

MAPPING CHANGE IN PROFESSIONAL IDENTITY GROWTH IN DOCTORAL ENGINEERING STUDENTS

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Abstract - While identity development in engineering students has attracted scholarly attention for over two decades, very little is known about the process of professional identity development in engineering doctoral students. This brief paper describes a research study that employs user-experience (UX) methods to identify critical change indicators in professional identity development. It focuses on journey mapping to track change processes in identity development and reports how the researchers' use of journey mapping as a research method changed, oscillating between the collection of visual qualitative data to coded quantitative data and back again. It also discusses how this oscillation has required the research team to adopt various technologies to assist with the analysis and visualization of findings.

Index Terms – Journey maps, user experience, graduate education, researcher identity development.

INTRODUCTION

While identity development in engineering students has attracted scholarly attention for over two decades [1], very little is known about the *process* of professional identity development in engineering doctoral students [1]–[3]. To address this gap, the NSF-funded research project—**Mapping Identity Development in Doctoral Engineering Students**—employs user-experience (UX) methods, including user profiles and journey mapping, to identify critical change indicators in professional identity development.

This brief paper focuses on journey mapping to track change processes in identity development. It reports how our use of journey mapping as a research method has changed, oscillating between being collected as textual qualitative data, transformed to visual qualitative data, and then coded as quantitative data, and back again. It also discusses how this oscillation has required the research

team to adopt various technologies to assist with the analysis and visualization of findings.

JOURNEY MAPPING AS UX METHOD

Among the UX methods employed in this research, journey mapping was chosen initially to capture doctoral engineering students' perceptions of their personal identity development process and the interaction between this process and doctoral program design, using participants from a large state university in the United States. Journey maps are a “visual depiction of what users need and what steps they take to fulfill those needs as they interact with a product” from the first interaction to the last [4]. For this research study, we chose to designate the maps we co-created with doctoral students in engineering as journey maps; however, as Robert Curedale notes in *Experience Maps*, “A journey map focuses on identifying touch points. An experience map focuses on the emotions your customer experiences. In practice many people use these terms interchangeably. The particular lanes can be mixed and matched to your goals” [5]. Although our overall research study is guided by four research questions, our use of journey maps was directed primarily at one: *What is the process of developing engineering identity (primarily, researcher identity) in doctoral students?* The map template we designed was intended to collect touch points, pain points, and other experiences longitudinally as doctoral students progressed through their programs.

To collect data for the journey maps, we designed our study to co-create journey maps with participating doctoral students: “In a co-creative journey mapping workshop, [designers or, in our case, researchers] invite participants who have solid knowledge about the experience [being mapped]....”[6]. A participatory design practice, co-creating or co-designing is “about co-production rather than one designer making decisions in isolation and asking for user feedback at specific points in the process” [7]. In

[illegible]

For the training exercise and later with their own journey maps, participants used a series of PowerPoint slides to describe the experiences that they perceived as either promoting or hindering their development as a researcher. Participants used a different slide for each semester. Figure 2 provides an example of the semesterly journey map template participants used.

DATA OSCILLATION AND TRANSFORMATION IN JOURNEY
MAPPING ANALYSIS

I. First move: From textual to visual maps

The first transformation, which resulted in a preliminary codebook, began in June 2021 with a pilot study (#IRB2019-58) that set the stage for the funded proposal. With the aggregated semesterly maps from the pilot study in hand, the researchers worked through each semester to create a visual map of comments. The purpose of this mapping exercise was to develop a code set of experiences identified by participants and to begin to identify and count touchpoints (both positive and negative), other mapped experiences, and emotional responses to all these experiences. Figure 3 provides an example of the initial mapping exercise.



Mapping your Researcher Identity Instructions

The table will help researchers create a journey map of the activities that developed your identity as a researcher. This exercise asks you to review the ACTIVITY RUB that you have been developing your identity as a researcher in your field. For each semester, you'll list the activities. Then you'll use a short phrase to describe whether the activity was a positive or negative experience. Finally, in words, you'll explain what made this activity memorable (either positively or negatively) and discuss how it shaped your research identity.

SEMESTER	ACTIVITIES	EMOTIONAL RESPONSE	HOW THIS ACTIVITY BUILT RESEARCHER IDENTITY
<p>WRITE THE SEMESTER IN THIS COLUMN</p>	<p>IN EACH ROW, INDICATE THE ACTIVITY COMPLETED. Activities may be FINELY GRAINED, such as course assignments or activities, OR BROAD, such as a complete course, attendance at a conference, or an internship experience. For ongoing experiences, such as organizational memberships, list activity each semester.</p>	<p>INDICATE YOUR EMOTIONAL RESPONSE TO THE ACTIVITY, USING ONE OF THESE FIVE TERMS: VERY NEGATIVE, SOMEWHAT NEGATIVE, NEITHER POSITIVE OR NEGATIVE, SOMEWHAT POSITIVE, VERY POSITIVE</p>	<p>IN WORDS, EXPLAIN WHY YOU LISTED THIS ACTIVITY AS MEMORABLE IN DEVELOPING YOUR IDENTITY AS A RESEARCHER.</p>

Journey maps generated in our study describe retrospectively how participants initiated their journeys at the beginning of doctoral work and conclude with their leaving the program or graduating. Over the course of the

TABLE 2. QUALITATIVE COUNT OF CODED EXPERIENCE CATEGORIES AND EMOTIONAL RESPONSES.

Coded experiences	V N	N G	S N	N	S P	P	V P	Total s
Courses (in general)	1	3	1	2	13	1	6	47
Projects & Assignments	3	1	6	1	10	1	23	45
Research (individual)	2	2		5	7	6	20	42
Overall program	3	5	3	1	3	4	8	27
Advising	2	5	3	1	5	2	3	21
External factors, such as CoVid	3	2	1		1	2	2	11
Scholarship (presentations, publications)				1	1	1	4	7
Mentoring					2	2	1	5
Grand Total	14	18	19	7	41	3	4	205

III. Third move: From spreadsheet to textual and visual maps again

As Nunnally and Farkas (2017) explain, “Quantitative customer journeys provide only the steps a customer takes. A qualitative journey focuses primarily on emotions. Combining data from both sources allows you to create data-driven customer journeys that account for real task time and latency with awareness of human needs. These can be used as baselines for ... establishing longer-term roadmaps” [9, p. 63]. With this advice in mind, researchers are moving to more sophisticated mapping methods. Although not yet completed, at least two additional technologies will be used in the next phase of research. To visualize quantitative data, researchers plan to use Tableau, which will allow researchers to map aggregate and individual data both chronologically and categorically. For mapping qualitative data across time, Miro will be used to diagram timelines, specific touchpoints and pain points, and emotional responses on individual and aggregate maps. Drawing from the engineering toolkit, they will also experiment with Behavior over Time graphs (BoT), a graph designed to show change over time, which can assist with illustrating identity development processes chronologically. Because this move is currently underway, examples are not yet available.

CONCLUSIONS

This year’s IEEE ProComm conference is centered on the idea that “nobody steps in the same stream twice.” Over the first year of our longitudinal study of research identity development, we have learned that even analyzing the same data set stream has required us to step into the

data—the participants’ individual and aggregate journey maps—in multiple ways to understand what the maps are telling us. With each step, new insights are revealed, and our ability to see changes is challenged. Furthermore, with each step, we engaged new technologies to support our analysis. To collect the data, we trained participants using a persona that required them to identify touch points and pain points that promoted or hindered the persona’s researcher identity development. They then transferred those experiences to a map template. From this training, participants then generated their own maps in PowerPoint based on their own experiences. With these maps completed and aggregated in a Word table, researchers used a sticky note approach to create visual maps of aggregated experience by semester and generate a preliminary set of categories and a codebook. Categories were then tested and verified when the visual map codes were applied in an Excel spreadsheet and visualized in tables. In future research, the coded data will be transformed again into more sophisticated quantitative and qualitative maps using Tableau and Miro. Throughout this process, moving into the data stream required different visual and technological means to map the participants’ experiences. These moves have allowed researchers to begin to understand the process of researcher identity formation in doctoral engineering students.

ACKNOWLEDGMENT AND DISCLAIMER

This material is based upon work supported by the National Science Foundation under Award No. 2205033. Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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