Work in Progress: Epic Fail – An Attempt to Observe Mentoring Relationships Within Short-term, Lab-based Research Experiences for Undergraduates (REU) Programs

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Introduction

When Jane Goodall, an English anthropologist, went to Tanzania to venture into the little-known world of chimpanzees in the wild, a layer of understanding that was unobtainable through observations in zoos was gained. Our study leverages this ethnographic approach by similarly exploring the little-known world of short-term, lab-based mentoring relationships by engaging in mentor-mentee daily lab experiences.

This work-in-progress introduces our research team’s first attempt and epic failure to develop and use a lab-based observation protocol in order to appropriately investigate lab interactions. A brief introduction about the Research Experiences for Undergraduates (REU) and mentorship are provided prior to discussing the initial design for the observation research, lesson learned, and next steps.

Background

Research Experiences for Undergraduates (REU)
Attention to the Research Experiences for Undergraduates (REU) summer program has grown in the last few years. The National Science Foundation (NSF) launched the current REU program in 1987 and has seen rapid growth promoted by policy actions associated with potential outcomes for participants [1-2]. There consequently is an emerging body of literature that has examined the impact of the REU program on students’ early engagement in science, technology, engineering, and mathematics (STEM), persistence and retention in a STEM major, and integration into STEM culture [3]. Yet, little is known about how the program supports students and how students learn through their research experiences. The extent to which the design of the REU programs have relied upon existing studies has also been questioned by National Academies of Science, Engineering, and Medicine [2]. A joint report emphasized the need to investigate the mechanisms for how the REU program works, why they work, and how to rigorously evaluate the outcome to address the still many “unanswered questions and opportunities (p.4)”.

Mentoring Relationships
The concept of mentorship has been widely investigated as a mechanism to support research training in STEM [4]. The use of mentoring has been recently advocated to support REU programs as part of the education programs associated with NSF Engineering Research Centers (ERC). Research of these programs has demonstrated benefits for both mentors and mentees, including increasing mentee engineering identity and interest in postgraduate study and increased knowledge, management, and self-confidence for mentors [5-7]. There is a lack of research exploring the development of mentoring relationships when considering the nature of STEM and the research setting of the REU [2].

An additional note regarding this research space is that the majority of studies focusing on mentors and mentees in REU programs have used self-reported data. The retrospective nature of self-
reported data is considered to be informative to the quality of established mentoring, but not the development of a mentoring relationship over time [2]. Descriptive, but not causal or mechanistic, data is needed to further explore mentoring relationships.

Research Design

This study was designed as a response to the identified need to investigate the process of mentoring relationships rather than its effects in the STEM REU program settings, i.e., short-term and lab-based. An ethnographic approach with a repetitive observation strategy was chosen to closely look into the development of the interpersonal relationship between mentors and mentees over time [8].

Observation Protocol Development: Model for Short-term, Lab-based Engineering Mentorship

Our team designed a pilot observation protocol based on Chandler & Larson’s Model for Short-term, Lab-based Engineering Mentorship (Figure 1) [9]. This is a model developed for the purpose of mentoring education within NSF ERCs and is based on multiple theories from leadership and organizational studies [9]. This model represents the mentor-mentee relationship over time while it focuses on two variables: 1) direction or explicit instructions provided by the mentor to the mentee, and 2) support or assistance and encouragement from the mentor. Our initial efforts attempted to observe the ‘direction’ and ‘support’ components of mentoring relationships via the interactions and/or collaborative works among mentors and mentees in real time. A total of 23 items – 13 items to observe ‘direction’ and 10 items to observe ‘support’ – were generated by referring to the example situations provided from the model.

![Figure 1. Amount of support and direction in lab-based engineering mentoring (adapted from [9])](image)

This study did not have a theory-driven hypothesis or research questions, but instead leveraged this model with the purpose of understanding the development of mentoring relationships through the collection of empirical evidence on ‘direction’ and ‘support’ components. Additional goals for this study included testing, improving, and using this model as a guide to develop mentoring education programs.
**Data Collection and Participants**

Direct observations of informal mentor-mentee interactions were made by a researcher who was familiar with an engineering lab environment and had experiences in qualitative data collection. Structured, observer-as-participant observations [8] of each mentoring pair were conducted for roughly 30 minutes per week throughout the eight to ten-week REU program. Data collection for each mentoring pair also included unstructured, observer-as-participant observation using field notes of informal practice activity, meetings, and mentoring education document review. Observation-informed semi-structured interviews lasting approximately 15 minutes were undertaken and audio-recorded following observation data collection as a secondary data collection method for the purpose of data triangulation.

The data were collected from two different REU programs associated with two ERCs at a large, public university in the southwestern part of the United States. Both ERCs are primarily associated with the school dedicated to sustainable engineering and the built environment, but affiliated faculty and students are located across numerous disciplines and programs. The overall data included 9 mentoring groups, consisting of 12 mentors (faculty, post-docs, and doctoral students) and 9 mentees (undergraduate students).

**Initial Results**

Our first attempt to explore short-term, lab-based mentoring relationships through observation research encountered many obstacles and failures. Several identified shortcomings regarding what, when, and where we need to observe mentorship were revealed by our initial efforts. This was not the intended goal of this research, but resulted in valuable insights to assist moving forward. The overall emergent shortcomings included: 1) difficulties in capturing two hypothesized components – direction and support – in real time, 2) many interactions occurring outside of the lab space, and 3) additional influencers beyond the mentor.

**Difficulties in Capturing ‘Direction’ and ‘Support’ in Real Time**

The biggest shortcoming of our initial attempt was that the two constructs intended to be observed were not contextualized enough in this specific setting. The items for the observation protocol were generated relying on the Short-term, Lab-based Engineering Mentoring Guide [9] because such observations had not been undertaken previously. Many of the items were ended up not being appropriate for observing what was perceived as ‘direction’ or ‘support’ by mentees. The developed items failed to capture the interactions and/or behaviors that appropriately represent the mentees’ perceived support and direction, which consequently led to an inability to measure mentoring relationships.

This epic failure and research design flaw enabled the research team to learn about the needs of conceptualizing ‘direction’ and ‘support’ in short-term, lab-based REU settings, which we now view as a prerequisite to develop an effective observation protocol. This encouraged the research team to design an exploratory semi-structured interview to understand the mentees’ perceived ‘direction’ and ‘support’ in their REU experiences. Analysis of these interviews is in-progress and will ultimately be used in the development of a more robust observation protocol.

**Interactions Outside the Lab Space**
Another lesson learned was the need to understand the nature of lab experiments. Mentors and mentees are not always in the lab together nor does their time in the lab remain consistent throughout the REU program. It was observed that as time goes on, most interactions between mentors and mentees occurred outside of the lab space, including the mentors’ offices. Our initial attempt failed to consider the nuances of lab collaborative work resulting in the observer missing many of the interactions.

This epic failure helped the research team to take the nature of lab experiments into account for designing our future research plan. For example, a timeline is needed in advance of the REU program. The frequency of observation needs to be more frequent (e.g., once per day) rather than once per week to detect changes. All types of interactions, including face-to-face/verbal interactions and distance/non-verbal interactions should be observed.

**Additional Influencers**

The settings for these observations are important to note when situating the research. This is important even when the program is the same, but organized by different groups. In our setting, the REU summer programs were run by two different ERCs. We discovered that differences exist in terms of program structure (e.g., duration, schedule, and mentor-mentee paring system), mentoring education system, and type of experiments. We learned from this first attempt that such external variances greatly influence the mentoring relationships. For instance, if there were any events that the mentors and mentees could introduce and interact themselves prior to the beginning of the official ‘lab-day’, the interactions that delivered ‘support’ and ‘direction’ were already observed.

Existence of such additional influencers should be acknowledged before analyzing collected data. It is suggested that future iterations include such events in the research team’s observation plan. This implies the need of properly understanding the possible influencers that may have impact on the mentor’s plan. A practical recommendation is to ensure that consent and cooperation exist between the different stakeholders (e.g., mentors, mentees, PIs of each mentoring pair, educational directors, lab students not participating in the mentoring, etc.) to facilitate the observation and to share the data on additional influencers.

**Future Work**

The emerging and unexpected findings enabled the research team to learn the needs of characterizing the nature of mentoring relationships in short-term, lab-based experiences. A new model is needed to determine the appropriateness of observing ‘direction’ and ‘support’ as indicators. This model is in progress with potential additions addressing the shortcomings of our first attempt. Such additions include conceptualizing ‘direction’ and ‘support’ in the program settings to properly capture what we aim to observe, planning the observation schedule considering the nature of lab experiments, accounting for additional influencers to observe in an appropriate time and place, and determining the range of observation. The in-progress model and future iterations of this research will attempt to achieve the initial purpose of our research, which was to develop a sound assessment tool to observe mentoring relationships in short-term, lab-based settings. Our attempt enabled our failures to be ‘epic’ by gaining knowledge in a real-life environment, which resulted in valuable and practical advice for our overall research.
Reference


