STEM Career Exploration Database (CED?)

Introduction / background

STEM professionals are well compensated and highly in demand. Yet, the STEM training pipeline appears to be leaky. Many students who start out in pursuit of STEM degrees end up switching majors, or dropping out of college. Even STEM graduates often do not continue along a STEM track in pursuit of a STEM-related career. [add REF - expected job vacancies in STEM]. The issue of persistence is most particularly pronounced among traditionally underrepresented stakeholder groups in STEM. One of the high-impact practices that can promote STEM retention, of a broad cross section of students, in a STEM path is participation in an undergraduate research experience (URE). In UREs, students conduct research with a faculty mentor in the field in which they are studying, either during the academic year, or during the summer. There is a large - and growing - body of research describing the benefits of URE to students. Yet, the mechanism explaining how UREs generate positive outcomes is not well understood. Our goal is to understand how specific aspects of UREs are related to positive student outcomes. To achieve this goal, we are characterizing URE structure using theoretical framing from the domain of work psychology, with specific emphasis on the implications of job characteristic theory and the work design model. According to the work design model (Morgeson and Humphres, 2006), work can be characterized along four dimensions: task characteristics, knowledge characteristics, social characteristics and work context. In our project, URE participants will report on their experience in terms of these four dimensions, and on the perceived benefits of having participated. Participants will receive feedback on their responses, and encouraged to interact with the web-based exploration database to: 1) reflect on their research experience, 2) compare it to the experiences of other URE participants, 3) and to a sample of STEM-related occupations with attributes coinciding with students’ URE-anchored preferences drawn from professional occupational databases (O*NET).

The anticipated benefits of the project fall into three broad categories: benefits for individuals, benefits for society and benefits for our participants in our research group:

For individuals. Individuals pursuing a STEM-related degree will have the opportunity to explore a curated, comprehensive set of STEM-related occupations drawn from the Occupation Information Network (O*Net). O*Net is a free, online database that contains almost a thousand job definitions, designed to enhance students’ and job seekers’ understanding of the occupational landscape in the United States today. Systematic, curated exposure to the O*Net will help students currently pursuing STEM degrees to explore career options directly coinciding with their academic interests, to identify a subset of matching occupational tracks, and to find professional occupations they will find fulfilling based directly on their STEM-related preferences and interests.
For our research group. This research focuses on relationships between the structure of undergraduate research experiences (UREs) and a range of positive STEM-related outcomes. In this research we use a survey-based approach to collect data bearing both on students' research experience, as well as their preferences for various aspects of this research experience. We are developing a comprehensive STEM-occupational database to allow research participation to directly benefit from their participation by using their survey responses, and their preferences/likes/dislikes to explore a range of STEM-related career options. Importantly, because students will be able to access the interface being developed for this project again and again, they can engage in more refined occupational search as their research preferences and interests mature over time.

For society. Broad work-force involvement in STEM-related careers is recognized as a priority by a number of governmental agencies. The curated exposure to STEM-related occupations the process described in this proposal facilitates should systematically increase students' persistence in both STEM-related college degrees, and following graduation subsequent persistence toward and into STEM-related careers.

Methods (sources of data)

1. Self-reported survey data.
2. Professionals: self-reported survey OR students in seminar courses interview alumni or acquaintances about their current jobs.
3. Job titles and occupational descriptions drawn from O*NET.

Functionality

Users:
Student who completed a URE:

1. Participants will complete an online survey. The survey will capture the nature of participants’ experience in the URE or internship, and their preference for this experience. Participants’ responses will be “saved” and their individual results will be emailed to them and they will be asked to grant permission for their responses to be added to the database to create a student-normed archive. (addition to the database will require QC…admin, ?)

2. Students’ survey responses will be compared the the WDQ-aggregated URE profile of other research participants, providing students insight into the consistency between their own experiences and those of other URE participants. The reported benefits and outcomes associated with their URE experience also will be compared to the aggregate benefits and outcomes associated with URE profiles associated with the same STEM discipline, work setting (e.g., lab, field, computer, field-education) Students will gain insight into the consistency of their URE experience with contemporaries involved in similar research activities. Students will also gain insight into
the perceived benefits of contemporaries involved in similar activities, and the consistency of their own perceived benefits with those experienced by their contemporaries. This insight addresses three important questions that individuals: making the time, energy, and effort investment to participate in a URE are likely to have:

a) Was my URE experience typical or atypical relative to the normative experiences of similarly aged, similarly experienced cohort members participating in comparable UREs?
b) What kinds of outcomes and benefits do other student participants in UREs tend to have?
c) Were the outcomes and benefits that I experienced as a result of my participation in a URE similar to or distinct from the outcomes and benefits reported by others, and what were those similarities and differences?

3. Students will be able to compare their own WDQ-URE profile to the WDQ-URE profile of STEM professionals in their anchored discipline. This will allow them to address two important questions associated with STEM persistence.

a) How typical of the STEM-anchored occupational classification I’m potentially interested in pursuing was this URE experience?
b) What STEM-anchored occupational titles matched or coincided with my preferences following this research experience?

4. Students will be able to compare their own WDQ-URE profile to anchored occupational titles from O*NET, and through determination of this matched correspondence identify what occupations in O*NET have similar characteristics to what I experienced? Students will also be able to identify what occupations in O*NET have similar characteristics to the attributes of the URE that I most preferred.

5. Participation in this research will also facilitate curated evaluation and reflection: Following participation, research participants will be in position to consider several important questions. a) Which dimensions or aspects of their URE experience did they either most like or most dislike. In light of these preferences, what kinds of future work experiences are most likely to allow participants to be involved in similar kinds of activities?
b) Which aspects of their URE participation are likely to be most directly related to their future job satisfaction?

6. Participation will also allow students to create what can be characterized as an “ideal profile”. This would be accomplished to by modifying their current profile to incorporate students preferences, and identifying occupational matches for some aspects of the URE and weighting these aspects more heavily, while essentially mitigating others by weighting these aspects less heavily. Importantly, again, because participants can go through the process iteratively they can update their preferences following subsequent URE experiences to identify more occupational categories that align with their maturing and evolving preferences and experiences.
1. Complete the survey (WDQ-URE, specific context, ideally job code - but how?), save individual results, and grant (or not) permission to add their data to the database to facilitate generation of a normative baseline.
   (If the future: if measures of job satisfaction/benefits are easily obtained - add them - to allow for reflection and comparison?)
   Add qualifier: self-reported or from interview
   Go onto 3-6 above
   High school student or freshmen: considering internships or research experience or just future career: steps 5 and 6?

Data

1. Student experience: Individual profile of the experience in URE based on survey completed by individuals
   The survey has four sections:
   I. Characteristics of undergraduate research experience (URE)
   II. Work-Design Questionnaire (WDQ) for URE
   III. Outcomes of URE participation
   (IV. Demographic and institutional characteristics. - only use for research?)

2. STEM Professional background info and WDQ profile
   Background info includes: discipline, years of experience (? year BS, MS, PhD was earned and current year?), job title from O*NET, type of organization (industry - start up, small company, large company, academia: carnegie classification? Government agency?)

3. Job titles with a set of descriptors from O*NET database
   (Occupational Information Network job analysis database:
   https://www.dol.gov/agencies/eta/onet )

Mapping between O*NET descriptors and WDQ is here (Dan’s spreadsheet)

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Table: field /description details
[need to add]

WDQ:
Job Characteristics Profile based on WDQ: numeric score [None, 1-5?] for each of the categories below, average score based on 3-6 survey items
Task Characteristics
Autonomy
   Work Scheduling Autonomy
Decision-Making Autonomy
  Work-Methods Autonomy
Task Variety
Task Significance
Task Identity
Feedback from Job

**Knowledge Characteristics**
Job Complexity
Information Processing
Problem Solving
Skill Variety
Specialization

**Social Characteristics**
Social Support
Interdependence
  Initiated Interdependence (others depend on you)
  Received Interdependence (your work depends on others)
Interaction outside the Organization
Feedback from others

**Work Context**
Ergonomics
Physical Demands
Work Conditions
Equipment Use