PURM
Perspectives on Undergraduate Research & Mentoring

Using Generative AI to Support Undergraduate Research Reflections to Highlight Career Readiness Competencies

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Introduction

Undergraduate research experiences (UREs) are high-impact educational activities that provide students with skill development and personal growth opportunities (Kuh, 2008). Additionally, UREs provide students with many opportunities for development with demonstrated gains in skills such as teamwork, critical thinking, and work ethic (Newell and Ulrich, 2022; McClure-Brenchley et al., 2020). As a high-impact practice, undergraduate research engages students in disciplinary content alongside a mentor “to make a scholarly or artistic contribution to knowledge” (CUR, n.d.). As undergraduate education increases its emphasis on supporting students’ career readiness, undergraduate research has been shown to support these outcomes (MacDonald et al., 2024). Undergraduate research contributes to deep learning and self-reported gains (Pierszalowski et al., 2021). Although students develop skills through UREs, they may have difficulty articulating these skills to new contexts or may not recognize the skills they have acquired without mentor interventions. Technology could support students in addressing these gaps in skill recognition and articulation by extending mentoring and scaffolding reflection capacity.

The National Association of Colleges and Employers (NACE) developed and revised a list of eight career readiness competencies following iterations of employer surveys and a NACE member taskforce in 2015, 2017, and 2020 (NACE, n.d.). Additionally, institutions have developed their own set of competencies that lend themselves tangentially to career readiness, such as Purdue University’s LEAD competencies that derive from a student affairs leadership framework while considering NACE competencies and the university’s general education curriculum (Roger C. Stewart OSLEC, n.d.). These lists of competencies provide guidelines on how to develop initiatives to support student success but require additional training in recognizing and translating them.

The Council on Undergraduate Research (CUR) is focusing attention on these competencies with the development of a taskforce to advance the work of bridging the gap between URE skill development with career readiness recognition and articulation in practice and scholarship (MacDonald et al., 2024). Following studies highlighting the skills gained from undergraduate research, connections have been established between NACE career readiness competencies and UREs (Burt et al., 2024; MacDonald et al., 2024; Mekolichick, 2021; McClure-Brenchley et al., 2020; Newell and Ulrich, 2022). Although students participating in UREs develop these competencies, they may not explicitly recognize nor articulate these transferable skills when asked by others (Burt et al., 2024). Mentors may support student researchers in recognizing the competencies they are developing beyond the technical and disciplinary knowledge and skills but may not be consistent. With this spotlight of career readiness from CUR and society, now is the time for undergraduate research scholars, mentors, and practitioners to focus on supporting students in developing and recognizing relevant career readiness competencies.

Technological tools have been used to support student learning through e-portfolios, discussion boards, videos, and digital badges (Kehoe & Goudzwaard, 2015). These digital tools, when properly deployed, extend conversations and reflections about experiences and classroom activities. Generative artificial intelligence (GenAI) chatbots support students' skill development and learning through providing immediate feedback and personalized interactions (Ma et al., 2024). GenAI, specifically ChatGPT, has supported students' reflective practices when following prompts that encourage strong reflection pedagogy (Yuan & Hu, 2024). GenAI is recommended to support personalized learning with experiential learning activities but has not been applied to URE reflections (Qadir, 2023; Rawat et al., 2024). Mentors now have to consider how to include GenAI within their work with undergraduate researchers, such as with examining outputs and ensuring there is no dependency on these tools (Schreiber & Waagen, 2025). Therefore, we propose that a GenAI chatbot could support undergraduate researchers in identifying career readiness competencies through responsive journaling when appropriately framed within a mentoring relationship.

This paper describes a GenAI chatbot the Purdue University Office of Undergraduate Research (OUR) designed with Purdue's Rosen Center for Advanced Computing's (RCAC) technical expertise to support students in identifying and articulating the career readiness competencies that they have developed. This paper does not outline how to develop these competencies within students, but a growing number of practices are available. Additionally, this paper does not describe the technical developments of the chatbot. Instead, this paper invites the reader to consider how a GenAI chatbot can conceptually integrate theoretical underpinnings of reflection when trained with these competencies and critical reflection prompts.

Background

Career Readiness Competencies

Career readiness is a set of cognitive and non-cognitive skills that defines the preparation of an individual in launching and managing their careers (Green et al., 2023). Various skills have been determined by educational associations, employers, and faculty to support if students are career ready. Defining career readiness competencies provides standards whereas employers and higher education can meet the expectations of students, families, and society to develop a well-rounded workforce. In meeting this need, the National Association of Colleges and Employers (NACE) developed and revised a list of career readiness competencies that currently includes eight areas: career and self development, communication, critical thinking, leadership, professionalism, equity and inclusion, teamwork, and technology (NACE, n.d.). These competencies have been useful in guiding evaluation and assessment work throughout higher education (Moore & Thaller, 2023; Nadler et al., 2022; Newell & Ulrich, 2022). These competencies provide institutional and interinstitutional language for guiding programming, assessment, and evaluation.

Institutions have developed their own sets of competencies to evaluate and assess student learning outcomes. These institutional competencies, especially those connecting to societal outcomes, can provide granularity and language that national competencies like NACE may not provide to students or institutions. Purdue University's Roger C. Stewart Office of Student Leadership, Engagement and Community developed twenty LEAD competencies. Purdue LEAD competencies categorize the competencies into four core areas (Roger C. Stewart OSLEC, n.d.):

- *Communication*: Listen and observe, nonverbal communication, summarize and distill information, verbal/sign communication, and written communication

- *Self-awareness* (intrapersonal awareness and development): Continuous learning, initiative and follow through, personal responsibility, resiliency, and self-understanding
- *Collaboration* (interpersonal skills and intercultural knowledge): Appropriate and productive relationships, cultural awareness, helping others and working together, organizational behavior, and service
- *Ways of Thinking*: Decision-making and problem-solving, ethics, idea generation, reflection and analytical reasoning, and systems thinking and planning

Undergraduate Research as Skill Development

Recently, colleges and universities have faced criticism questioning their value in meeting educational and research expectations (Guthrie, 2019). Employers share that they seek employees based on their competencies and not necessarily degrees (Bone et al., 2025). Universities have responded to this criticism by emphasizing their students conduct high-impact practices and, more specifically, experiential learning opportunities to provide “real-world” applications of theoretical course material (An & Loes, 2023). High-impact practices are deep-learning activities requiring students to demonstrate their learning through applied settings that can be translated to better outcomes while students continue their college career and as graduates seeking employment (Kuh, 2008).

Undergraduate research as a type of high-impact practice develops many key skills within students that employers seek in a competent and effective workforce (NASEM, 2017). Miller et al. (2025) suggested that career readiness competencies should be structured throughout campus programming and learning goals. While applying disciplinary knowledge from coursework to societal challenges through research projects, future graduates are trained in skills such as critical thinking, working as a team and as an individual contributor, and communication. Following a summer URE, students rated the NACE competencies that they developed, emphasizing many competencies were gained (Miller et al., 2025). However, the authors concluded that additional attention needs to be given to leadership, equity and inclusion, technology, and teamwork. Similar studies have identified this trend of some career readiness competencies not being emphasized in UREs (Newell & Ulrich, 2022). This could be a skill development concern or a lack of deep reflection to make the connection between what actions students were completing and the variety of competencies.

Technology Use in Undergraduate Education Reflection

The URE reflection process includes technology as a set of tools to support student researchers and their mentors and can contribute to bridging the gap between skill development, recognition, and articulation. For example, online journals such as course discussion boards and collaborative word processors (*e.g.,* Google Docs) are used by students in sharing what they have accomplished and what they learned with mentors (King & LaRocco, 2006). These online journals provide opportunities for follow-up and asynchronous discussions. Additionally, digital badges are used to recognize competency within specific topics to highlight micro-credentials that students demonstrated while gamifying the learning process (Alt, 2021). These badges can be used to highlight competencies to graduate schools and employers. Finally, e-portfolios can be a collection of URE products along with reflections to highlight competence and learning (Picardo & Sabourin, 2018; Weber & Myrick, 2018). E-portfolios are commonly used to demonstrate tangible outcomes to future employers and collaborators and require students to consider what are valuable cases of their work. These examples of technology use are often touted as valuable contributions to the URE as exemplified by recent presentations at ConnectUR conferences, CUR’s annual conference.

Considering the use of these digital tools, technology provides many advantages in supporting URE reflection and career readiness. Technology provides the scalability needed to reach many students

(Ma et al., 2024). With asynchronous and multimodal options, technology can be accessible to more individuals. Additionally, technology has the potential to be personalized to an individual with tailored prompts, adaptive content, and customization of how information is shared. Finally, as mentors' training, expectations, and availability vary, technology used for URE reflection could support students who do not have readily available access to mentors to discuss career readiness competencies (Limeri et al., 2019). With an available technology that could support all undergraduate researchers, those with absent mentors or those with dissimilar personalities or communication preferences can receive some guidance on the value of their UREs.

In addition to the advantages, there are some challenges that are important to consider when incorporating technology. Although it is assumed that students may be digital natives, there are digital divides where access to tools or familiarity with the various platforms will vary (Jaggars et al., 2021). Furthermore, there are ethical considerations students and governments are taking seriously such as accuracy, privacy, trust, and access (Farangi et al., 2024). Therefore, it is important to consider these challenges alongside the advantages of incorporating additional technologies into the URE reflection environment. It is expected, when integrating technology within a URE, that it will be used as a tool for the student and mentor and not as a replacement for the mentoring relationship. Shanahan et al. (2015) summarized ten salient practices of undergraduate research mentors and GenAI should support achieving these practices and not replacing valuable mentorship contributions (2015). The use of a trained GenAI chatbot could connect competencies students demonstrated from what they shared with the chatbot about their URE.

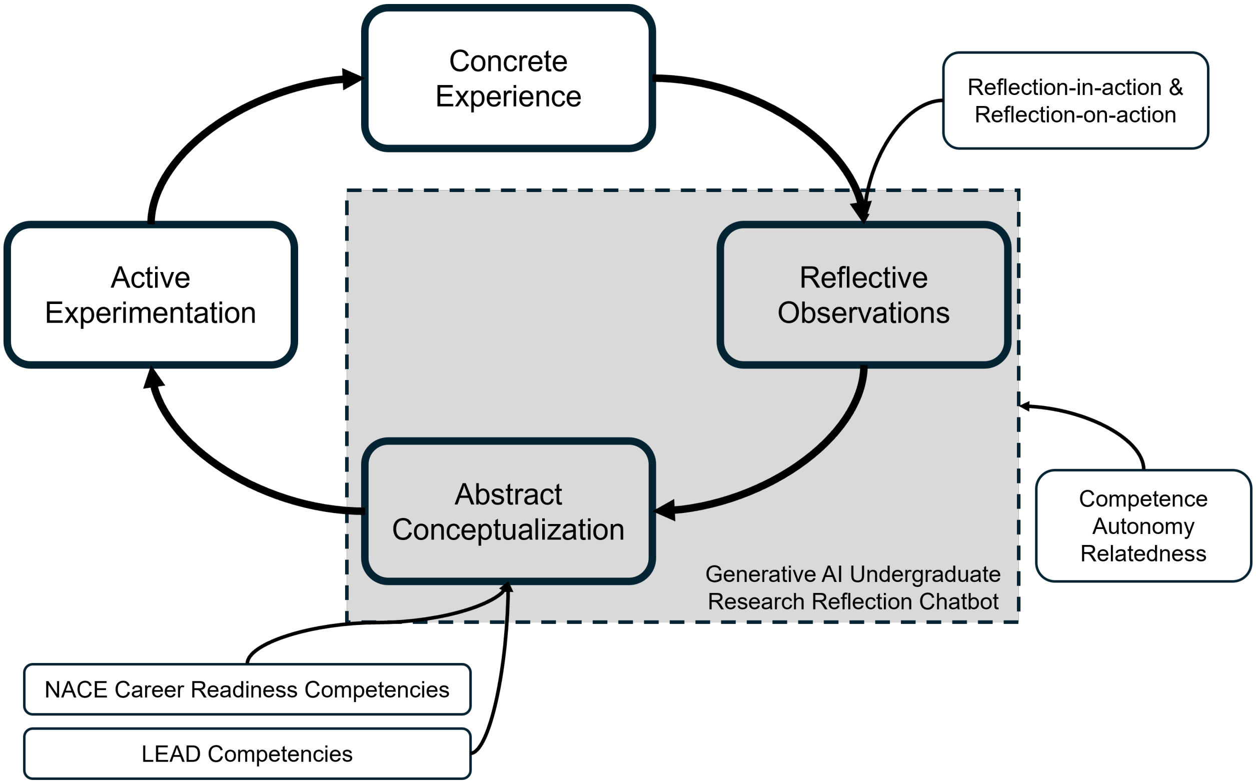
Conceptual Framework

The conceptual framework will consider how the GenAI chatbot platform and actions intersect UREs career readiness competency reflection. Figure 1 is a conceptual map created to illustrate this ecosystem where experiential learning, reflection, and motivation, and career competency theories and/or concepts are integrated.

Undergraduate research is a type of experiential learning where learning happens by reflecting on a concrete experience. As an integral part of Kolb's (1984) experiential learning cycle, reflection transforms concrete experiences into learning opportunities through abstract conceptualization and active experimentation. This paper focuses on the reflective observation and abstract conceptualization components of Kolb's cycle. As student researchers will connect their reflections to future actions, the chatbot summarizes examples of what future actions they can implement by continuing in the cycle with active experimentation for future experiences.

Critical reflection increases student engagement in learning (Colley et al., 2012). Reflection requires students to slow down and consider how the experience connects with what they already know (Colley et al., 2012). Schön's Reflective Practice describes two types of reflection needed for effective reflection: reflection-in-action and reflection-on-action (Roozenburg & Dorst, 1998). These practices help differentiate between reflecting while the experience is happening and after the experience has concluded. While much can be learned when looking back on the experience, it is useful to reflect while still actively engaged. This allows reflection on what has happened and provides opportunities to reflect forward on what is to come. This deep reflection as part of the mentoring process contributes to students' ability to articulate key career competencies (Miller et al., 2025). With a GenAI chatbot, students could improve their reflection-in-action as it is available to provide suggestions during an experience without concerns for mentor availability. Additionally, a responsive journaling environment can support deep reflection on these topics by requiring multiple iterations of exploratory and clarifying questions before providing a summary of connections between the activities and the competencies. This process increases the amount of information it can use for making these connections and requires students to think deeper about the process and rationale for the work.

Figure 1. *Conceptual Framework for GenAI Chatbot Design*



Self-Determination Theory provides additional theoretical considerations for a GenAI chatbot. This tool should include components where students have autonomy in learning, feel competence while learning, and believe the content and feedback is related to their situations (Deci & Ryan, 1985). Self-Determination Theory provides a framework on how motivation contributes to an individual's actions for determining the degree an action would be taken. By considering these "basic psychological needs," Deci and Ryan (2000, p. 227) posit that motivation is not static and is situational based on how the elements are supported in a certain context, such as within a GenAI chatbot. Within this platform, students can choose when to engage with it (autonomy), students provide the content and information about their experiences the chatbot uses to create personalized responses and suggestions for future work (relatedness), and students' responses are validated and summarized with rationale on how the student met the career readiness competencies (competency). However, care should be given so students do not feel relatedness to the tool itself.

Finally, a GenAI chatbot demonstrates self-regulated learning strategies by providing relevant and useful responses and content that "promote self-observation, self-evaluation, and self-improvement" (Zimmerman, 1990, p. 6). Educational chatbots are found to be useful in improving self-regulated learning by identifying goals and students having control over the process (Guan et al., 2025). Therefore, a GenAI chatbot could demonstrate a self-regulated learning environment by being available when students want to engage, providing supportive responses with reflective questions and concrete suggestions for further skill development.

GenAI Chatbot for Responsive Reflection

Overview

Since OpenAI's deployment of their ChatGPT tool, GenAI chatbots have proliferated within higher education systems (Deguara, 2024). These chatbots support faculty, staff, students, and prospective students in completing business tasks and meeting the educational mission within a learning management system. To implement our conceptual framework (Figure 1), we developed a GenAI chatbot to support URE critical reflection with responsive journaling focusing on career readiness competencies and are currently conducting iterative user testing with feedback. Created with the support of Purdue's RCAC and the Purdue GenAI Studio, the GenAI chatbot connects NACE and LEAD competencies to URE activities students provide in their interactions. These URE activities were compiled from previous student reflections and studies (MacDonald, 2024; Mekolichick, 2021; Lopatto, 2007). Included in this work were graduate students who, in addition to building the chatbot, provided guidance and suggestions on language, functionality, and usefulness. Importantly, Purdue's RCAC maintains its own servers to ensure student information is not shared externally.

Design Principles

When creating the chatbot, we wanted to ensure it was conversational, pushed students to think deeper, and was accessible to all student researchers. We wanted the chatbot to have a coaching tone to reflect a type of discussion they may have with a mentor or career counselor. Although the intention is not to trick students into thinking they are speaking with a person, it is to encourage them to share more information about the experience as if they were talking with an individual. We also designed the chatbot to summarize and mirror students' reflections back to them as a version of active listening and to ask follow-up questions to encourage deeper thinking. This allows the student to clarify what the chatbot understood from what they said. Finally, we wanted a chatbot that would support all student researchers regardless of discipline or stage of research. This was important to ensure all students feel their experiences and work are appropriate.

User Experience with Chatbot

User experience is a crucial component for the chatbot's adoption and success. Below is how students experience interacting with the chatbot along with the rationale for why this information or step was included.

1. The student starts at a landing page where they share logistical information about themselves and their URE such as their name, project name, and mentor. This information is used in the chatbot's responses when it is following up with students. This helps ground the student's reflections within an undergraduate research context to prevent scope creeping into other activities. After testing, we removed the requirement of a project name and mentor in case students had multiple experiences they wanted to consider.

2. After students submit logistical information, the platform has a short video on how to interact with the various platform components and how to interact with the chatbot. When considering potential digital divides, this video provides guidance on the functionalities of the platform and emphasizes the conversational tone students could consider for the interaction. Although we are clear this is a tool, we wanted students to feel like they did not have to formalize their thoughts or reflections before engaging and responding.

3. Within the chatbot platform, there are three pages of URE and career readiness information available to the students. These pages include information about the competencies the chatbot will be describing and connecting to their experiences, background information about reflection and the approach the chatbot will take to support their reflection, and Purdue University resources to support their undergraduate research career readiness

journey. This static information was important to help users recognize the rationale and content the chatbot was trained to consider along with what the student is sharing.

4. To get the interaction started, the chatbot invites the student to share about their URE with, "*Welcome {Name}! To get us going, can you tell me about your research project with {insert research project name}? You can share what the research is about and how you are conducting it but be sure not to include items such as data and other confidential information."* This welcome personalizes the interaction and reminds students that, although the information is not shared externally, they should not include confidential information or data a research mentor may not want to be shared or kept outside protected research environments. If students do not include a project name and/or mentor information, it removes this component of the initial invitation for a response.

5. Following initial interactions, the chatbot will summarize the information and ask clarifying questions about the research experience itself or critical reflection questions about their personal experiences within the project. Through summarizing the conversation, the student can clarify or correct information the chatbot has interpreted. Within each response from the chatbot, there is at least one question students *could* reply to. After at least three iterations of replying to the chatbot, the student can select from two buttons "That's all for now" and "I'd like to respond." The button provides autonomy to the student to determine the next steps and when the outputs are produced.

6. When the student clicks the "That's all for now" button, the career readiness competency output is generated with additional clarifying questions about their experiences. When students answer those clarifying questions, the editable and exportable competency table is updated summarizing their entire conversation of competencies they demonstrated, those they did not, and how to demonstrate competencies they lacked from the conversation. These opportunities for clarification allow the output to be more relevant to students.

7. When the student has finished the interaction, the chatbot provides examples of possible resumé/curriculum vita or LinkedIn bullet points following a bullet point formula (Sadler, 2015). These bullet points provide tangible outputs that can be incentives for students to complete this activity while highlighting best practices when creating effective bullet points for marketing documents and websites. Like previous interactions, students can continue the conversation by selecting "I'd like to respond" or "That's all for now" in case students want to add more information.

Connections to Conceptual Framework

Throughout the responsive journaling environment, the chatbot is asking clarifying questions about the students' concrete UREs and summarizing alongside career competencies they are demonstrating. Therefore, the student is focused on the "reflective observations" and "abstract conceptualizations" components of *Kolb's experiential learning cycle* (1984).

During the conversations, students can start an interaction at any point in their URE to begin reflecting on their experiences. By utilizing the chatbot throughout the URE and then reflecting on how they have progressed, students are demonstrating reflection-in-action and reflection-on-action as emphasized in *Schön's Reflective Practice* (Roozenburg & Dorst, 1998). Additionally, guided reflection by the chatbot can elucidate less apparent URE skills that are present but not articulated (Burt et al., 2024).

Students have autonomy to engage with the chatbot whenever they want and control how and when the interaction concludes. The chatbot provides personalized summaries and suggestions for future work that are related to the student's responses and activities. Finally, the chatbot makes explicit connections throughout the interaction on how the student met career competencies and how they could develop competencies they appear to lack from the experience. These engagements embed the pillars of *Self-Determination Theory* (Deci and Ryan, 200) within the chatbot.

Finally, students can complete these conversations at any time and can learn more about the competencies, the value of reflection, and Purdue resources available to them. Through these interactions, students engage in *self-regulated learning* (Guan et al., 2025). As students choose when and how to engage with the chatbot's conversations, students begin to demonstrate self-observation and self-evaluation. With the support of the chatbot, students are provided with a series of potential activities within their URE that could meet the competencies not demonstrated within the interactions. Therefore, students can choose self-improvement options to enhance their URE.

Strengths

This chatbot can provide scalable and personalized support to many students at one time. As demonstrated in one-on-one reflective discussions with mentors, workshops, and coaching sessions, this personalized and time-consuming practice (MacDonald et al., 2024) can be scaled through the chatbot. This chatbot provides a low-stakes interaction to begin reflecting to articulate their skills and career readiness competencies, a current need for students (Burt et al., 2024). Instead of focusing on finding a time to meet or replying to static, prompted reflections, students can begin reflection activities whenever with immediate responses.

This chatbot encourages ongoing reflective habits rather than one-off required assignments or journals. It also highlights reflection as a dialogue between what is known (*i.e.,* what the student shares) and how to think deeper (*i.e.,* what the chatbot asks). Additionally, we control some of the discussion to be focused on career competency and critical reflection topics. As students are encouraged to think deeper about their research experiences through this responsive journaling environment, students could begin to critically reflect on their experiences beyond the chatbot and beyond career readiness competencies. This transfer of reflection capabilities has been reported between higher education coursework and work environments (Griggs et al., 2016) and may be a result of interacting with this tool.

Finally, the information students share is maintained on a Purdue server not connected to public or corporate servers. Therefore, the information students share is not used to train future iterations of models, a common concern with data privacy when using AI tools (Farangi et al., 2024). Reflection with other GenAI tools, such as ChatGPT, can be accomplished with proper prompt development and refinement (Yuan & Hu, 2024), but there is a concern for data privacy with these tools and appropriate prompt engineering. Relying on the technical skills of AI experts at Purdue's RCAC, students can focus on their experiences instead of creating a better prompt or their own AI agent.

Limitations

The chatbot is not a replacement for mentor feedback. Without additional guidance or technical training, it cannot know more about the students' experiences than what students share with it. Unlike research mentors, the chatbot is not a disciplinary expert and cannot support making disciplinary connections for the student like a mentor can. Therefore, summaries are exportable to facilitate future mentorship discussions.

There are ethical considerations of using GenAI to assist in reflection that is conversational (Ruane et al., 2019). Students need to trust the platform and recognize the limitations of GenAI when using it as a reflection tool. As we developed this tool, there are specific strategies that address ethical considerations of transparency, privacy, and agent persona as addressed by Ruane et al. (2019). Students who engage with the chatbot are informed they are not interacting with a person, how the interaction is stored, and that they need to intentionally decide for the interaction for the chatbot to continue (*i.e.,* “I’d like to respond” or “That’s all for now” buttons).

Implications for Practice and Scholarship

It is important to recognize that a GenAI chatbot is a *tool* to support students’ URE reflections and to make connections with career readiness competencies. This tool does not, and should not, replace student researchers’ conversations about career readiness with their mentors, peers, and career counselors. This tool supports students’ reflective practices, which in turn could lead to fruitful conversations about career competencies and what students gained from the experience by beginning discussions at a deeper reflective level. Therefore, it is recommended that the chatbot is used as an initial reflection starting point that carries over into mentorship discussions with exportable summaries and potential skill development opportunities. This practice can support common mentoring practices as described by Shanahan et al. (2015). For example, mentors could adopt structured practices such as asking students to send the results before or bringing the exported competency summary to meetings or using the chatbot’s suggested activities to develop competencies to co-create short-term mentoring goals. For example, if a student’s reflection indicated a lack of professional competencies, a mentor could intentionally assign a small project-management task and use the chatbot’s summary as a starting point for discussing growth areas. Additionally, it can encourage future activities, such as presenting their work or serving as a peer mentor, to demonstrate communication or leadership competencies. Although the chatbot is limited in providing disciplinary norms and technical skills, it can provide general guidance that may be relevant to their URE context. A potential complication with the deployment of the GenAI chatbot is the avoidance of mentor interactions because of an assumption the chatbot is filling this need. Mentors would need to set clear expectations of when meetings will happen to ensure mentorship conversations continue.

This GenAI chatbot requires empirical research on the efficacy of its use in URE reflections. With a responsive journaling environment, a chatbot could support a student in thinking deeper and making connections with career readiness competencies, but it could lead to students offloading reflective activities to an external chatbot. Therefore, evaluating static reflections from a prompt or right after a conversation with a mentor or career counselor would feature any similarities or differences of the chatbot. This could demonstrate if the chatbot’s responsive journaling environment could have similar reflection outputs as in-person discussions. There is also an opportunity to determine if interacting with this chatbot would impact reflections for other activities, highlighting the transferability of reflection practices.

Future considerations for GenAI chatbots beyond the reflection component include chatbots helping students during other portions of the research process such as determining students’ interests or determining fit with potential research opportunities. There are common conversations undergraduate research office staff and student ambassadors have with students and having students self-reflect with a GenAI chatbot prior to an appointment could lead to more robust conversations during the appointment.

Overall, the inclusion of GenAI within a mentoring experience should consider the strengths and weaknesses of the tool. If offices of undergraduate research or undergraduate research mentors want to include GenAI within their work to support students’ reflections, it is worth considering a conceptual framework that could guide its use. Institutions without the ability to create an AI agent or

GenAI chatbot can use the conceptual framework to guide prompt engineering considerations such as using expert/dynamic role and few-shot prompting methods.

Practical Considerations for Implementation

When integrating a GenAI chatbot into undergraduate research reflections, several pragmatic considerations can help ensure the tool supports mentoring relationships in a secure and effective way. First, hosting a chatbot on institutionally managed servers allows programs to maintain control of how student information is stored, accessed, and retained. Communicating these practices and reminders not to upload sensitive data help users trust the tool.

Deliberate integration among existing mentoring practices ensures the chatbot is used and supports current activities. The chatbot is valuable as a starting point for conversations instead of a standalone reflection platform. Encouraging students to bring chatbot summaries with their opinions can enrich discussions, help mentors better understand students' progress towards demonstrating career competencies, and include concrete examples of student thinking during meetings.

Mentors may need assistance in determining the role the chatbot can have and how to interpret the generated summaries to incorporate them into their mentorship meetings. Providing examples of how mentors might use summaries will help ensure a supportive experience across mentors. This guidance must reinforce mentors' role as disciplinary experts with the chatbot serving as a reflection tool.

Likewise, students will need orientation to the platform, so they understand its value and limitations. Brief video and how-to guides can help students know how to engage with the chatbot. Making the tool accessible supports equitable participation across students with varying degrees of GenAI-tool literacy.

Finally, programs should consider implementing a reflection chatbot early in the research experience to help students record their activities, consider broader skill development, and learn of potential opportunities they could consider. Its use should be included in existing program structures that encourage reflection such as journals, learning contract reviews, and regularly scheduled review meetings. This encourages students to view reflection as an ongoing element to their personal and professional development. As programs use the chatbot, ongoing evaluation, such as comparing chatbot-support reflections to traditional approaches, can inform future use and changes for better long-term success.

Conclusions

Reflection is a key component to experiential learning activities, as described in Kolb's (1984) experiential learning cycle, and deep reflection requires dialogue with mentors. In fast-paced higher education environments, experiential education activities, such as UREs, are well-regarded because they apply course concepts in multiple contexts. UREs build career readiness skills that graduate schools and employers are seeking (Newell & Ulrich, 2022). With theoretical applications, technology, such as a GenAI chatbot, can make these competencies more explicit and support students in recognizing and articulating these skills. Therefore, initial deep reflection can be scaled through personalized dialogue between student researchers and a chatbot that responds with clarifying and critical reflection questions and feedback.

By combining GenAI capabilities with deep critical reflection techniques, a chatbot can advance a novel approach to meeting experiential learning pedagogical needs. This chatbot could complement and support discussions with mentors by asking additional questions to systematically support all undergraduate researchers in independent, apprentice-style, and course-based UREs.

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