Editorial: Focused Collection: Preparing and Supporting University Physics EducatorsRachel E. Scherr¹ and MacKenzie R. Stetzer²¹*Department of Physics, Seattle Pacific University, Seattle, Washington 98119, USA*²*Department of Physics and Astronomy and Maine Center for Research in STEM Education, University of Maine, Orono, Maine 04469, USA*DOI: [10.1103/PhysRevPhysEducRes.12.010002](https://doi.org/10.1103/PhysRevPhysEducRes.12.010002)**I. INTRODUCTION**

The goal of this Focused Collection is to highlight the current state of the field of physics education research as it relates to preparing and supporting physics educators at colleges and universities. Given the diversity of efforts in these areas, it is not surprising that the collected articles differ substantively in focus and context: professional development of undergraduate learning assistants (LAs) and graduate teaching assistants (TAs), faculty adoption and implementation of research-based instructional strategies and assessments, systemic change models, and informal learning environments. A wide range of research methodologies are also employed in the work showcased in the Collection.

This Focused Collection was approved by the PRST-PER editorial board in August 2013. The call for papers for the Collection was published in March 2014 [1]. Articles were not invited, though the guest editors did contact potential authors with expertise in these areas to encourage submissions. Prospective authors were asked to submit short proposals in May 2014. The 30 resulting proposals were reviewed by the guest editors and the journal editor or associate editor. Based on the proposals, authors were either invited to submit a full manuscript, invited to submit a full manuscript with specific reservations noted, or not invited to submit a full manuscript. The deadline for manuscript submissions was 28 November 2014. Thirteen full manuscripts were submitted. Each was evaluated through the standard PRST-PER peer-review process, with the guest editors consulting with the journal editors as needed. In a few cases, authors decided that they could not complete needed revisions in time for the focused collection. As a result, this Focused Collection includes 9 papers.

Papers in this Focused Collection fall into three distinct categories: research on the preparation and practices of graduate TAs, research on undergraduate LA programs, and research on instructional transformation at both faculty and institutional levels. In what follows, we situate the papers in this Focused Collection in the landscape of existing scholarship in that area. References to previous work are intended as a starting point and do not constitute a comprehensive review of the literature.

II. PREPARATION AND PRACTICES OF GRADUATE TAs

While there has been considerable research on the preparation and professional development of K-12 teachers in physics and other science disciplines, the extent to which the findings from this work translate to the context of graduate TAs in physics is an open question. In recent years, the physics education research community has established its own research base on graduate TAs in physics. Researchers at the University of Washington have regularly reported TA understanding of specific topics in physics in papers describing investigations of student understanding [2]. Researchers at the University of Maryland have characterized TA-student interactions [3] and investigated TAs' buy-in to reform instruction and beliefs about teaching and learning [4]. Koenig *et al.* have examined the relationship between TA practices and student learning [5]. Spike and Finkelstein have documented the effectiveness of a specific approach to TA preparation in helping TAs attend to student difficulties with content [6]. Research by Lin *et al.* has explored the extent to which TA beliefs about example solutions align with research-supported best practices in problem solving [7]. West, Paul, and colleagues have used a computerized real-time instructor observation tool to document substantial variation in instructor behaviors, suggesting that students in the same course are having significantly different course experiences [8].

In this Focused Collection, Spike and colleagues present a validated framework, TA-PIVOT (TA Practices In and Views of Teaching), for examining how physics teaching assistants talk about and engage in physics teaching [9]. Hinko and colleagues demonstrate that when university students and post-docs interact with children in after-school programs, they display three main pedagogical modalities: instruction, consultation, and participation [10].

III. UNDERGRADUATE LA PROGRAMS

The original Learning Assistant (LA) program, at the University of Colorado—Boulder, had multiple synergistic goals, including (1) improving student learning in undergraduate science courses via peer facilitation of student-centered instruction and (2) raising interest in

careers in K-12 teaching [11]. The program led to improved student learning in LA-supported courses and increased recruitment into certification programs for prospective science teachers [11]. The effectiveness of the LA model in physics was extensively documented in a 2010 article in the *American Journal of Physics* [12]. Numerous disciplines at numerous institutions now use LAs to support course transformation and physics teacher education efforts. Courses transformed with LAs are rich environments in which to conduct physics education research [13].

In this Focused Collection, Chini and colleagues describe Learning Assistants practicing physics pedagogy in a highly immersive mixed-reality classroom simulator [14]. Close and colleagues describe how participation in an LA program supports both stronger “physics student” identity and stronger “physics instructor” identity, and reconciles these into a coherent integrated physics identity [15].

IV. INSTRUCTIONAL TRANSFORMATION: FACULTY AND INSTITUTIONS

The preparation and support of university faculty as educators has been studied largely in the context of faculty adoption and adaptation of research-based instructional strategies (RBIS) in physics as well as the obstacles faculty encounter when attempting to transform their instructional practices [16]. Henderson, Dancy, and colleagues have so far led this research area. In this Focused Collection, Dancy and colleagues report that when adopting specific instructional strategies, faculty generally modify them, and may modify out essential components [17]. Turpen reports that faculty choose to use an especially popular instructional transformation (Peer Instruction [18]) because it is not lecture, and because they have had positive experiences with it [19]. Madsen and colleagues find that faculty are interested in using research-based assessments of their students’ learning but want practical help, community and expert advice, and comparisons to others’ results [20].

Faculty development is guided by departmental and institutional conditions, and departmental and institutional change supporting physics education has emerged as another area of physics education research. For example, Henderson, Beach, and Finkelstein have conducted an analytic review of the literature on the promotion of instructional change in STEM courses, in which they examined the effectiveness of four emergent categories of change strategies: “disseminating curriculum and pedagogy, developing reflective teachers, enacting policy, and

developing shared vision” [21]. In this Focused Collection, Khatri and colleagues claim that to effectively propagate instructional strategies, developers should interact with users during development and dissemination and support adopters [22]. Corbo and colleagues offer a research-based framework for promoting institutional change in higher education [23].

V. FUTURE DIRECTIONS

Given the many different research threads that are directly related to the theme of this Focused Collection, it is quite a challenge to make specific recommendations for (or predictions of) future work. At the same time, some long-term directions are clear. In the area of TA preparation and professional development, studies will continue to investigate the extent to which specific models of TA preparation lead to improved TA attitudes and practices as well as increased student learning. Given the multiple goals associated with undergraduate LA programs, future research will continue to explore the impacts of these programs on the learning and teaching of STEM at all levels, K-20+, and will likely also investigate the extent to which such programs help shape future STEM professionals in both industry and academia. In the area of instructional transformation, we anticipate that a continued, productive interaction between theoretical and experimental work will lead to the identification of more effective models for faculty professional development and for greater insight into the kinds of infrastructure, support, and resources that are required to support sustained instructional change at the college/university level. As the PER community continues to move in these directions, we believe that the papers showcased in this Focused Collection will play an important role in guiding future work.

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