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Supporting Occupational Identity Development through AI-Assisted Self-Reflection and Mentor Interactions

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Abstract: To support learners in developing career-related identities, we must attend to both their imagined selves in the field and their evolving knowledge of prospective careers. In this study, we designed an educational tool that leverages large language models (LLMs) called Careergram, a career identity reflection tool that prompts students to reflect on their evolving occupational identities and seek out support from their mentors. We piloted the tool in an undergraduate educational data science research fellowship program. Using a lens of identity development, we analyze how this tool was taken up and used by three learners, who represented different profiles of occupational identity development. Through rich descriptions of each participant, we identify different ways that learners utilize Careergram to facilitate conversations with their mentors, and shed light on learning processes that can support learners' development of career-related identities.

Introduction

Individuals embarking on career pathways face challenges in developing occupation-related identities (Callahan et al., 2019). To take on an identity of a specific career, learners must find alignment between their imagined selves (Holland, 2001) and their place in a potential occupation (Ahn & Nguyen, 2022). We conceptualize the facets of occupational identity to include an understanding of learners' competency beliefs (Bandura, 2006), social capital (Bourdieu, 2011), structural opportunities to be exposed to different experiences (Azevedo, 2011), self imaginations (Shepard & Marshall, 1999), and plans for the future (Symonds et al., 2011). In addition, the cultural norms, practices, expectations, qualifications, and skills specific to an occupation are often taught or passed along implicitly, through a hidden curriculum unique to each occupation (Portelli, 1993). For learners to take on an occupational identity they must uncover the hidden curriculum of a career and find alignment between a career and themselves. A critical question in the field focuses on how educators and educational programs might better facilitate learners' evolving identity development over time, and guide learners more equitably on pathways to fruitful occupational futures (Equitable Futures, 2021).

In this paper, we describe the first iteration of an ongoing design-based research project (Collins et al., 2016) in which we implemented a prototype of Careergram, which is an AI tool that leverages large language models (LLMs) in order to prompt learners to reflect on aspects of their occupational identities and seek discussions with their support network (mentors, advisors, peers, etc.). We deployed our Careergram prototype in a data science fellowship program that serves underrepresented undergraduate students. We then examine how learners used Careergram to seek career-related information from program mentors and how mentor-mentee pairs discuss career development when aspects of a mentee's identity have been revealed through AI-assisted self-reflection. Using an identity-focused lens, we analyze how Clara, Christina, and Jackie (pseudonyms), three learners that represent different occupational identity profiles, interact with Careergram and utilize it with their mentors. We will describe how participants worked with the AI output in the Careergram tool to facilitate conversations with their mentors, and how those conversations may support our learners in developing occupational identities. This work contributes to our understanding of how a learner's occupational identity influences how they fill career-related knowledge gaps and how LLM-embedded tools can promote sociocultural learning interactions between mentors and mentees.

Theoretical background

Our theoretical framework builds upon previous scholarship exploring: (a) occupational identity development in the face of barriers and knowledge gaps and (b) the affordances of AI in generating boundary objects that can be used to facilitate different learning processes.

Occupational identity development and the hidden curriculum of careers

We conceptualize occupational identity development as a deeply cultural process that occurs along domain-specific learning pathways. When learners decide which careers to pursue, they experiment with and eventually

take up new practices, resources, and identities related to that career domain (de Royston et al., 2020). Using this framework, Ahn & Nguyen (2022) describe occupational identity as including five vital constructs: self-positioning, competency, social capital, structural opportunities, and navigation. Self-positioning involves the ways that a learner perceives themselves in relation to imagined possible selves (Shepard & Marshall, 1999). Competency describes how a learner perceives their evolving knowledge, skills, and capabilities related to an occupation (Bandura, 2000). Social capital is composed of an individual's network of peers, family, and friends that support them in personal and professional matters (Bourdieu, 2011). Structural opportunities are the relevant activities and experiences, both formal and informal, that advance a learner toward their goals (Azevedo, 2011). Navigation outlines how a learner plans what milestones and accomplishments are necessary to transition from their present self to their imagined future(s) (Symonds et al., 2011). The development of these identity constructs is career specific. For example, a learner can have a strong sense of navigation in one career but not in another. Development of the five occupational identity constructs is also culturally and institutionally mediated. Due to systemic inequities, some students may be empowered while other students are marginalized along various pathways (de Royston et al., 2020).

For this reason, researchers and practitioners sometimes refer to the existence of a “hidden curriculum” for a domain (Portelli, 1993), such as the hidden curriculum for navigating social class (Apple, 2004), higher education (Margolis, 2001), or engineering careers (Villanueva et al., 2018). In this study, we focus on the hidden curriculum of occupational identity development in a broad sense, which may include all five constructs in our conception of occupational identity: the knowledge about what one needs to learn, what one needs to do, who one needs to connect with, and what one’s life in a career would be like in various careers. Information about whether or not a career aligns with a learner's identity can be obscured or fully absent from a learner's traditional education (Hafferty & Hafler, 2011). For marginalized and underrepresented minority learners, the systematic lack of exposure to a career’s hidden curriculum can become a significant barrier to occupational identity development (Giroux & Penna, 1979). One way for learners to conceptualize their own occupational identity development and address the hidden curriculum of careers is to first reflect on specific components of their occupational identity, and then address areas for improvement with their community of support (e.g., mentors, advisors, parents, teachers, peers, etc.) who can teach or illuminate the hidden curriculum.

Designing Careergram as a boundary object to facilitate learner interactions

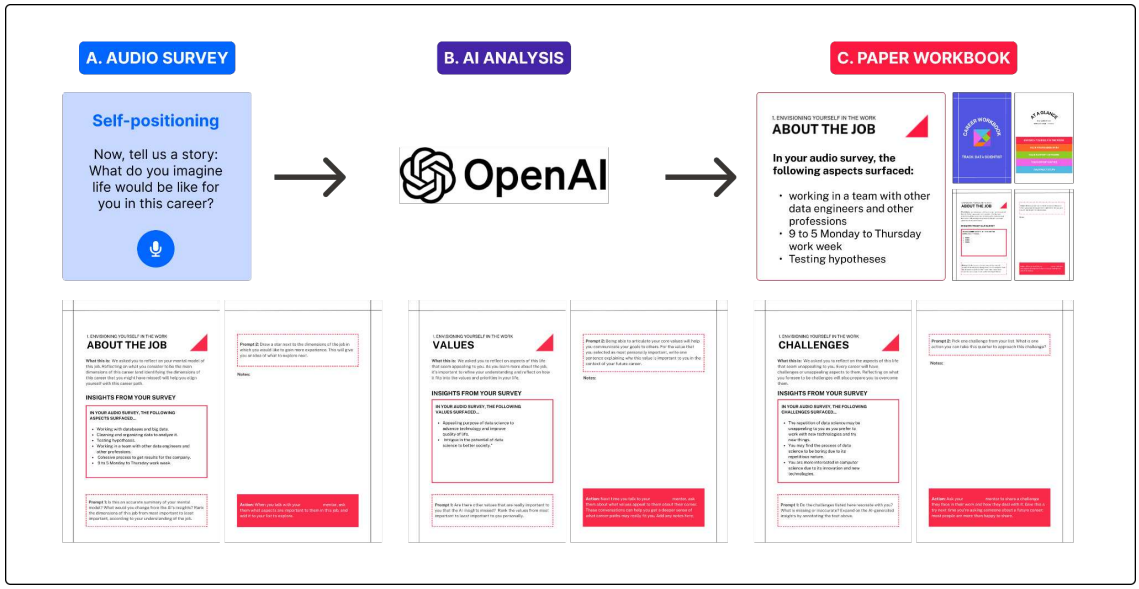
The recent advancement of LLMs and generative AI has granted users the capability to process, analyze, and generate large amounts of text (Cooper, 2023). Some researchers have leveraged LLMs to design instructionist tools that focus on content delivery like AI tutors, teaching assistants, and mentors (e.g. Chen et al., 2023). Others have urged researchers to use generative AI to facilitate novel interactions that promote ambitious learning (Uttamchandani et al., 2020). Scholars in this paradigm are designing tools that foster rich social interactions and empower their users (Hmelo-Silver et al., 2022). In line with these directions, our team endeavored to design AI tools that might address key barriers in the process of occupational identity development, and potentially foster important learning interactions that may help address these key barriers. The prototype that we designed – called Careergram – is a reflection tool that asks learners to share their stories and perspectives around their self-positioning, competency beliefs, social capital, structural opportunities, and navigation plans in a potential career path. We designed and piloted the reflection prompts to elicit rich responses from learners, even from very short snippets of audio input. We also designed AI prompts to leverage the OpenAI LLM (using text-davinci-003) to analyze the qualitative data and provide reflective syntheses of the learners’ different identity facets. For the first iteration of our project, we printed paper “workbooks” that scaffolded how learners viewed the AI analysis and output of their audio responses. The workbooks also included reflection questions and suggestions for using the AI output with advisors or mentors to talk about occupational identity topics (see Figure 1). Our design goal for this prototype was to help learners reflect on their identity stories, but also lightly reveal and suggest ways to navigate the hidden curriculum of seeking mentorship from others. Thus, the AI tool is designed as a mirror and guide, rather than a replacement mentor.

Future iterations of our prototype will facilitate an entirely digital, screen-based (mobile, web, etc.) process. However, in the first design cycle of our project, we utilized a paper prototype to facilitate research analyses on how learners react to and interact with the AI-based output. In the following analysis, we understand the Careergram tool as a boundary object that might potentially facilitate key learning interactions between learners and mentors, with our AI tool mediating these interactions. Boundary objects are defined as artifacts that serve as a bridge for a person’s interaction across various social worlds (Akkerman & Bakker, 2011). They are artifacts that are adapted to the contexts they are being used in order to satisfy the needs of users on both sides of a social boundary (Star & Griesemer, 1989). These artifacts become significant to sociocultural learning as

students encounter and cross the boundaries of different social worlds across all places of learning, including when they contact their mentors (Phelan et al., 1991).

Figure 1

A Snapshot of the Process behind the Careergram Prototype



(A) Students take an audio survey with five open-ended questions that prompt for learner reflections, (B) We analyze the data with the GPT-3 API and prompt engineering, (C) Researchers created a paper workbook (prototype) for each student with the results from the AI Analysis.

Methods

Context of the study

Our study is situated within an Educational Data Science Fellowship Program (EDSFP, pseudonym), an initiative designed for upper-division undergraduate students at a West Coast R1 (High Research Activity) university. The central goal of EDSFP is to support traditionally underrepresented populations, including students from minority racial/ethnic backgrounds and first-generation college students, who are interested in pursuing advanced graduate study and careers in data science. A key design of this year-long program is the placement of participants with research mentors. Under the guidance of faculty and/or graduate student mentors, the students assimilate into ongoing research projects and gradually develop their own independent research projects. The 2023 cohort of EDSFP consists of 14 student fellows, who are simultaneously active participants in our ongoing research study. Of these 14 participants, 13 identify as women, while one identifies as a man. Four fellows identify as Hispanic/Latine, four as Southeast Asian, five as East Asian, and one as White. Additionally, six of the participants self-identify as first-generation college students, and one fellow identifies as a person with a disability.

Data sources

We focus our analysis on two rounds of semi-structured interviews, each lasting 20-30 minutes, and a "think-aloud" small group activity conducted during the initial 10 weeks of the EDSFP. To describe the occupational identity of participants as they entered the program, the first interview occurred during the third and fourth weeks of the program and asked students about their self-positioning, competency beliefs, social capital, structural opportunities, and navigation plans in the field of data science. The "think-aloud" activity was conducted in the seventh week of the program. During this session, participants were introduced to the Careergram prototype for the first time. Working in small groups, participants shared their initial impressions of the prototype, highlighted notable features, and shared their reactions and perceptions about how the AI performed in synthesizing their reflections in the workbooks. In the week following the think-aloud session, participants met one-on-one with their program mentors to discuss career-related topics. A second interview took place in week 10 and consisted of questions related to Careergram and participants' experiences with their mentors. In total, the dataset comprises 28 interview transcripts (two per participant) and four think-aloud transcripts (3-4 participants per group).

Analysis

The interview and think-aloud transcripts were reviewed by two authors, who identified key ideas and excerpts, organizing them into affinity diagrams to visually group related concepts (Hanington & Martin, 2019). These diagrams served as the foundation for creating analytical memos for each participant, providing detailed narratives capturing their experiences, perspectives on the Careergram prototype, occupational identity development, and mentor relationships. Affinity diagrams and memos informed the development of a comprehensive codebook, structured around three core themes: interactions with the Careergram prototype, its role in mentor-mentee relationships, and occupational identity development.

Using Dedoose, a qualitative data analysis software, two authors initiated the coding process. They independently coded the same interview transcript to refine definitions and enhance the codebook, repeating the process for a second interview. A code application test yielded a Cohen's kappa coefficient of 0.76, indicating solid agreement between coders. Subsequently, the two authors independently coded the remaining transcripts and held meetings to iteratively refine the codebook and discuss emerging themes.

To investigate our research question, three authors used Dedoose's code co-occurrence feature to identify specific excerpts where participants used Careergram to facilitate conversations with their mentors. Detailed descriptions of these excerpts were generated and discussed in three consensus meetings between the authors, elucidating how learners approached Careergram, and how they facilitated conversations with mentors using Careergram. Our findings are presented in the following section.

Findings

In this section, we focus on three participants that are representative of the spectrum of occupational identity development we observed in our participants: (a) Clara with a nascent occupational identity, lacking specific interests and career aspirations, (b) Christina with a developing occupational identity, driven by clear interests but dealing with doubts about her competency beliefs and how she may fit within the field of data science, and (c) Jackie who exhibited a strong sense of occupational identity, with clear career aspirations that align with her values and goals. All of these participants were able to make use of Careergram, but the centrality of the tool in conversation and the types of interactions facilitated by Careergram differed for each learner. Through the following case vignettes, we show how learners' occupational identity played a role in how they used Careergram AI outputs and facilitated conversations with their mentors.

Clara: Uncertainty and checklist questions

When Clara entered EDSFP she was unsure about what career was right for her. She had recently added a second major in sociology as she feared that her psychology major would be considered "useless." EDSFP was her first opportunity to gain experience conducting research during her undergraduate education. She was unsure if data science would be something she would enjoy doing. She described having uncertainty regarding research tasks and was worried about coming up with her own research project. She felt like she lacked a mentor who was hands-on and could help keep her on track. Her support network was centered around her mother, who supported her emotional well-being. She hoped that her faculty mentor could become a central figure within her professional support network. The most important characteristic in a future career to Clara was salary, as she aspired to support her family financially. When asked about what goals and aspirations she had for the future she told us:

> I don't have any, like specific goals… I haven't narrowed down my career yet, at all… I'm taking [EDSFP] to kind of see how to become a researcher, how to do it officially and if this is really what I want to pursue at the end of the day. But, my main thing is just unfortunately, money. So I'm wondering, whatever the job is has to be like a well high paying job, because I do want to take care of my family more. Yeah, like, help them out of debt.

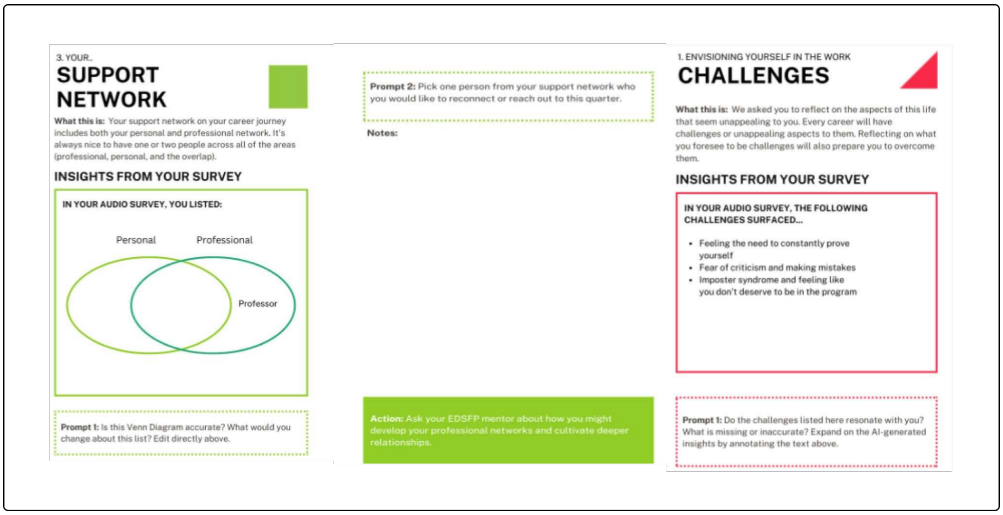
Her goal of finding a financially sustainable career sparked her interest in pursuing data science or graduate studies in order to increase her future earning potential.

When Clara first used Careergram, we characterized her occupational identity as being in a nascent phase. She voiced a developing imagination of data science as a field, with few social relationships, and a still-developing understanding of how to navigate the field (hoping that the program and her mentor would be the primary launchpads for her career into data science). Relatedly, we observed that she often relied on the AI syntheses of her Careergram reflection to ask rote questions of her mentor. She talked about using the Careergram workbook to ask questions directly out of the workbook as they appeared, rather than as reflective tools to spur deeper conversation. For example, she described how she brought up the "Support Network" section of the workbook (see Figure 2) in her conversation with her mentor. She desired for her mentor to become a central part

of her professional network and followed through with the action prompt urging her to ask her EDSFP mentor about how she could develop her support network. She approached the AI output as a checklist of topics to ask her mentor, rather than as an introspective tool to imagine more deeply about her own experiences. Using Careergram outputs as if they were a checklist eventually became a detriment to the conversation. She described how her mentor would inadvertently answer questions she planned to ask before she asked them and she felt challenged to "keep up" with the conversation until she decided to begin asking her own in-depth questions about certain topics.

Eventually, Clara and her mentor diverged from the workbook content and the conversation turned to a deep conversation around representation and how she, a working-class Latina, may be perceived within the field of data science. She recalled that her mentor, who is also Latino, described his own personal experience making space for himself in the field, telling her she must "bring your own chair to the meeting, there's no chair for you." Clara and her mentor used Careergram to build rapport and make space for deep identity-related questions. They first addressed concrete concerns related to components like Clara's professional network. After making their way through the Careergram workbook, they eventually used the foundation facilitated by Careergram to discuss potential concerns and challenges related to their shared identity. Clara's mentor revealed aspects of his own occupational identity, describing how aligning himself and fitting into the field of educational data science necessitated that he create his own space and "bring his own chair to the meeting," affirming both her concerns and her ability to navigate the field. Through Clara, we learned about how a nascent occupational identity can potentially promote the use of Careergram as a conversational crutch. Using the workbook as a checklist rather than asking about specific concerns and questions surfaced by the workbook nearly inhibited Clara and her mentor from having a vital discussion on identity and the field of data science.

Figure 2
Support Network Pages from Clara's Careergram Workbook. A Challenges Page from Christina's Careergram Workbook.



Christina: Identifying knowledge gaps and guiding questions

When Christina joined EDSFP she was forming a sense of her occupational identity. She was still figuring out exactly what she wanted to do for a career, and whether or not she wanted to pursue graduate school. She had concerns about her ability to become a researcher and felt like she didn't quite "belong" in data science. As a first-generation college student, she often felt imposter syndrome. She described how this caused her to feel a need to prove herself and made her doubt herself when she experienced successes like being admitted into EDSFP. Christina was driven by a desire to acquire more technical skills and had a strong research interest in teacher retention that stemmed from her experience with a "revolving door" of math teachers during her K-12 schooling, which she felt had stunted her math knowledge and proficiency. When asked about why she joined EDSFP, Christina responded,

> So honestly, I didn't really know that data science was like a thing that I could really do in research, or well, I guess, I kind of knew that, but like, it feels like such a broad term that I didn't really understand it…. I was like, Oh, well, I'm really interested in helping teachers and

> stuff like that, and figuring out how to better their lives… So I guess that's really where it came, like, oh, data science is something I could learn and it's interesting. And it can help further my goal of just figuring out how to not fix but support the teachers, I suppose.

Christina described how "Careergram showed me a lot of the gaps I had in my knowledge" and that in response she asked her mentor specific questions from the workbook to abate her concerns. Unlike Clara, Christina did not rely on Careergram as a checklist. She utilized Careergram outputs as a starting point from which she incorporated her own thoughts, concerns, and questions: "A lot of it helped me guide the questions... it really helped me…forward what kind of questions I wanted to end up asking him." One of the first things Christina brought up to her mentor was her Support Network page, and like Clara, her Support Network page was sparse, consisting of just her EDSFP mentor and a professor with whom she no longer kept in regular contact. She realized that while answering Careergram reflection prompts, she did not have as many connections as she assumed she did, so she asked her mentor how to build her support network. She shared her desire to better utilize their mentor-mentee relationship and "make it a two-way street." Recognizing and reflecting on her experience in EDSFP, she told her mentor that she felt she wasn't "utilizing the unique place I'm in and the unique opportunities I'm given." He then provided advice on how to address the gaps in her support network.

She also followed up with a discussion about one of her main concerns, the feeling of constantly needing to "prove herself," which was reflected back to her on a Challenges page in her career workbook (see Figure 2). In return, her mentor told her that graduate school is an opportunity to explore and define what your interests are. After learning that graduate school is meant to be a period of ongoing "discovery," Christina felt significantly less concerned about the need to be "constantly [showing] you know what you are doing." After their discussions about support networks and perceived challenges in becoming a professor, her mentor went on to share how he became a professor. Christina described that the way "he built himself from the ground up" was admirable and how he described his desire to be both a good researcher and a good teacher was "enlightening" and made her more confident about her interest in becoming a professor. Through Christina, we see how learners beginning to conceptualize their own occupational identities may approach Careergram as an opportunity to identify knowledge gaps and utilize outputs to guide conversations with mentors.

Jackie: Self-reflection and new directions

Jackie entered EDSFP with a stronger sense of occupational identity. During a previous experience as a research assistant, she learned that she enjoyed education-related research. Through that experience, she developed a deep interest in designing educational technologies for disabled learners like herself. She hoped that becoming an educational technology researcher would mean she could make a large impact in improving learning for disabled students. Unlike Clara and Christina, Jackie had a robust network of mentors who have helped support and encourage her from high school until the near completion of her undergraduate degree. When asked about her interests, Jackie told us,

> I think just the opportunities that I've had, and the things that I've learned, even if they weren't specific opportunities, it just taught me a lot. A lot of the mentors that I have they are teachers, and sometimes they would tell me, oh, this is something that you would see in the classroom, or, I would see it myself when I was being a volunteer and I think a lot of that has shaped my research interests. But also, because I'm a student, and I have a disability… And after learning more about educational technology, I do think that's a way that it could, that learning experiences can be better for students with disabilities.

Jackie's strong mentee-mentor relationships were a notable context to use Careergram. Jackie used Careergram in different ways than Clara and Christina. Rather than directly asking questions from the workbook, Jackie talked to one of her longtime mentors about the notes and questions she wrote after reflecting on the workbook. She sought to clarify her understanding of her progress toward her goals of being an educational technology researcher and discussed what she was learning in the EDSFP program, rather than addressing specific knowledge gaps that were highlighted in the workbook.

Jackie described how the process of generating and reviewing Careergram's AI output led to a lot of self-reflection. Most importantly she thought more deeply about the steps she had planned to take in order to achieve her goal of becoming a researcher (navigation). She then wrote down questions for herself related to her career goals and aspirations in the notebook. Prompted by the workbook, Jackie reached out to one of her personal mentors (not an EDSFP program mentor). She described how she had known her mentors for a long time, and usually they just "catch up on life," but during this conversation, the topic of EDSFP and Careergram came up in

conversation. She ended up talking to her mentor about her plan to pursue graduate school and shared some of the personal reflection questions she had written in her notebook. Her mentor gave her advice related to her personal questions and recommended people for her to reach out to regarding questions the mentor could not answer. Overall, Jackie felt like the conversation with her mentor provided her with more clarity around her future career plans. Through Jackie, we see how learners with strong senses of occupational identity may use Careergram as an opportunity for deep self-reflection and bring new thoughts and ideas to discussion with long-term mentors.

Discussion

We analyzed how three learners with different senses of occupational identity made use of Careergram to address the hidden curriculum in occupational identity development. Through these vignettes, we see that learners with different profiles of occupational identity development approached Careergram in different ways. Each learner used Careergram to facilitate conversations with a mentor and to address knowledge gaps or uncertainties about careers they aspired to pursue. In response, mentors provided insights and shared aspects of their own career development experiences.

In the case of Clara, a learner with a nascent occupational identity, the absence of reflection on Careergram and her own career knowledge led her to approach the workbook like a checklist. This high level of facilitation inhibited a conversation with her mentor as she was unsure where to lead the discussion when she exhausted questions to ask from the workbook. Eventually, Clara and her mentor moved beyond more surface-level discussions of developing support networks to deeper issues of identity, inclusion, and perceptions of the field. For Christina, a learner in an early state of occupational identity development that may be similar to many college-level learners, Careergram was used to address specific concerns and gaps in her knowledge. Christina reflected on the workbook and her experiences, then brought specific concerns to her conversation with her mentor. Christina and her mentor discussed how to deepen their mentor-mentee relationship and make use of her experience in EDSFP. Then, they discussed her anxiety stemming from a need to belong and prove herself. Her mentor went on to describe aspects of how he became a professor and their common passion for teaching affirmed Christina's desire to become a professor. Jackie had a stronger sense of occupational identity and a larger network of mentors that she relied on to support her development. Careergram still proved useful to her and her mentor. Jackie approached Careergram with deep reflection on her career plans, she wrote notes and questions for herself on workbook pages and was prompted to reach out to one of her long-time mentors. For Jackie, Careergram facilitated a process of further interrogation of her navigational understanding of becoming an educational technology researcher, thus introducing new topics of discussion within her mentor relationship.

Learners at different stages of occupational identity approached Careergram in different ways. This insight affords us the opportunity to test finer conjectures of web-based iterations of Careergram in the future. For example, we plan to leverage advancements in LLM technology (e.g. the recent introduction of GPT-4) to generate *personalized reflection activities* or follow-up prompts *that promote deep reflection on occupational identity* constructs and encourage learners to use Careergram to *identify knowledge gaps* in the ways that Christina and Jackie exhibited with our paper prototype. We also see an opportunity to engage mentors in the reflection process. Even in the case of Clara's mentor, the AI-based output of Careergram seemed to prime her mentor to anticipate helpful topics to talk about, even if Clara was not ready to take full advantage of the tool herself. This observation inspires some theoretical learning conjectures for us, such as *encouraging mentors to reveal aspects of their own identity* more readily. Taken together, our work sheds light on the possibility of making the complex and potentially ill-structured process of occupational identity development into a more guided process that meets learners where they are in their identity trajectories. Finally, our project illuminates a process for aligning the affordances of AI (in our case LLMs) to directly facilitate key learning interactions (in our case, guiding a deeper revealing of self between learners and mentors) that would otherwise be difficult to train people to do, or are inequitably distributed across learners at scale.

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