, he has come to the end of it, which actively destroys his family's legacy, "exiling it from the memory of men." I used to consider myself part of the "race condemned to [three] hundred years of solitude," much like the Buendias. It wasn't until I joined my research group and reflected on the way I narrate my identity that I found "a second opportunity on earth."

I hold a deep connection to this novel because of its roots in my Latin heritage and the reflection of myself I see within

the Buendia family. Much like Aureliano, I carry my father's name, and his father's before him, and so on, going back three hundred years. To be precise I am the tenth in line, a fact I take great pride in and feel integral to my identity. Much more than my name, though, my father passed down to me his identification with engineering. He instilled in me his philosophy that "engineering is more of a mindset than a career." He would tell me stories about his late nights staying up studying engineering, take me to see firsthand how he was helping optimize the systems in his workplace, and help me study before tough science and math classes throughout high school. This is what inspired me to become an engineer and identify as one when I first started studying the field. But I quickly learned that I couldn't base my engineering identity on just my father's ideals. During my first semester, I struggled greatly with classes because I lacked my unique motivation for engineering. I found myself feeling like Aureliano, almost reading from a prophecy where I was told what I had to be passionate about. Although I respected and appreciated the engineering identity that had been passed down to me, just like some poetic prophecy, I felt as though it wasn't true to me. I never told anyone this, though, and continued to struggle in silence attempting to force my identity into something it wasn't. In my second semester, I attempted to take a larger course load, worth twenty credits, since I saw all my peers doing it. I believed that perhaps I just needed to immerse myself deeper in engineering to understand my relationship to it. I decided that I would work hard and join a research team. When my friend invited me to a meeting for one, I immediately accepted, not knowing what to expect. I remember during that very first meeting the professor told us a very personal story that moved me greatly. It was a story of struggle and growth and a story of overcoming professional challenges, which allowed her to find her own motivation to move on and to craft her new identity, without letting others define her. This amazing story convinced me to join her research group.

As time went on, I studied stories from other individuals while reading about narrative identity as a research and practice [23][24]. The concept was completely foreign to me but the ideas called me to learn more. By narrating stories of their learning journeys, our interviewees were able to gain a deeper understanding of their identity as engineers and their motivations for engaging with the field. This practice continued as well at our weekly meetings, where students and professors would occasionally share stories of their studies. Some of these stories would lead to amazing discussions about the identity of faculty and the student body within our tiny engineering community at Olin. Bit by bit, I was learning the language of narrative identity through firsthand observation of it being used, just like how, in the novel, Aureliano took years to decipher the complex code that the prophecy was written in. Like Aureliano, I have been trying to learn how to understand my own prophecy, i.e., my engineering identity, through my research about others' learning journeys. If it weren't for the openness of my professors and peers, the research I did on narrative identities, and the examples of narratives I saw

firsthand each week, I wouldn't have been able to provide this analysis. Over the past semester, I have been trying to decipher my own code using the skills I learned in my research, culminating in this meta-analysis of my learning journey so far. This is just the first step and I still have ways to go to fully unravel my motivations and identity within engineering, but it is a process that I am excited to undergo. Hopefully, I can come to fully decipher my prophecy like Aureliano and even go further and write my own story, crafting my own engineering identity and understanding my motivations to engage with the field.

#### *F. Thao's Reflection*

My name is Thao Nguyen, and I am a first-year student at Olin College. I plan on majoring in Engineering with Computing concentration. This past semester was also my first semester on the Learning Journeys EER team. In my first semester at college, I was first introduced to ideas about identity and life journeys through a liberal arts class. I found this interesting and in this reflection, I write about how this led me to engage with research in this area, and how it has affected me so far.

For as long as I can remember I was a believer of determinism, or some obscure amalgamation of the theory combined with my own beliefs. The point is that I just didn't understand or support free will. I believed that I had a predetermined destination in life that I would eventually get to, no matter what. It made life easier, or so I had thought. Narrative identity [23][24] was new to me. I had recently picked up the term from a class I took in my first semester of college. Here, I learned that it was a way of processing and thinking of identity, through an internalized and ever-growing story. However, an issue I had with this theory was that it fundamentally went against what I believed. Narrative identity argues that the way I interpret my life affects my story which then affects my identity, and the way I interpret my life is not inherently concrete or determined, it's something that depends on me myself. This made no sense to me, I couldn't register it, and it truly shattered what I thought was me. If my identity was integrally based on how I chose to perceive life, wouldn't that mean that I had free will? I looked back on my past experiences, seeing that any certain experience can be considered through many lenses, all defined by how I wanted to interpret them. I was wrong.

My outdated and selfish way of thinking didn't make my life easier, it quite literally did the opposite. It made it harder, but not harder as in strenuous; rather, harder as in worse. I feel now as if this was just a projection of my coping mechanism and how determinism as a whole was just an escape for me. It never allowed me to properly reflect on anything because everything was out of my control. So I began to change my way of thinking. Not only did I start to consciously decide how I wanted to interpret my life, but I also began to consciously hold myself responsible for my actions. And what better place to do that than in the research team that looks into the learning journeys of students through the lens

of narrative identity! Through this opportunity, I experienced a sort of meta-meta-analysis of my own learning journey. From reading and analyzing narrative identity-based literature to deep discussions with the team about the ins and outs of this framework and practice to writing this reflection itself, I was able to learn even more about myself. Having the opportunity to own these reflective experiences is something that has played into reshaping my own learning journey. I think that if I never found this group, participated in these meta-reflective exercises, or even met the people on this team, I would not have been able to have these insights. It makes me wonder how differently I would think and operate. Even though I am new to EER, I have begun to understand what “free will” means and how narrative identity plays into it. Learning and exploring the idea that my life is an ever-evolving story has only inspired me to take life into my own hands; taking the first step towards learning even more. By reading the narrative identity literature and engaging with research data, I have been able to use others’ learning journeys as an example of how to digest mine. Now I wonder more about whether I can relate to others’ journeys, if I can emulate what they are doing, or even maybe avoid it. I appreciate this newfound ability that has led me to here-and-now and I even look forward to the “future insights” and “changes” that I will encounter as I continue to work in the EER space.

#### IV. CONCLUDING REMARKS

The above narratives illustrate the profound impact of engaging in engineering identity research on EER students’ personal identities and their learning journeys. Through these meta-analyses, participants not only gain insight into themselves but also learn to navigate their educational paths and research more effectively. Through their reflections, Antisana, Vanshika, and Priya become aware of and engage in meaning-making about a perceived conflict between their varying interests and their identity as engineers. They furthermore shift their relationship to this notion of ‘conflict’ and begin making sense of it as an asset that makes them “well-rounded engineers,” “who they are,” further discovering the complexities of their relationships to passion and career. Bridget, through her exploration via painting and advocacy for inclusive educational practices, discovers a meaningful intersection between her roles as a visual artist and an EER scholar. Mario and Thao, the newest members of the EER group, grapple with their identities and the construct of narrative identity by engaging in this practice with written narratives, discovering new perspectives, and embracing the ambiguity of self-discovery.

This Innovative Practice Paper argues that engagement in the reflective methods described serves as a valuable experience for student researchers, EER students, and the larger EER scholarship landscape. The EER students’ process and resulting artifacts showcase that this innovation had and continues to have a profound, lasting positive impact on their learning journeys as engineers and scholars. Furthermore, engagement in EER scholarship fosters opportunities for engagement with meta-reflection, empowering individuals to design their own

lives and serving as possible pivotal (or “turning point” [23][24]) moments in their learning trajectories. This meta-analytic practice invites the EER students to critically assess the reciprocal effect of their research and their identities by allowing them to address their own biases, blind spots, and assumptions through the lens of their learning journeys. Finally, this work brings together multiple analytical methods – those from social science and design-based research – as a novel approach to the research paradigm. This paper invites the FIE audience to engage engineering undergraduates in EER while they also engage in self-reflective practice to develop their knowledge, skills, attitudes, behaviors, and identities nurturing a humanistic paradigm, often underprivileged in traditional engineering education practices.

#### V. ADVISOR REMARKS

This innovative practice was emergent from the students’ experiences of doing meta-analytical work of investigating their own learning journeys while they were analyzing the journeys of others. In the context of our small institution, Olin students have a lot of individual attention through their academic work as well as through advising and the Office of Student Affairs. And yet, over the last few years of our research group’s engagement in this project, I found that students continued thirsting for further engagement and introspection into their own experiences as they grow into their multiple identities, only one of those being engineering.

The EER students came to realize that they wanted to engage in a more formal investigation of their learning journeys and they reached out to me with a proposal to do so through an innovative practice described above. My goal in this process was to hold intellectual, compassionate, and empathetic space for what was emerging for them individually and collectively, allowing for their authenticity to shine while also not imposing the “rigor” of academic standards for publication. I invited the vulnerability and colloquialisms to be present, which allowed for the depth of their self-presentations to be evident: not polished, not fully organized or examined, at times still at the very surface of discovery, but certainly with the potency of something compelling yet to come.

Through this Innovative Practice Paper, my goal was to support the fully emergent student process of self-realization. This work is a result of the students’ initiative, ambition, and excitement to share stories of their individual learning journeys and the lasting positive impact of EER on their trajectories. As such, with this paper, I also invite engineering education scholars to join me in engaging engineering undergraduates in their EER to not only support their ongoing scholarship but to also support the growth and development of engineering students and their evolving identities.

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