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ORIGINAL ARTICLE

Designing an AI Career Mentor for Early Career Researchers

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ABSTRACT

This study describes the design and evaluation of a Generative Artificial Intelligence (GenAI) digital mentor tailored for Early Career Researchers (ECRs). Despite the proven benefits of mentorships for ECRs, access to effective mentorship remains limited due to constraints on experienced researchers' time and their varying mentorship skills. Drawing on Career Construction Theory, research career mentorship, and Design Science methodology, this article documents the creation of a digital mentor and evaluates its assessment accuracy and guidance specificity in responding to career-related queries. The findings indicate that the digital mentor was fast, provided actionable career progression mentoring comments, and made explicit references to the mentee's experience, skills, and university's strategy. However, its skills assessment had weak similarity when compared to the mentee's self-assessment, a peer assessment, and a research leader's assessment of the mentee's skills. Nonetheless, ECRs can consider using a digital mentor to obtain fast contextualised comments on developing their career within their university.

Keywords: Career development; Early career researcher; Mentorship; Generative AI.

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INTRODUCTION

Receiving mentorship at the start of their career is crucial to nurture Early Career Researchers (ECRs) to become leading researchers, and then research leaders. When ECRs receive mentorship, they gain insights into developing their research agendas, navigating their academic landscape, and determining the professional networks needed for advancement. Therefore, effective mentorship not only accelerates the growth of ECRs, but also equips them with the knowledge, skills and strategies necessary to succeed in academia's competitive environment. While it may appear that having a mentor will greatly benefit an ECR, this is not always true. Scandura's (1998) Model of Dysfunctional Mentoring revealed ways where mentorship can sour, ranging from negative conflicts between parties, to sabotage, deception, and harassment. In higher education, mentors with different value systems can lead to negative experiences for the mentee (Eby et al., 2000). Nonetheless, there is a growing number of programmes designed as self-help guides for researchers, including professional development frameworks (see e.g. vitae, 2011), peer-to-peer coaching (see e.g. Dickson et al., 2021), and online platforms for informal mentoring (see e.g. Ferguson & Wheat, 2015). By empowering ECRs to take charge of their career development, these programmes enable them to construct an academic path suited to their individual circumstances and aspirations.

This study responds to the implementation gap between ECRs' mentoring needs and available mentoring solutions by designing and evaluating a digital career mentor. In this paper, ECRs are individuals within the first five years of completing a doctorate degree, and postdoctoral fellows are included. I explored Generative Artificial Intelligence (GenAI) to power the digital mentor, as opposed to other mentoring options, because GenAI can offer greater accessibility and convenience to mentees and is able to scope its responses to what the mentee chooses to share as data inputs. This study contributes to the career construction literature by exploring how GenAI can adapt career guidance to individual circumstances, thus enhancing the digital applicability of Career Construction Theory in a current context. Additionally, it advances the ECR mentorship literature by introducing an accessible mentoring solution that addresses the limitations of traditional mentorship models. This research uses Design Science methodology (Romme, 2023), and is guided by two research questions. Firstly, *how can a Generative AI-based mentor be designed to support ECRs in their career development*? This question seeks to explore the iterative prompts needed to customise the digital mentor to deliver tailored career development responses to the ECR's query. Secondly, *how suitable are the AI mentor's responses to career development advice?* This question assesses the digital mentor's feedback by comparing its outcomes with a peer ECR and a research leader within academia.

THEORETICAL BACKGROUND

In Career Construction Theory (CCT), career development is seen as a dynamic process influenced by

personal characteristics, social context, and environmental factors (Savickas, 2013). This perspective underscores the need to reflect on one's career narrative (Polkinghorne, 1990), be proactive (Berg et al., 2010; Cai et al., 2015; Fuller & Marler, 2009; Seibert et al., 2001), and stay adaptive (Creed et al., 2009; Nilforooshan, 2020; Savickas, 2013; Savickas & Porfeli, 2012; Zhang et al., 2024), when constructing one's career path effectively. However, determining when and how to reflect on career events can be challenging because individuals may lack structured guidance or tools to construct their careers (Nalis et al., 2022). Thus career counselling (see Savickas, 2015), a session where a professional counsellor helps individuals understand and navigate their career paths, assists individuals in reflecting on and making informed choices in their career development. While most of these sessions traditionally occur in-person, such career interventions can also be delivered digitally. For example, Pordelan et al. (2021) demonstrated that individuals who used digital tools to reflect on their career narrative scored higher in career decision self-efficacy than those who engaged in in-person reflection.

Reflecting and proactive planning on one's career are crucial in the early stages of an ECR's journey toward success, "for it is here that researchers can make a name for themselves through ground-breaking, innovative research" (Roberts, 2002, p. 12). This need to plan ahead is further amplified by the precarious employment market that ECRs face (Powell, 2015). Such precarity can lead to ECR's dissatisfaction at work (Van Der Weijden et al., 2016), heightened stress and anxiety (Gloria & Steinhardt, 2016), and having to make difficult decisions about prioritising work and personal needs (McAlpine & Amundsen, 2018). Additionally, this instability hinders the development of an ECR's research profile (Wöhrer, 2014) and reinforces their intellectual uncertainty, which is when ECRs doubt the value of their contributions to society (Skakni et al., 2019). Even if ECRs are resilient to overcome these challenges on their own, it may still not be enough to lead them on a successful career. As Browning et al. (2014, p. 126) pointed out, "research leaders are highly likely to come from active and supportive research cultures, and to be mentored."

Mentorship offers two key benefits for mentees, 1) career functions, which help mentees "learn the ropes" of their organisations, and 2) psychosocial functions, which assist mentees in building trust and professional relationships (Ragins & Kram, 2007). In academic medicine, receiving mentorship during the early stages of one's career can facilitate a successful transition to professional independence (Sambunjak et al., 2006), particularly for marginalised individuals who face unique career challenges (Byars-Winston et al., 2011). In higher education, effective mentoring programmes have been associated with increased personal confidence (de Vries, 2005) and stronger prospect for promotion and tenure (Feldman et al., 2010). However, not all mentoring relationships are beneficial. Levinson (1991) highlighted early on that mentors can sometimes be excessively critical, demanding, or even undermine the mentees' career progression. In a survey of psychology doctoral students, Clark et al. (2000) identified common issues faced by mentees, including mentor unavailability, feeling a lack in meeting mentor's expectations, exploitation, and mentor's negative personality traits and behaviours. Furthermore, many research mentors feel ill-equipped to mentor effectively (Fleming et al., 2013), and there are significant burdens associated with being a research mentor (see Lunsford et al., 2013).

As the literature highlights the critical need to guide ECRs in their early career stages for success, yet also reveals the challenges and risks of establishing effective mentorship without overburdening mentors, this study addresses the implementation gap between ECRs' mentorship needs and available solutions by proposing and evaluating a digital career mentor.

METHOD AND DATA

This project uses Design Science (DS) methodology (Romme, 2023) (see Figure 1) to create a digital mentor for ECRs, then compare the similarity of the digital mentor's responses with a self-assessment, peer ECR's assessment, and a research leader's assessment and mentoring comment.

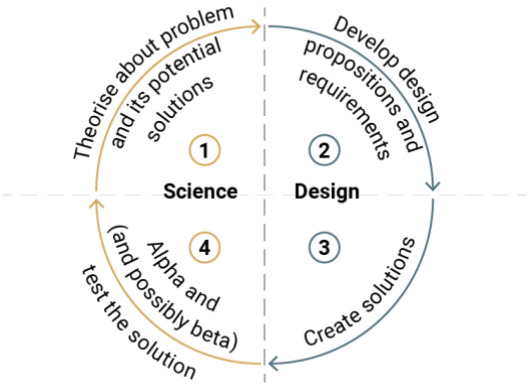

Fig. 1. Design Science methodology (Romme, 2023)

I started by *conceptualising the problem*, focusing on the mentee's need for timely career guidance, the lack of mentorship availability, and the lack of skilled mentors, which can lead to negative mentor relationships and poor career guidance. Based on this review, an initial *design proposition* emerged, "An accessible mentor, equipped with information about the ECR's career experience, skills, and current work environment, that provides constructive feedback to develop an ECR's career and psychosocial functions." There were two *design requirements*, 1) the mentor must customise feedback to meet the specific needs of the ECR, and 2) it should provide feedback not only on

the ECR's research career also on their overall career trajectory.

To address the design proposition and requirements, I developed a digital mentor that allows ECRs to customise the mentorship experience to their unique circumstances by inputting their experience level. Additionally, the digital mentor is accessible to ECRs whenever they need guidance. I describe how I chose the solution platform in the *Design Instrument selection* section, and how I created the solution in the *Results* section. I tested the tool for speed, accuracy and specificity.

Design instrument selection

Conversational GenAI refers to large language models (LLMs) that imitate human-like conversations by relying on machine learning algorithms and advanced natural language processing techniques. These GenAI tools can simulate interactive conversations with users on a variety of topics by reading user inputs and generating text-based responses. Common tools include OpenAI's ChatGPT-4, Anthropic's Claude 2, and Meta's Llama 2. I chose ChatGPT-4 as it has the lowest hallucination rate at 2.5% compared to other LLMs (Hughes et al., 2023/2024) based on Vectara's Hallucination Evaluation Model (Hughes, 2023). In other words, ChatGPT-4 has the lowest rate of providing incorrect or misleading responses. Individuals have also customised ChatGPT-4 to be research mentors (see e.g. Rodriguez, 2023; Sinclair, 2023) and career mentors (see e.g. Lin, 2023; Ye, 2023), which other subscribers can use.

Data comparison

Generally, I analysed the digital mentor's feedback **speed**, assessment **accuracy** and guidance **specificity**, by comparing its outcome with 1) a self-assessment, 2) a peer-assessment from another ECR, and 3) an assessment and mentoring advice from a research leader. The ECR is a colleague whom I regularly share research and career problems and discuss solutions (problem-solving). Through regular informal peer coaching, I provided the peer ECR with insights into how I problem-solve work challenges and find career opportunities. I have worked with the research leader for over six years in different capacity. I regularly ask the research leader for advice regarding research and career opportunities (decision-making). I also co-supervise Higher Degree Researchers with this research leader, providing the research leader with experiences of my research supervision and management skills.

RESULTS

Designing the GenAI digital mentor

There were three phases to designing the digital mentor. The first phase was to determine a strategy to provide information (commonly known as prompting) to the digital mentor about the mentee. The second phase is to prompt the digital mentor to analyse the mentee's professional career thus far. The third phase is to further prompt the digital mentor with current contextual information about the mentee, so that it can provide career development feedback.

Phase 1 - Prompting strategy

There are different prompting strategies available to provide GenAI with information and queries. Such strategies include, but are not limited to:

- **Standard prompting**: The basic method where a LLM model generates a response directly from the task description without additional instructions or examples.
- **Zero-shot "Chain-of-thought" prompting** (Kojima et al., 2022): This method makes the LLM model to respond iteratively in a "think step by step" format, to breakdown and articulate the approach to solving tasks.
- **Expert prompting** (Xu et al., 2023): This technique creates an expert persona tailored to the query context, which is then used to generate a more authoritative response, with options for static or adaptive expert identities.
- **Multi-persona prompting** (Du et al., 2023): This method involves creating multiple personas to engage in a collaborative dialogue, refining ideas before delivering a synthesised final response.

After testing the different strategies, I selected multi-persona prompting as it responded specifically on how to improve research skills, and generally on career development and well-being.

Phase 2 - Customising the digital mentor

To further tailor the digital mentor's responses to the mentee's research background, I provided 1) a self-reflective narrative of my career trajectory, and 2) my academic curriculum vitae. This narrative used CCT to unpack and analyse my career progression over the past 13 years, was double peer-reviewed and is forthcoming as a book chapter (Tan, 2024). The academic curriculum vitae lists my professional experience, research publications, research grants, awards, services, and association memberships. The subsequent response took 173 seconds to generate and is reported in Table 1.

Phase 3 - Contextualising the digital mentor

To guide the digital mentor on how to assess and provide feedback to the mentee, I provided 1) vitae's (2011) Research Development Framework (RDF), 2) the mentee's home university's Academic Promotion Standards, and 3) the mentee's home university's Mission & Strategy document. The RDF is used to assess the mentee's skills to help identify areas for improvement. 11 of the 63 criteria in this RDF were removed as it assessed qualities not described in the self-reflective narrative or the CV, such as *C1 Professional conduct* and *C3.3 Infrastructure and resources.*

Table 1. Digital mentor's career analysis of mentee

Career Development
Tenure and Beyond: Given your tenure-track position, your immediate focus should be on building a strong foundation for achieving tenure. This includes developing a clear research agenda that aligns with institutional goals and your personal research interests in Generative AI and more-than-human design. Set specific milestones for the next 5-10 years, such as leading major research projects, contributing to curriculum development, and positioning yourself as a thought leader in your niche areas.
Maintaining Well-being: Given your past experiences with burnout, it's crucial to maintain a healthy work-life balance. Set clear boundaries between work and personal life and engage in activities that promote mental and emotional well-being. Regular reflection on your career trajectory can help you stay aligned with your goals and values while preventing burnout.
Career Resilience: Stay informed about emerging trends in architecture, design, and AI. This will enable you to anticipate and adapt to changes in the academic landscape, ensuring the longevity and relevance of your career. While your focus is on academia, remain open to opportunities in industry or consultancy, where your expertise could be highly valuable.
Research Development
Interdisciplinary Collaborations: Continue to seek opportunities to collaborate across disciplines. Explore how Generative AI and more-than-human design can intersect with emerging fields like sustainability, digital ethics, or urban planning. This will not only broaden the impact of your work but also open up new avenues for research funding and practical applications.
Strategic Publication and Funding: Continue to aim for high-impact journals and explore larger, interdisciplinary grants that align with your research agenda. Clearly define and communicate your research agenda, emphasizing how your work addresses pressing issues in both academic and practical domains. This will establish you as a leading voice in the intersection of Generative AI and architecture.
Network Development
Strategic Collaborations: Focus on deepening your existing collaborations with senior researchers and industry partners. Actively seek out mentorship opportunities from leaders in interdisciplinary research, which can provide new insights and enhance your visibility in the academic community. Additionally, consider expanding your role as a mentor to PhD students and junior colleagues, which will contribute to your professional development and strengthen your leadership profile.
Professional Development
Skill Enhancement: Take advantage of professional development opportunities, particularly in grant writing, project management, and advanced teaching methods. Reflective practice will be key to adapting your strategies as needed and ensuring continuous growth.
Leadership Roles: As you transition into more senior roles, focus on developing your leadership skills by taking on more significant roles in research projects and academic committees. This will prepare you for future opportunities to lead larger research teams or academic departments. Additionally, continue to hone your communication skills, particularly in presenting complex ideas to non-specialist audiences, which is crucial for public engagement and securing interdisciplinary collaborations.

The University's Academic Promotion Standards, which has 35 criteria in 6 categories, is used to compare the mentee's current achievements (based on the CV) and standards that have not been achieved, whereas the university's Mission & Strategy document is used to identify opportunities for the mentee to focus on to achieve standards needed for career promotion. The digital mentor's assessment and feedback of the mentee is discussed in the next section, compared with the self-assessment, peer's assessment, and research leader's assessment outcomes.

Testing the digital mentor's skills assessments

The mentee took an hour to self-assess his research skills by identifying the phases and characteristics he associated with in each of the 52 criteria of the 4 domains in the RDF. The peer ECR and research leader identified the phases and characteristics they perceived the mentee to be in separately. The ECR took 20 minutes, and the research leader took 2.5 hours. I prompted the digital mentor with the RDF and asked for an assessment of the mentee based on the prior information provided. Table 2 shows the similarity assessment scores between the self-assessment and the additional three data sets across the RDF domains.

Overall, the digital mentor scored 0.38 similarity with the research leader, 0.40 with the peer ECR and 0.29 with the mentee's self-assessment. This suggests a general lack of alignment between the digital mentor's assessments and those of humans, compared to the peer and the research leader. The digital mentor showed moderate similarities for assessment *A1 Knowledge Base*, scoring 0.57 against the research leader and peer ECR, and higher score at 0.71 with the self-assessment. It scored a low similarity of 0.20 in assessing *A2 Cognitive Abilities* and had the highest similarity of 0.80 with the research leader and peer ECR in assessing the mentee's *A3 Creativity*. In *B1 Personal Qualities*, the digital mentor aligned moderately at 0.50 with both the research leader and peer ECR. Assessment of *B2 Self-*

Management showed 0.40 similarity with the research leader, but a full match at 1.00 with the peer ECR.

The digital mentor achieved 0.00 similarity when it came to assessing the *C2 Research management* in comparison with the research leader and peer ECR. With only 1 characteristic assessed within the domain *C3 Finance, funding, and resources*, the digital mentor had 1.00 assessment similarity with the mentee and researcher leader.

Table 2. Similarity index score of digital mentor's research skills assessment of mentee and research leader, peer ECR, and mentee's self- assessment.

	Digital mentor vs Res. leader	Digital mentor vs Peer ECR	Digital mentor vs Mentee	Mentee vs Res. leader	Mentee vs Peer ECR	Peer ECR vs Res leader
Overall	0.38	0.40	0.29	0.60	0.50	0.38
A1 Knowledge Base	0.57	0.57	**0.71**	**0.86**	**0.71**	0.57
A2 Cognitive abilities	0.20	0.20	0.20	0.60	**1.00**	0.60
A3 Creativity	**0.80**	**0.80**	0.40	0.60	0.60	0.60
B1 Personal qualities	0.50	0.50	0.17	0.17	0.33	0.50
B2 Self-management	0.40	**1.00**	0.40	0.40	0.40	0.40
B3 Professional and career development	0.25	0	0	0.50	0.0	0.25
C2 Research management	0	0	0.33	0.67	0.67	0.67
C3 Finance, funding and resources	**1.00**	0	**1.00**	**1.00**	0	0
D1 Working with others	0.25	0	0.25	0.60	0.50	0.63
D2 Communication and dissemination	0.33	0.67	0	0.67	0	0
D3 Engagement and impact	0.2	0.33	0	**0.80**	0.60	**0.80**

The digital mentor's similarity score for D1 *Working with others* was low at 0.25 and 0.00 against the research leader and peer ECR respectively. The human evaluators had more moderate alignment, ranging from 0.50 to 0.63. For *D2 Communication and Dissemination*, the digital mentor aligned lowly at 0.33 with the research leader but better at 0.67 with the peer ECR. Finally, D3 *Engagement and impact* showed low alignment at 0.20 and 0.33 against the research leader and peer ECR respectively. The human evaluators aligned more closely, ranging between 0.60 to 0.80.

Testing the digital mentor's promotion assessment

The digital mentor took 2 minutes, the mentee took 5 minutes, and the research leader took 15 minutes to assess the mentee's current academic standards according to the university's promotion standards. The peer ECR did not complete this activity as the peer was of the same academic level. Table 3 shows how the digital mentor, research leader, and mentee compare in their assessments of the mentee's completion of various promotion activities within the university's 6 categories, whereas Table 4 shows the similarity index between the 3 different assessments.

Table 3. Promotion activity completion assessments of the digital mentor, research leader, and mentee

	Digital mentor	Research leader	Mentee
Teaching Activities (6 tasks)	37%	100%	67%
Teaching Impact (5 tasks)	60%	100%	60%
Research Activities (9 tasks)	55%	67%	55%
Research Impact (5 tasks)	20%	0%	40%
Service Activities (7 tasks)	43%	57%	43%
Service Impact (3 tasks)	67%	33%	67%
Overall	**46%**	**63%**	**54%**

The digital mentor rated the mentee 46% completion of activities required for a promotion across the six different areas. This rating is 8% lower in satisfaction than the mentee, and 17% lower than the research leader. The digital mentor notably underestimated Teaching Activities (37%), though it aligned more closely with the mentee on Research Activities (55%) and Service Activities (43%) and Service Impact (67%).

Table 4. Similarity index of the digital mentor's, research leader's and mentee's assessment of fulfilled promotion tasks

	Digital mentor vs Res. leader	Digital mentor vs Mentee	Res. leader vs Mentee
Teaching Activities (6 tasks)	0.33	0.33	0.67
Teaching Impact (5 tasks)	0.6	0.2	0.6
Research Activities (9 tasks)	0.33	0.33	0.33
Research Impact (5 tasks)	0	0.2	0
Service Activities (7 tasks)	0.29	0.29	0.29
Service Impact (3 tasks)	0.33	0.33	0.33
Overall	0.31	0.29	0.44

The digital mentor showed limited similarity with human evaluations across all categories, scoring no higher than 0.33 for all criteria. The research leader and mentee show higher agreement overall (0.44), indicating that human assessments align more closely with each other than with the digital mentor.

Testing the digital mentor's mentoring comments

The digital mentor took 18 seconds, and the research leader took approximately 15 minutes to provide six mentoring comments (see Table 5), based on the promotion assessment activity above.

Table 5. Comparison of digital mentor's and research leader's mentoring comments

	Digital Mentor (18 seconds)	Research Leader (15 minutes)
Learning and Teaching	[Mentee], to align with [university's] vision of being a '[University Goal 4] in education, I recommend that you take on a formal Head of Course role. This will allow you to lead curriculum innovations that integrate [university's] emphasis on technology and industry engagement. For example, you could spearhead the development of a new course module that incorporates Work Integrated Learning, ensuring that [university goal]. This aligns with [university's] commitment that [University Goal 1] and will position you as a leader in curriculum development. To further enhance your impact in Learning and Teaching, focus on leading initiatives that improve the quality of teaching and learning through reflective practice and the establishment of external benchmarks. Given your innovative work in integrating Generative AI into design education, you could develop a cross-disciplinary framework that benchmarks student outcomes in technology-driven design courses. This would demonstrate leadership in improving curriculum development and align with [university's] goal of fostering a 'tech-biased, innovative' education environment.	[Mentee] has exceeded expectations in designing and delivering innovative and industry relevant curriculum and content as he has delivered interdisciplinary, and industry engaged subject matter.
Research	[Mentee], your leadership in research is strong, but to elevate it to Academic Level C, consider leading large-scale collaborative research projects that directly address [university's] strategic research priorities, such as [university research focus] or [university research institute]. You could, for example, initiate a collaborative project on sustainable digital fabrication techniques, partnering with industry and government to develop technology solutions. This aligns with the [university's] '[University Goal 3]' and will enhance your research profile within the university's strategic framework. To increase your research impact, focus on public engagement and media presence that highlights the societal and technological implications of your work. For instance, you could contribute articles or op-eds on the role of Generative AI in sustainable architecture to national media outlets. This would not only raise your profile but also support [university's] strategic goal to influence public policy and generate public debate on key issues. Your research could become a cornerstone for [university's] ambition to be seen as a leader in 'technology and innovation' that drives societal transformation.	[Mentee] has achieved high quality research as a recent ECR. [Mentee] is a new generation of academic that understand the value of research currency that is applied and aims to seek impact.
Leadership & Service Activities	[Mentee], to further your leadership credentials, take on more significant administrative roles within your department, such as managing a strategic initiative or leading the development of a new academic program. For example, you could lead a university-wide project aimed at integrating digital tools into teaching practices, aligning with [university's] digital transformation goals. This would not only demonstrate your capability in managing complex projects but also contribute to [university's] strategy of becoming the 'most digitally accessible university in [country].' To enhance your impact in leadership and service, focus on how your contributions improve the operation of external boards or committees in alignment with [university's] strategic goals. For example, if you are involved in an external industry board, work to establish new partnerships that directly benefit [university's] research and educational offerings. Demonstrating how your leadership has led to strategic improvements will be critical, particularly in contributing to [university's] vision of becoming a 'global best practice' university. Highlighting these achievements in your promotion application will underscore your leadership impact at both the university and broader industry levels.	[Mentee] demonstrates strategic leadership as his service contribution engages in generous and collaborative opportunities. [Mentee is] inclusive and understands that the changing university enterprise requires academics such as himself who can operate beyond his cognate disciplinary domain to contribute to social impact.

The digital mentor provided detailed comments rapidly compared to the research leader. As the digital mentor was informed with the mentee's career narrative and CV and the university's Mission and Strategy document for analysis, its mentoring comments provided some explicit connections between the mentee's required promotion focus, existing skills and the university's targets. For example, in the Learning and Teaching, the digital mentor gave feedback on the mentee's research expertise and the university's goal of fostering "a 'tech-biased, innovative' education environment." Another example of the digital mentor's comment specificity on Research is its ability to target one specific research institute based on the mentee's research agenda. Not only was it able to identity an appropriate research group for the mentee to focus on, but it also provided an actionable example for the mentee to leverage their expertise in "digital fabrication techniques" to create opportunities for developing technology solutions for the industry. This directly addresses one of the four explicit university

missions. In comparison, the research leader, who is a long-standing member of the university, provided succinct mentoring comments that were less explicit with the actionable strategies, but identified the mentee's unique values. For example, the mentee's ability to "deliver interdisciplinary and industry engaged subject matter [content]" and inherent understanding of "the value of research currency that is applied and aims to seek impact."

DISCUSSION AND CONCLUSIONS

This study documented and analysed how a GenAI digital mentor for ECRs was developed and how it compared with a peer ECR's and research leader's assessment and mentoring guidance. In the sections below, I describe the main findings, describe the subsequent research opportunities that follows from this study and give recommendations for ECR's developing their own GenAI career mentors.

RQ1 - How can a GenAI mentor be designed to provide support to ECRs in their career development?

Despite taking the longest time, using multi-persona prompting to create a GenAI digital mentor can align with CCT's view, that career development is dynamic and must consider the personal, social and environmental factors outside the working context (Savickas, 2013). When queried with "*What should an early career researcher in [author's research field] at a university focus on in their career?",* **standard prompting** strategy yielded a response specifically on research development (niche, publication, and funding), teaching, networking, and professional development. **Expert prompting** yielded similar responses and included research impact, embracing interdisciplinary approach, and prioritising well-being. **Zero-shot CoT prompting** yielded similar outcomes, though included the consideration of short-term and long-term career goal. Only **multi-persona prompting** provided all these foci, but also to "Tailor your CV and cover letters to highlight your unique contributions to [author's research field], whether applying for academic positions or industry roles," and "Keep your options open between academia and industry." In other words, multi-persona prompting provided a response where the ECR can consider developing a career outside the university and in doing so, reminds the ECR that their career is not confined to higher education. This type of feedback may support individuals in staying adaptive, a crucial element of CCT career development (Creed et al., 2009; Nilforooshan, 2020; Savickas, 2013; Savickas & Porfeli, 2012; Zhang et al., 2024).

As ECRs face precarious employment (Powell, 2015) and can suffer in one's health because of the precarity, multi-persona prompting strategy may encourage ECRs to re-assess their career options and consider alternative career opportunities. Providing the digital mentor with a career narrative and CV that contextualise the ECR's past and present experience was necessary to "remind" the ECR of past incidences. For example, the digital mentor identified the importance of maintaining well-being, "given your past experiences with burnout." (refer to Table 1, Career Development). This approach could alleviate the challenge posed by the lack of structured guidance or tools, which can make reflecting on past events difficult (Nalis et al., 2022). The digital mentor also identified that "your immediate focus should be on building a strong foundation for achieving tenure" (refer to Table 1, Career Development), alluding to the existing opportunity the ECR has. While this might imply that the digital mentor prioritises work, which can make it even harder for ECRs to make decisions about work life balance (see McAlpine & Amundsen, 2018), it also reminded the mentee to "set clear boundaries between work and personal life" and to "engage in activities that promote mental and emotional well-being."

RQ2 - How suitable are the GenAI mentor's responses to career development advice?

The digital mentor assessed poorly by rating the mentee more favourably and thus scored low similarity when compared to the self-assessment, peer's assessment and research leader's assessment. This provided mixed results. On one hand, the inaccurate assessment could boost mentees' confidence in their skills. While this digital 'mentorship' might produce outcomes similar to those gained through proper academic mentorship (see de Vries, 2005), it is achieved through false means, potentially leading to negative repercussions such as a lack of proper skills development. On the other hand, the assessment could help mentees alleviate some intellectual uncertainty (see Skakni et al., 2019). As shown in the results, the digital mentor evaluated the mentee's creativity skills more favourably than the mentee's self-assessment, aligning more closely with the evaluations from the peer researcher and the research leader. This alignment may help mentees recognise the skills they are underestimating in themselves, thereby improving their intellectual certainty and boosting their confidence in a more accurate and constructive manner.

When compared with the research leader's mentoring comments, the digital mentor's comments were more concrete, while the research leader focused on 'soft' values and unique career development opportunities. As Ragins and Kram (2007) pointed out, mentorships can offer career functions and psychosocial functions to mentees. In this context, the digital mentor may excel in providing career functions feedback, helping mentees "learn the ropes" within their organisation. Conversely, the research leader mentor is better suited to providing psychosocial functions feedback, guiding the mentee in

building trust with colleagues and fostering professional relationships within the work environment.

Theoretical implications

This study demonstrated how ECRs can use a digital mentor to apply CCT in creating a dynamic and context-specific career development path (Savickas, 2013) for themselves. This approach is particularly beneficial for ECRs, who often face precarious employment situations (Powell, 2015) and must adapt to and leverage career opportunities as they arise. While most career counselling traditionally occurs in-person, the digital mentor designed and tested in this research strengthens the applicability of CCT in the digital age and expands the range of digital career interventions available for individuals to develop their careers. Additionally, this study showcased the use of Design Science methodology (Romme, 2023) in creating and testing a digital artefact. Given that ECRs require strategic planning in their early stages of their careers to achieve success (Roberts, 2002), and that mentorship is often essential to nurture ECRs into future research leaders (Browning et al., 2014), the availability of mentoring in higher education remains limited due to the significant burdens on research mentors (see Lunsford et al., 2013). Therefore, the creation and testing of this digital mentor addresses the implementation gap – the lack of mentorship opportunities for ECRs in higher education.

Practical implications and limitations

While the research aims and the artefact created was to assist ECRs in getting specifical and timely feedback regarding their career progression through a 24/7 digital mentor, an opportunity that presented itself at the end of the research is that this digital mentor may also assist mentors to provide quicker and more tailored advice to their mentees. For example, a mentor may use the digital mentor to first generate mentoring comments that connects the mentee's experiences with the universities' strategic opportunities, then further discuss how the mentee's unique values align with this opportunity.

Nonetheless, digital mentors cannot replace the role of human mentors, as humans bring emotional intelligence, empathy, and the ability to build trust and rapport with mentees. But given the increasing demands on research leaders' time, the limited resources to help research leaders become effective mentors, and the growing number of ECRs and the need of career guidance, such digital mentors – or mentor assistant – may offer research leaders an additional practical opportunity to address the mentorship implementation gaps. A practical limitation of using GenAI to power a digital career mentor is *drift* (see Peckham & Jeff, 2024), which can occur in two ways: *model drift*, where the algorithm's performance degrades over time as it becomes misaligned with current data, and *data drift*, where changes in the input data—such as the data users provide—affect the model's ability to generate accurate, relevant outputs. Even when a GenAI-powered tool is running locally (i.e., not connected to the Internet) to give users more control, the significant hardware demands can be prohibitive. Although the GenAI used to create the digital mentor provided specific feedback to the mentee's data, its long-term effectiveness hinges on addressing drift through regular updates. Acknowledging this limitation is essential for the ethical use of GenAI in digital mentoring.

Limitations and recommendations

A study limitation is that the design of the digital mentor, specifically the information provided to the GenAI, had to be text. This required the mentee's career narrative to be explicitly written. If the mentee does not describe certain career events in the text, the digital mentor was unable to reference those events to provide more detailed career development feedback.

While it can be assumed that ECRs seeking to advance their career typically have a curriculum vitae that summarises their work experience, a CV primarily captures achievements, such as publication outputs, without reflecting their skills gained during the process or the impact of the work. Hence the digital mentor could detect accomplishments and provide feedback on them, but struggled to identify more nuanced aspects, like professional networking skills.

Future research could focus on developing a standardised textual format that enables mentees to input their career narrative alongside their CV, making the information explicit and more accessible for the digital mentor to analyse and use as reference points. Future research could adopt an intervention approach to identify the effects and perceptions of using digital mentors to mentor ECRs. This may help validate the usefulness of digital mentors for ECRs, clear of ECR's perceived biases of digital mentors.

Conclusions

This study contributes to the Career Construction Theory literature by detailing the creation and testing of a digital career mentor designed to help Early Career Researchers (ECRs) in developing their careers. This is particularly important given that mentorship is critical to their success, yet often scarce in higher education. Hence, I used Design Science methodology to design a digital mentor tailored to provide feedback on ECRs' overall career development, rather than solely focusing on their research development. The digital mentor's assessment and feedback were tested by comparing its output with a self-assessment, peer's assessment, and research leader's assessment. The findings reveal that the digital mentor provided feedback that were specific to research, generic to career development, and anchored in the mentee's past career events. However, the digital mentor performed poorly in assessing the mentee's

skills, yet offered substantial actionable strategies for career development within the mentee's university. These findings are valuable for future ECRs, as they demonstrate that while the digital mentor can offer convenient and accessible mentorship to some extent, it also highlights area where further refinement is needed. Ultimately, this study addresses the implementation gap in ECR mentorship, offering a digital solution to the mentorship shortage in higher education.

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