



# Research Experiences for Undergraduate Students: The Role of Mentorship in Transferring Circularity and Digitalization Skills, Attitudes, and Knowledge in Food Systems

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## Abstract

Developing knowledge, skills, and research attitudes is crucial for undergraduate students to address issues and innovation in agriculture and food systems. Universities play a significant role in addressing these needs by providing students with high-quality educational experiences. This research employed a case study research design to obtain insights and perceptions from one group of previous Research and Extension Experience for Undergraduates (REEU) faculty mentors. Drawing on the lenses of the Social Cognitive Career Theory's Performance model (Lent et al., 1994), we rationalize the role of reflection and feedback from mentors in enhancing the learning environment. Data were collected through a focus group and analyzed using open and axial coding to identify recurring themes, patterns, and insights. Four major themes emerged: sense of preparation, the pairing process, relationship challenges, and mentors' implications to better understand the ability and past performance related to mentorship and this program. These themes provide a broader picture of the nature of mentorship within this REEU, highlighting the need for scaffolding, effective communication, and collaborative strategies for fostering positive mentorship experiences.

**Keywords:** Circularity, Mentorship, Performance, Social Learning, Undergraduate Research Experience

Circularity and Digitalization (CD) are meaningful concepts in modern food systems. Circularity addresses linear economies' flaws by integrating sustainability principles like efficient resource management, reducing environmental impacts, and facilitating recycling of organic and non-organic materials such as plastics and electronics for repurposing or remanufacturing. (Andrews, 2015; Burger et al., 2018). Similarly, digitalization has transformed food and agricultural production by merging data-driven solutions with cutting-edge technologies that enhance the systems' processes (Tang et al., 2002).

Beyond farming methods, CD significantly impacts the commodities value chain, where successful implementation relies on collaboration among various stakeholders, including farmers, processors, distributors, retailers, policymakers, and consumers. This collective effort is crucial for reducing waste, lowering transportation emissions, and adopting sustainable economies (Hedberg & Šipka, 2021). CD approaches require rethinking traditional knowledge and practices across systems while encompassing everything from crop development to waste management and resource conservation.

Higher education institutions are instrumental in equipping future generations with the knowledge and skills to advance agriculture and food systems (National Research Council, 2009). These institutions strengthen students' professional and scientific development by offering experiential learning opportunities with programs such as Research and Extension Experience for Undergraduates (REEU). High-quality mentorship is central to these experiences. When this mentorship is provided by faculty members, it becomes a critical component in shaping undergraduate research and professional journeys.

Mentorship, particularly in STEM fields, significantly influences students' development of a scientific identity

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and their career trajectories (Atkins et al., 2020). As discussed by Kuchynka et al. (2021), mentorship programs at the college level play a key role in building students' confidence and encouraging them to pursue STEM careers. Additionally, educational programs with a mentorship component can support students' professional growth and leadership development in agriculture (Lamm et al., 2017). Providing research experiences is essential for preparing professionals with the skills needed for CD in food systems.

To address the need for preparing the next generation of professionals in agriculture and food systems with CD skills, the College of Agriculture and Life Sciences (CALs), through the Department of Agricultural and Biological Engineering (ABE) and the Department of Agricultural Education and Communication (AEC) at the University of Florida, hosted a REEU. Funded by USDA/NIFA, this program enables students' comprehensive immersion into the research process and provides the knowledge necessary for CD.

The REEU in CD is a ten-week program designed to engage undergraduate students from diverse cultural and academic backgrounds in faculty-mentored research. The program offers an enriching, experiential learning opportunity by integrating workshops, research projects, field activities, and mentor-led presentations. Open to undergraduates at all academic abilities and experience, the program emphasizes developing CD skills and knowledge through contemporary challenges in agriculture and food systems.

As the demands on agriculture and food systems continue to evolve, fostering high-quality mentorship through programs like the REEU prepares and inspires students for STEM careers while contributing to the development of resilient, sustainable, and technologically advanced agricultural and food systems. Such efforts are vital for the advancement of a sustainable future.

### Purpose

The purpose of this study was to understand key aspects of the mentoring component of this REEU from the perspectives of the faculty who mentored students. Our objective was to analyze the reflective feedback from faculty mentors who had previously hosted an REEU student from this program and how their experiences could improve the program. A single question guided our inquiry: How does mentoring feedback improve learning experiences for REEU programs? Understanding this aspect of this REEU will allow us to enhance the learning environment in upcoming iterations of this program. Lessons learned in this program may also benefit others leading REEU programs.

### Theoretical Framework

Mentoring is shaped by social experiences and factors in the learning environment that support learners in managing their efforts toward personal goals. The essence of mentorship can be understood through theories that emphasize the social construction of knowledge (Doolittle & Camp, 1999). One such theory is Bandura's Social Cognitive

Theory (1989), which highlights the pivotal role of the social learning environment in shaping behavior and learning outcomes (Bandura, 1991). Within SCT, personal agency is central as individuals actively influence their learning and development through reciprocal determinism—a dynamic interaction between personal factors, behaviors, and environmental influences (Bandura, 1989, 1991, 2002). This dynamic framework makes SCT particularly relevant for understanding how social cognitive processes foster growth through modeling, feedback, and a supportive learning environment.

Building on these foundational concepts, Social Cognitive Career Theory (SCCT) (Lent et al., 1994), an advanced model rooted in SCT, offers a conceptual framework for understanding how self-efficacy and outcome expectations drive self-regulation and goal-directed behavior (Lent & Brown, 2019). We adapted the SCCT performance model to analyze mentors' feedback within the REEU program (See Figure 1). This operationalization enabled us to examine how mentors' past performance and abilities inform their future achievements and persistence in mentoring roles. The SCCT model provided valuable insights into mentors' self-efficacy, outcome expectations, and adaptive decision-making by focusing on feedback mechanisms.

Feedback, a cornerstone of experiential learning, encourages reflection, prediction, and the internalization of learning experiences (Roberts, 2006). Assessing the mentors' perceived performance using the performance model enabled us to identify and develop program strategies to improve and enhance their mentoring practices. By acknowledging the significance of feedback in shaping effective mentoring approaches, we can contribute to creating impactful educational research programs and fostering dynamic learning environments for undergraduate research experiences. By facilitating and analyzing reflections on program activities, mentors can improve their mentee's learning experiences and their performance in facilitating future educational research experiences.

### Methodology

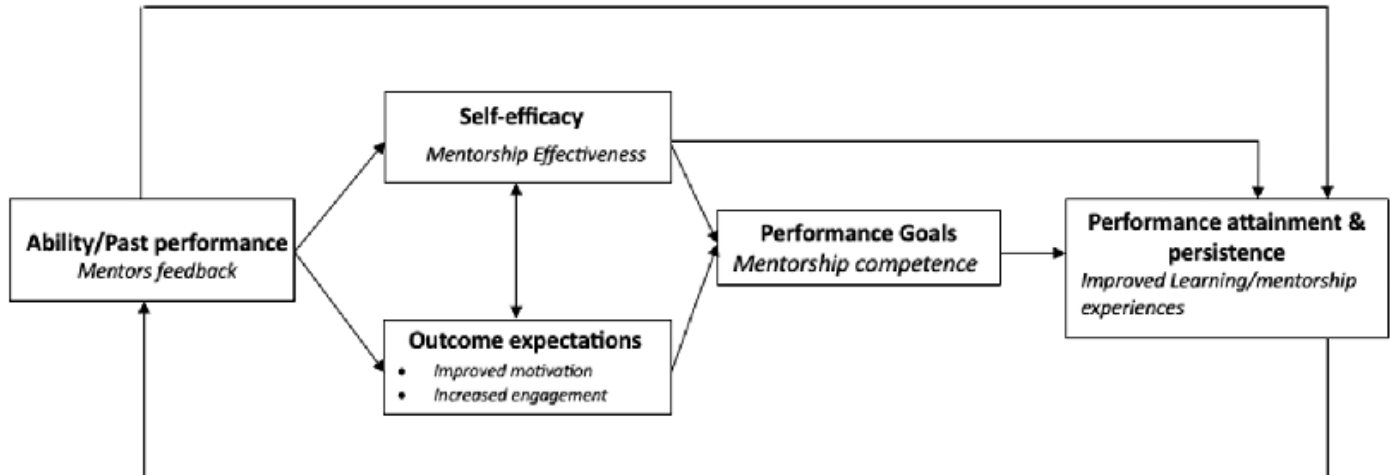
This study employed a case study research design to obtain insights and perceptions from one group of previous REE mentors. Case studies allow for group dialogues that can identify connections among phenomena, contexts, and individual experiences (Saldaña & Omasta, 2021). We collected data through a focus group, allowing for an in-depth exploration of participants' experiences, self-performance, opinions, and recommendations. All previous faculty mentors for the program (N = 8) were invited to participate, and five agreed. Three faculty mentors could not attend the focus group session due to time constraints and availability.

### Data collection

The questions for the focus group explored different aspects of the mentoring experience, including a sense of preparation, the pairing process, and relationship challenges. We also asked faculty mentors for their

Figure 1

Integration of the SCCT Performance Model and Mentoring Feedback



**Note.** Adapted from Lent et al. (1994) Social Cognitive Career Theory Performance model.

opinions and general recommendations for improving the program. The focus group took just over 45 minutes and was facilitated by a researcher from a different department than any of the mentors to encourage discussion and obtain more detailed insights from the participants. The focus group took place virtually over the Zoom platform, and transcriptions were collected using the Otter.ai app. The transcripts were revised, cleaned, and condensed to ensure quality over the analysis process.

## Data analysis

The data was analyzed using open and axial coding to identify recurring themes, patterns, and insights (Saldaña & Omasta, 2021). We followed a naturalistic inquiry approach to establish trustworthiness in our methodology (Lincoln & Guba, 1985). We engaged in peer debriefing, data triangulation with observations from project directors, as well as member-checking to ensure that the researcher's interpretations accurately represented the mentors' perspectives. With only five participants, we chose not to provide detailed information about these mentors to protect confidentiality.

## Findings & Discussion

After analyzing mentors' perspectives and reflections concerning the REEU program experience, four key themes emerged, which include a sense of preparation, the pairing process, challenges, and mentors' implications. These themes facilitated a comprehensive interpretation of the role of mentorship in this REEU. Each theme is discussed below.

## Sense of Preparation

The program ensures mentors are equipped to work with REEU students by considering specific factors before each cycle. A short mentorship course is offered to educate mentors about program goals and how knowledge is imparted to students, covering various topics such as effective mentorship, successful internships, and culturally competent mentorship.

As a matter of interest, we wanted to learn about the effectiveness of this resource; some mentors remembered completing the training, while others did not. This suggests that faculty serving as mentors have a sense of readiness when it comes to providing mentoring related to their role in the university. Although having supervised or advised students can help establish a strong sense of preparation, not going through the program's training may present an obstacle to performance and a general understanding of the program's objectives. Still, participants found the resource helpful, particularly for engaging with newer generations of students. One participant said:

I think every generation has its new elements, so it's always good to revisit. I do think it's a lot of personality based, like if you're some people, it's a lot easier for them than others just because of the way things work, but it's always good to hear what's the newest stuff.

As the mentors highlighted this as a strategic resource, the inquiry turns into why a mentor may not utilize this resource to enhance the sense of preparation to work with their students. A participant explained, "I'm always interested in hearing it. I just don't, you know, mandatory training is never my super joy. And so, we have enough of them already" Likewise, another mentor exposed a perceived challenge related to recruitment that gravitates around this issue. The perceived challenge was associated with last-minute recruitment, emphasizing the importance of timely involvement so they can be fully aware of the program's

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purpose. It can be crucial for them to engage more and connect with students from other mentors. As an example, one participant shared:

In my case, I was recruited at the last minute because somebody dropped. So, I didn't know very well what was going on early on, but I think later it was good. I participated in some of the events. I think they did some field visits to different places in Gainesville. I went to some of those and then to the final presentation, and I don't know. I think their communication, at least with my student, was good.

Late recruitment for this program is uncommon, but it can be challenging for preparedness, according to program directors. The directors have emphasized the importance of communication with all participants, including mentors and students, which has been highly effective throughout the summer program. Mentors have also agreed that consistent communication has been beneficial. However, a participant raised concerns about the availability of mentors, which is worth considering.

I think they did a really good job communicating, sending weekly reminders, and also scheduling for the meetings. I didn't attend much. I think it's also because, in the summertime, everyone is traveling, so it is really hard to schedule to attend this.

As expressed by this participant, professors in this program may often struggle during summertime, depending on their professional commitments. The mentors agreed that it is essential for them to reflect on their commitments, such as research or faculty appointments, as this can interfere with their participation in program activities even though they would like to be more engaged. One participant shared a reflection on being a mentor of the program:

I know some folks who are nine months who are much like, no, that is my time, and so other ones are more like that, you know, they make it work. So, I think that's, I guess, people self-select because if you're really concerned about that, you would not sign up for this program.

The focus group participants expressed various factors that affect their sense of preparation. Some mentors have concerns about mandatory training and their involvement in the program because it may interfere with their schedules, especially during the summer when some may be traveling or have other commitments. Additionally, they feel that committing to training may be difficult due to time constraints before the program begins. However, they are still willing to do the training, even though they would prefer more informal sessions on things to consider when becoming a mentor of circularity and digitalization.

Despite completing or not completing the training, all mentors feel confident in guiding undergraduate students. They explained that they drew upon their previous experiences with graduate students and undergraduate students who volunteered at their laboratories or participated in different programs that their lab has hosted. These experiences equipped them to navigate the challenges presented by the REEU initiative. Still, some mentors shared that there is a sense of uncertainty in addressing mentees' goals, which relates to the student's expectations.

One person said:

I think these refreshments are good. If they are tailoring, specifically undergrads. And especially undergrads with different backgrounds. Some of them have clear expectations of what they want, so it is easier to mentor them. And then sometimes you get somebody that really needs a lot of help, and perhaps I don't even know how to offer that.

Under the REEU context, the relationship between mentors and students can be affected when students have unclear expectations and require more direction than support. This can cause confusion between a mentorship and a supervisory role. Thus, when asked how they could better prepare to be mentors considering this challenge, participants shared their insights. One suggested reflecting on failed relationships with students to learn from those experiences, stating, "I learned a lot more when something didn't work. And I reflected a lot more on how sometimes my relationship with students didn't work and why and what I could do differently." Mentors recognized the importance of feedback but emphasized that relying solely on feedback is not enough to improve.

Enhancing the ability to guide others is crucial but requires a willingness to learn from past failures. Mentors who take the time to reflect on their experiences and learn from their mistakes are better equipped to help their students succeed. In addition, mentors find that building a collaborative community is a valuable approach to meeting the needs and expectations of their students. By working together and leveraging each other's strengths, they can provide the support their students need to excel.

### Pairing Process

The success of REEU's learning strategies is heavily reliant on effective mentorship. Accurate pairing is a crucial component in building a solid mentor-mentee relationship. However, connecting students with diverse backgrounds and appropriate technical skills within the program's context poses significant challenges. A participant shared insights into the pairing process, emphasizing the importance of careful matching to ensure reasonable expectations on both sides.

We had all kinds of different backgrounds, a lot of them being almost non-technical at all. So, the trouble is if you get somebody who is just wholly not technical at all, then it's a long slog to get them into feeling like they have done on top of stuff. So, I think a lot of matching needs to be done so that people aren't, you know, that there's a decent amount of expectation on each side.

Drawing from the mentors' reflection and the continuous realization of them having to provide mentorship to students who have yet to develop specific skills to use in the research projects, one of the mentors proposed that sharing more information about their work and research interest prior student recruitment could be instrumental for the pairing process. They shared:

I am not sure if advertising is necessary for them this year, as it was the last year for the mentors.

It is easier to promote on social media and a few relevant websites. They already have our bio on those platforms. I hope things will change this year because I had a student last year who was interested in agriculture but had never been to the field before. Although it turned out fine in the end, it can be a challenging experience for some students.

As implied, when engaging in a mentorship relationship, mentors need to consider the differences in backgrounds and, for the REEU context, and the program's introductory nature to research. This is especially true when establishing objectives and expectations. While potentially reciprocal, the mentorship relationship requires caution due to the unique essence that brings the program. One mentor suggested:

Pairing a student based on their passion for the work is so important. then they will have a clear goal, what will be our expectation for the students...I think it's important for students to have a basic understanding of their interests and how they align with the goals of their faculty.

The mentors mentioned that the program offered to students is unique compared to their usual mentorship outside the program. They also recognized the difficulties of working with students from diverse backgrounds. Therefore, the mentors emphasized the importance of having strategies in place to bridge the gap between students and enable effective collaboration. One participant mentioned that anything produced by the student would be considered a bonus rather than something worthy of publishing. They pointed out that the mentoring's primary objective is to enhance students' motivation through research experiences, which is already a valuable outcome. However, mentors stressed the importance of aligning the backgrounds of REEU students, as they can also benefit from guidance from other connections they can develop while working in their laboratory. These insights highlight the significance of building an inclusive research environment for undergraduate students. One participant said that:

I think it is good to pair with either graduate students or postdocs so they can get some direct help from them and other advice from students. I think that sometimes, if the faculty is not available, they can always reach out to somebody else.

Although research outcomes are challenging to achieve, and a few mentors shared some accomplishments, these outcomes should not be the sole focus or aim for publishable work but rather as a motivation factor for the students. One mentor shared an outcome based on a great match with their student:

I actually had an undergrad that was, you know, having a similar background. So that was a really good match, and we were talking about expectations. So, I said the expectations of if you do these you go to conference with us. So, I presented a poster of the work in the plant business retreat. And that was kind of like a good challenge for her to kind of complete the work. That worked well last year. So, I might be doing the same thing.

The conversation expanded to introduce the idea that the program provides mentorship from the primary

faculty professor and other individuals who can enhance the learning environment. The participants expressed that guiding REEU mentees can be a valuable opportunity to improve mentoring skills for themselves and their graduate students and postdoctoral researchers. This, in turn, can help those working with them to engage more effectively in the learning environment and improve their mentoring abilities. However, it is essential to note that at this level, the pairing process with others can occur naturally, and students may be introduced to multiple potential mentors with guidance from their faculty mentor to ensure the most impactful experiences with others.

### Relationship Challenges

Mentoring students in the REEU program can be challenging due to their diverse backgrounds and the interdisciplinary and introductory nature of the program. When asked about the challenges of mentoring the program's students, mentors identified the lack of technical skills as the most significant obstacle. One of the mentors highlighted that the lack of this could hinder students' research work:

Last year, the person I was working with was a science graduate. Although he was working on some projects with me, he lacked the technical expertise required to fully comprehend and contribute to what we were doing as he wasn't an engineer. This made things quite complicated at times.

The challenge of skill gaps among students significantly impedes the successful completion of research projects. In addition to this, it may also result in a range of other challenges, including student isolation. One mentor shared:

I found that my people tend to be very isolated in their work areas. One guy's working on this versus the other on that, you know, and so it's not always very useful. If a person's working out, I'll try to pair him up with grad students.

The cognitive dissonance, the exposure to a new learning environment, and the need for connections challenge student engagement despite the students' personality. A mentor shared his observation concerning this issue and highlighted the importance of spending time with the mentee.

Every student is unique and requires different levels of supervision. Many of them may require more attention than you might think. They may want to spend more time with you and discuss their thoughts and ideas with you. It is important to have a lab environment that is conducive to these interactions. It is important to remember that not all students are the same and some may require more assistance than others. It is crucial to always keep an eye on each student's progress and needs to ensure they are not left feeling isolated.

Mentors shared that it is suitable to try and find a more cohesive fit, as the program will be challenged in this aspect. For instance, one participant suggested focusing on facing this challenge and opening a dialog with the student.

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So, really, I'm trying to help their enjoyment and the learning experience in my field... So, it's less about, oh, there's this much work that just has to be done by somebody. When I converse with my students, I ask about the skills they wish to learn and the things they want to include in their CVs. This is the point where they usually express their interests, and if they require assistance in technical skills such as learning R, programming, or utilizing GIS, I try my best to help them achieve their goals.

Another notable suggestion involves a paradigm shift from traditional one-on-one mentorship to a more collaborative and inclusive approach. This added strategy aims to foster a dynamic exchange of ideas and skills among students through presentations and to facilitate collaborations when necessary or feasible. One mentor shared:

We should decide as mentors what critical skills are needed for studying circularity. You know, because I think that's what we can put together. We're all different, very different groups. That's the best part of what you have, in general, a deep bench of very collegial people. So, what do we think they should know to advance themselves in this field? And it's whatever field is right that's the point—that is supposed to be wide open.

As suggested, the research in circularity covers a broad range of skills and complexities. Thus, the need for communication and collaboration among mentors is crucial to enhance the learning environment and the mentor's performance and ability. The challenges mentors face in the REEU program are multi-faceted and highly connected with the complexity of the topic. These challenges arise due to students' diverse backgrounds, time to connect to students, and the need for technical skills. However, mentors are proactively engaging in discussions and proposing innovative strategies to overcome these challenges as we presented. Moreover, they are fostering a collaborative, connected, and supportive research community that goes beyond the pre-outlined strategies. This community recognizes and appreciates the space for connection and reflection to achieve substantial feedback that leads to improvement in performance.

### Mentors' Implications

Mentors reflected on the broader implications of their roles within the REEU program. Setting clear goals for REEU students to enhance motivation was identified as a shared responsibility.

I let them write a smaller, for instance, outline for the project and maybe what they should collect as data at the end. they also set up a clear goal; they should present their data to the poster sessions or undergrad symposium, those kinds of goals.

Mentors also recognize the significance of valuing students as unique individuals with diverse experiences, aspirations, and perspectives. Most notably, mentors have discussed the importance of investing more deeply in understanding their REEU students on a personal level.

This nuanced understanding enhances the mentor-student relationship and provides a more enriching and supportive learning environment. Another mentor shared his approach to overcoming cultural barriers with the student before establishing mentoring objectives.

I try to learn where they come from and what brings them joy. I'm trying to focus on the good, and I love food. So, we normally go around food and, you know, in the lab itself, and then try to connect with those students through some of those, cultural aspects, and then start learning more how I can help them with you know, technical skills and other more professional aspects. I try to connect with them, I guess socially and culturally.

Another topic brought into discussion was the value of involving graduate students working at their laboratories. This collaborative mentoring approach is a benefit for the REEU program and an opportunity for graduate students to practice and develop mentoring skills.

I think is good to give them a clear goal, what they should achieve. For instance, give part of the graduate school or undergraduate students' project to the interns. So, the intern can do their own work, and at the same time, their work can complement that of graduate students.

The mentors also expressed a desire for more interactive sessions, including group sessions, to help students develop these technical skills, at least at a basic level. Engaging in presentations, where mentors share their research, was also pointed out as a good way to foster collaboration and guidance from the different mentors but from a more collaborative approach. Thus, collaboration among mentors was emphasized, believing that learning from each other's strengths would contribute to a more effective mentoring environment, especially when targeting the transfer of highly technical skills, like coding, image processing, and other research and lab procedures related to digitalization.

If there's a common thing that we all need in, let's say, our analysis. We should probably teach that as a group to teach everybody corporately, and then have a go and then tune into specific areas because, you know, maybe there's some common theme or common skills that we could teach.

It is crucial to emphasize that this recommendation surpasses the mere replacement or alteration of some pre-established program activities. Instead, it is presented as a means for mentors to recognize the positive influence of mentoring on both academic and personal development and underscore the importance of additional program activities that can enhance students' experiences. Accordingly, participants shared their opinions when asked for feedback on other planned activities.

Those activities are very well designed and great for the students. Of course, the work in the lab is your work with them. They can interact with lab mates, but then they also belong to a group, so they learn from their peers. So, it's really, this feel, it's more, you know, interactive. I think that's super important for the students as well.

In addition to the pre-established strategies, a collaborative, connected, and supportive research community are some of the ideas the mentors suggested. Finally, the mentors suggested seeking feedback from REEU students as one of the most important things when looking at ways to improve their performance as mentors. "Write feedback for mentors as well and then send it to us. I think it's useful for the faculty to know what they should improve if anything is miscommunicated."

The insights gained from the focus group discussions have revealed that most mentors share a common perspective on how positive and negative experiences affect their ability to mentor effectively. In addition, the mentors have identified that receiving feedback from their students is crucial to improving their performance and offering a better experience to the students. Furthermore, the mentors emphasized the importance of activities outside the laboratory. They believe such activities provide students with broader experiences beyond just transferring knowledge or practicing skills and offer them great opportunities to grow as researchers.

Given the intricate nature of research in this field and the necessary training required, mentors have recommended that fostering positive experiences for students can effectively cultivate students' interest and ambition in developing skills and attitudes towards circularity and digitalization in food systems. Indeed, this is closely aligned with the program's intended outcome and purpose. Hence, we interpreted participants' feedback to refine program strategies and found that group intervention, like the one conducted for this research, provides a necessary space for reflection to understand the mentor's ability and performance within the REEU context

### Conclusions and Recommendations

The analysis of the themes *Sense of Preparation*, *Pairing Process*, *Relationship Challenges*, and *Mentors Implications* have provided insights into the nuances of mentorship within this REEU program. These insights offer an understanding of the complexities of fostering a conducive learning environment through reflective practices.

Mentors' *sense of preparation* is a critical aspect influenced by various factors such as communication, availability, and training. Some mentors found formal training helpful, while others prefer informal approaches as they already feel confident providing peer-to-peer mentoring. The influence of one's abilities and past experiences cannot be understated in enhancing their self-efficacy and performance (Lent & Brown, 2019). For this reason, mentors viewed themselves as equipped to serve as mentors in this program. Nonetheless, it is critical for mentors to grasp the program's objectives fully to deliver relevant experiences. It is worth noting that participants believed that mentoring a graduate student varied significantly from mentoring within this context. Our analysis suggests that organizing short meetings or information sessions to introduce mentors to the program's goals and clarify expectations before the next student cycle begins could be beneficial. These meetings should be concise and mindful of the mentors' schedules

and availability, considering their input.

Over the *pairing process* discussion, the mentors shared their concerns about the complexity of their research and the students' diverse backgrounds and skill gaps. The mentors stated that their role is to introduce students to the field and not to focus on specific research outcomes. To effectively teach circularity and digitalization skills to students new to the concepts, mentors should prioritize promoting student motivation and introducing them to role models, such as graduate students in the labs. This approach aligns with Bandura's theory of social learning (Bandura, 1969). Expanding the mentorship concept to a more social approach is important to transfer skills and knowledge. Graduate students, for example, can help students regulate their self-efficacy better, as they represent the closest role and experience level for undergraduate students, compared to the distance in experience and role representing a professor (mentors). By doing this, students can have an introductory experience that will help them build interest and persistence in developing the targeted skills and knowledge within the program. Additionally, it is recommended to look for strategies in sharing more information about the mentors, like research profiles and interests during the recruitment of students for each cycle. Sharing this information can help students increase interest in working with mentors and provide a starting point for students to set expectations.

The mentors have advised that when dealing with *Relationship Challenges*, it is important to assess the needs and expectations of students. They emphasized the need for personalized approaches and a deeper understanding of students' backgrounds and aspirations to establish realistic expectations. The mentors also highlighted that it is crucial to understand students' aspirations, backgrounds, and skills for the success of every cycle. To achieve this, well-defined objectives need to be established, robust relationships need to be cultivated and facilitated, and students' multifaceted development needs to be invested in (Montgomery, 2017). Moreover, mentors expressed the need to define, as a group, the knowledge and skills required for each cycle. As the background of students may differ on each cycle, it is suggested to assess this for each cycle and consider the possibility of providing more specific training over the program that helps students practice the targeted skill. Workshops on research writing and research skills can be critical to enhancing students' projects. Providing a scaffold approach for the research process can help foster students' persistence in learning new skills and knowledge.

Overall, mentors' implications lean towards collaborative mentoring approaches. Having spaces to share their work and socialize as a group (students and mentors) is important to enhance the learning environment. This strategy can help students broaden their understanding of different research that can be done around circularity and develop a sense of community. Likewise, graduate students' collaboration as embedded mentors should be recognized as they can help undergraduate students overcome feelings of isolation and research challenges resulting from complex tasks. This aligns with recommendations in emphasizing the importance

of mentorship programs in providing comprehensive support for undergraduate researchers to develop collaboration networks and foster dialogue to build a scientific identity (Atkins et al., 2020). Mentors also recognize the significance of receiving feedback from their students to improve their performance. Such feedback enables mentors to reflect on their mentoring experience and strive towards better performance. Therefore, creating opportunities for discussion and improvement based on the feedback collected from students can be highly useful for the program.

To conclude, we draw on the lenses of the SCCT performance model to rationalize mentors' ability and past performance (Lent & Brown, 2019), which allows us to understand how to enhance the learning environment. Mentoring within the REEU in circularity and digitalization is a collaborative partnership that involves mutual reflection and constructive feedback to enhance the educational experience (Montgomery, 2017). Overall, our findings underscore different nuances in the nature of mentorship within the context of undergraduate research experiences and highlight the importance of tailored approaches, effective communication, and collaborative strategies in fostering positive mentorship experiences.

Based on the findings, conducting further research to uncover students' experiences is also crucial for enhancing the program. Inquiring into students' feedback on mentoring can help expand the understanding on how effective mentorship is with a broad perspective. Exploring students' perceptions can allow mentors to improve their performance and competency in future iterations. Addressing this aspect of mentorship is essential as it enables the program directors to understand better and oversee the learning process, which contributes to facilitating transformative experiences for REEU students. Similar to SCCT, it is essential to consider the wide range of theories that can be used to understand the role of mentoring and the contextual aspects that influence career development from both mentor and mentee perspectives. Finally, by addressing the challenges identified with the help of the faculty mentors, other mentorship programs and initiatives can be enhanced and support the idea of facilitating a reflective and holistic development of students' skills and knowledge for circularity and digitalization.

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