Evidence-based pedagogical training for STEM Postdocs

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Project Rationale**:** Postdoctoral training is often viewed as a period of intense research training, during which scientists develop the independence required of academic faculty. Unfortunately, postdocs have few opportunities to develop the teaching skills that are also integral to faculty success. In this proposal, we seek to partially remedy this deficiency in postdoc training by designing and implementing a 6-session course in evidence-based educational practices for STEM postdocs. The adoption of evidence-based practices could improve retention rates for underrepresented groups in science when postdocs become course instructors. Moreover, the utilization of evidence-based mentorship practices among postdocs could improve research experiences for Stanford students.

Educational Aim 1**:** To design and implement an interactive 6-session course on evidence-based educational practices for STEM postdocs, comprising theory of learning, curricular design, active learning, classroom equity and diversity, assessment, and mentorship.

Educational Aim 2**:** To obtain detailed qualitative and quantitative feedback from enrollees on course effectiveness through questionnaires. We hope to submit our findings as a perspective or letter to the editor in a STEM education journal (*e.g., CBE-Life Sciences Education*).

Challenges: Many Stanford STEM postdocs work very long hours in the laboratory. A central challenge is designing sustainable and comprehensive pedagogical training for postdocs while achieving an appropriate balance of time efficiency and depth of training. Additionally, because no graduation requirements apply to postdocs and all participation is voluntary, it can be difficult to obtain continuity in attendance for postdoc training opportunities.

Our approach addresses these challenges in turn by 1) beginning the course with a day-long, expert-led symposium that will provide foundational material for all teaching sessions, enhancing continuity if postdocs must miss individual sessions, and 2) using a peer-led structure in the remaining sessions to obtain postdoc buy-in and dive in-depth into the STEM education research literature.

Aim 1 Approach: We will design an interactive teaching curriculum for Stanford STEM postdocs, comprised of several distinct pedagogical topics split into 6 sessions. Before the course begins, we will prepare by performing a thorough literature review of each topical area and curating materials for enrollees to critique as part of their class sessions (see topic list and corresponding course material in the itemized list below). We have secured commitments from Dr. Gloriana Trujillo of VPTL (Associate Director for STEM), Professor John Boothroyd (Associate Vice Provost for Graduate Education), Professor Susan McConnell (HHMI Professor of Biology and science communication expert), and Dr. Robin Colomb Sugiura of OPA (Associate Director of Programs) to serve as mentors in designing and organizing our educational material. We will provide our mentors with frequent written reports and course plans detailing our progress to ensure that we receive the best feedback available. We will advertise the course on campus and through OPA and enroll approximately 20 postdocs.

Our first session will be a day-long symposium covering the full range of teaching topics in the course. We will invite 3 Bay Area STEM education experts representing a range of teaching environments (*e.g.,* research universities and undergraduate-focused universities) to speak. This symposium will generate familiarity with recent research results in STEM education across

the core areas of the research literature that will be discussed throughout the course. We will ask our speakers to employ a range of different communication modalities, including panel discussions, Q&A, short teaching demos, and "think-pair-share" or clicker questions to stimulate interest and demonstrate various pedagogical techniques. To ensure that the material achieves a depth suitable for a postdoc audience, we will provide course participants with a thorough, written literature review of the areas of study in advance of class, which we will prepare during the course design phase.

Our five remaining 90-minute peer-led sessions will each focus on a distinct topic from the first day. Corresponding to each topic, postdocs will use the techniques they learn to critique specific teaching materials during our sessions (the type of material corresponding to each topic is shown in parentheses next to the topic in the list below). Groups of 3-4 enrolled postdocs will use and extend the materials we curate during the course design to lead each session.

1. Theory of learning and curricular design *(example lecture videos)*
2. Active learning *(critique active learning exercises, such as a POGIL assignment)*
3. Classroom equity and diversity *(hypothetical in-class scenarios)*
4. Assessment *(sample tests and assignments)*
5. Mentorship of student research projects *(critique enrollee ideas for mentored projects)*

Aim 2 Approach (work product, evaluation plan, and dissemination of results): While other courses with similar topical material exist elsewhere (*e.g.*, the University of Michigan's online course), we are not aware of other training opportunities for postdocs that focus primarily on 1) review of STEM education literature and 2) critical dissection of teaching materials using evidence-based teaching methodology. As such, we expect that STEM education professionals and researchers will be interested in our course design. We will collect detailed surveys from our participants about their experience in our course, and report our findings to a STEM education journal as a letter to the editor or perspective on postdoc pedagogical training.

Timeline

January-March 2017:

- January: curate materials, review literature, write learning objectives
- January-February: pick session 1 date, secure 3 speaker commitments by late February
- February: Provide draft syllabi, learning objectives, & course plan to mentorship team
- February-March: Design questionnaires. Incorporate mentor feedback. Advertise course.

April 2017: Session 1 symposium

April-June 2017**:** Peer-led bi-weekly sessions, collection of results/preparation of manuscript

Potential impact: Recent efforts at Stanford to improve pedagogical training for postdocs have revealed the eagerness of postdocs to become skilled teachers. However, resources currently available to postdocs are complementary to, and not competitive with, our proposal (*e.g.*, the postdoc pedagogy journal club, which is well subscribed but less thorough than our class, and the IRACDA training grant, which offers deep training but is only available to a very small number of postdoctoral fellows). Our project is in line with the program's funding objectives in that it will foster collaboration between STEM postdocs across disciplines, it will provide rigorous evidence-based pedagogical and diversity training, and it will help engender a sustainable community of postdoc teacher-scholars at Stanford.