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National Picture of Providers of Collegiate Professional Development for Teaching Mathematics: Formats, Topics, And Activities

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Teaching professional development (TPD) in collegiate mathematics has expanded over the last few decades. Providers of TPD, people who organize and facilitate professional learning about teaching, are at the center of this growth. Yet, little is known about who Providers are and what they do. To better understand the national landscape of Providers of TPD within university mathematics departments, this report shares data from a national survey where respondents were Providers. The focus here is on findings from survey questions asking about characteristics of Providers and the "providees" with whom they work, along with formats, topics, and activities used in TPD. Results suggest that Providers value active, learner-centered instructional methods promoted by research and policy. However, in the TPD itself, formats, topics, and activities commonly used by Providers may preach but not regularly practice activity-based methods.

Keywords: Professional Development Provider, Graduate Student Instructor, Teaching Assistant

Decades of research on undergraduate mathematics teaching, learning, and curriculum development have created an evidence-based foundation of resources for equitable teaching and effective learning. These resources include instructional materials, assessment tools, and practice guides for instructors (e.g., MAA, 2018; Carver et al., 2016; Garfunkel & Montgomery, 2019). However, getting implications from research into college mathematics classrooms remains a challenge (Archie et al., 2022; Pengelley & Sinha, 2019). Entry-level college mathematics classes are often taught by graduate students (about 35% [Blair et al., 2018, p.17]). In fact, 94% of graduate students will teach at some point. Graduate students can have a variety of instructional roles, from teaching assistant responsible for a lab or recitation session associated with a primary course where the instructor-of-record is a faculty member (LabTA) to a graduate student who is an instructor-of-record (GSI). Research indicates that college mathematics instructors (CMIs) in effective undergraduate programs, particularly novices, benefit from well-structured teaching-focused professional development (TPD) (Connolly et al., 2016; Friedlaender et al., 2014; Gehrtz et al., 2022). Those responsible for offering TPD to novice CMIs, including those who lead workshops, courses, and seminars as well as those who facilitate TPD as course coordinators, have come to be known as Providers of TPD (Braley & Bookman, 2022; Braley et al., 2023). Providers have a critical role within departments. However, little is known about who Providers are, what they provide, and how they provide it.

Context of the Study

In the U.S. there are 418 institutions granting a doctorate or master's as the highest mathematics degree and more than half have at least one Provider (some have three or more; American Mathematical Society, 2023; Braley & Bookman, 2022). This survey study was part of a larger project creating support for mathematics departments for designing teaching preparation

programs for graduate students. One step in the project was gathering baseline data for understanding the current status of post-secondary mathematics TPD. Among the 200 people who responded to the survey, 95 completed all aspects of it. This report uses analysis of those 95 full responses from 56 institutions. The focus is addressing two questions:

RQ1: (Who) Who are the Providers and who does their TPD target?

RQ2: (What) What formats, topics, and activities do Providers use in their TPD?

Related Literature

Understanding what Providers provide is critical at this time in undergraduate mathematics education because the field has reached a critical mass of policy and resources for TPD. In 2018, the Mathematical Association of America (MAA) released the *Instructional Practices Guide* (IPG), a report on recommended teaching practices in undergraduate mathematics. The guide summarizes the evidence-base on effective methods of instruction and promotes student-centered classroom-active methods as an expectation of and for the field. Moreover, multiple calls to include inquiry-based mathematics education (Laursen & Rasmussen, 2019) and active learning methods (Braun, et al., 2017) have been on the forefront of suggestions for TPD. Concurrently, a central resource for Providers has been developed by the College Mathematics Instructor Development Source (CoMInDS) project with hundreds of documents from and for Providers in an online repository and well-established networks of people to share resources (MAA, 2020). Also, recent projects such as *Student Engagement in Mathematics through an Institutional Network for Active Learning* (SEMINAL; Gobstein, 2016) have expanded use of collaborative learning methods through active-learning for Providers.

A study by the CoMInDS project found there is a great desire, but a struggle by department leaders to make sense of resources for their institutions (Bookman & Murphy, 2019). There is a clear need for guidelines for preparing LabTAs and GSIs. However, there is a reasonable concern: institutions vary in structure and resources in ways that are consequential for graduate student TPD. Thus, localized support–as through the work of Providers–is needed to demonstrate the impact and viability of such evidence-based research.

Prior research has identified the value of TPD for graduate students and its impact on teaching and learning, from course pass rates to level and frequency of complaints by undergraduates, to improvements in responsiveness and inclusivity (Hauk & Speer, 2023, Yee et al., 2023; Yee & Rogers 2022 and references therein). There is a gap in the research about both what and how TPD is provided (Hauk, et al., 2017). To address the gap, this survey study leveraged and revised some approaches used to examine secondary teacher preparation (Yee, Otten, & Taylor, 2018) to gather baseline data on current collegiate mathematics TPD.

Methods

Quantitative methods were used to analyze the survey data to determine who Providers are, what they provide, and how they provide it. Using multiple national listservs to contact Providers (e.g., CoMInDS, SEMINAL, RUME), a Qualtrics survey (vetted by an Advisory Board and Expert Providers) was sent out to more than 500 potential Providers across the United States. Among the 95 who responded to all the items (participants), 80% were from mathematics doctoral-granting institutions and 20% from masters-granting institutions. To answer the research questions, responses to five survey items were analyzed: (1) Who was the Provider, (2) Who was the main group the Provider worked with, (3) Which formats were used for TPD, (4) Which topics were discussed in the TPD, and (5) Which activities were used in the TPD. The

"Who" survey questions required a single selection. The "Formats," "Topics," and "Activities" questions were checkboxes, where more than one could be selected. Options offered on the survey were based on prior research on formats, topics, and activities prevalent across the United States (Bookman & Braley, 2014; Braley et al., 2023; MAA 2018, 2020) and interviews with Expert Providers conducted as part of the larger project. In what follows, descriptive statistics are used to describe the Providers and providees, while matrix-like "Upset" plots are used for combinations of checkboxes.

Findings

As indicated in Table 1 and Yee and colleagues (2023), 80% reported being either non-tenure-line Teaching Faculty (42%) or tenure-track faculty (38%). Thus, non-tenure-line teaching faculty have about as much responsibility for supporting graduate student's learning about teaching as do tenure-line faculty. The majority of Providers being teaching faculty suggests care is needed in future work examining questions around a Provider's role in the department. Also, more than 80% reported a focus on graduate students – including graduate students who are teaching assistants (42%), instructor-of-record (34%), or both (9%).

Table 1. Who: Providers and providees

The **faculty position** you hold		The **main group** served by professional development about teaching in your department	
Teaching Faculty (not tenure-line)	42%	LabTA	42%
Tenure-line Research Faculty	35%	GSI	34%
Tenure-line Teaching Faculty	3%	Novice Faculty	8%
Part-time or Adjunct Faculty	3%	Undergrad. Learning Assistant	1%
Other: chair (7%), time-limited full-time/post-doc position (10%)	17%	*Other*: both LabTA & GSI (10%), post-doc (3%), faculty (2%)	15%

Format

Providers indicated their use of seven different formats (six were described, the seventh was "other" and had room for the respondent to describe it). As indicated in Figure 1 (next page), a majority of participants selected some combination of three of the six formats:

(1) pre-semester orientation (bottom horizontal bar, 79 responses),
(2) meeting with a course coordinator (67 responses), and
(3) offering a single course about teaching (45 responses).

The right side of the "Upset diagram" in Figure 1 illustrates the connections among format co-selections. Most respondents selected two or more of the three most frequently selected formats. Among the 15 respondents choosing "other" as a format, mentoring and coaching (3) and weekly meetings (2) were the most common responses.

It is worthwhile to note that very few Providers selected only "one seminar or workshop" with most selecting other formats as well. Moreover, only one respondent had only pre-semester orientation and only one respondent had only meetings with coordinators. This echoes results from the CoMInDS surveys that the field as a whole is using multiple formats for TPD over longer periods of time with an increasing frequency of course-like structures (Bookman & Braley, 2014; Braley & Bookman, 2022; Braley et al., 2023). Indeed, any combination selected

by five or more respondents included meetings with coordinators, a course, multiple seminars, or multiple courses to complement a pre-semester orientation.

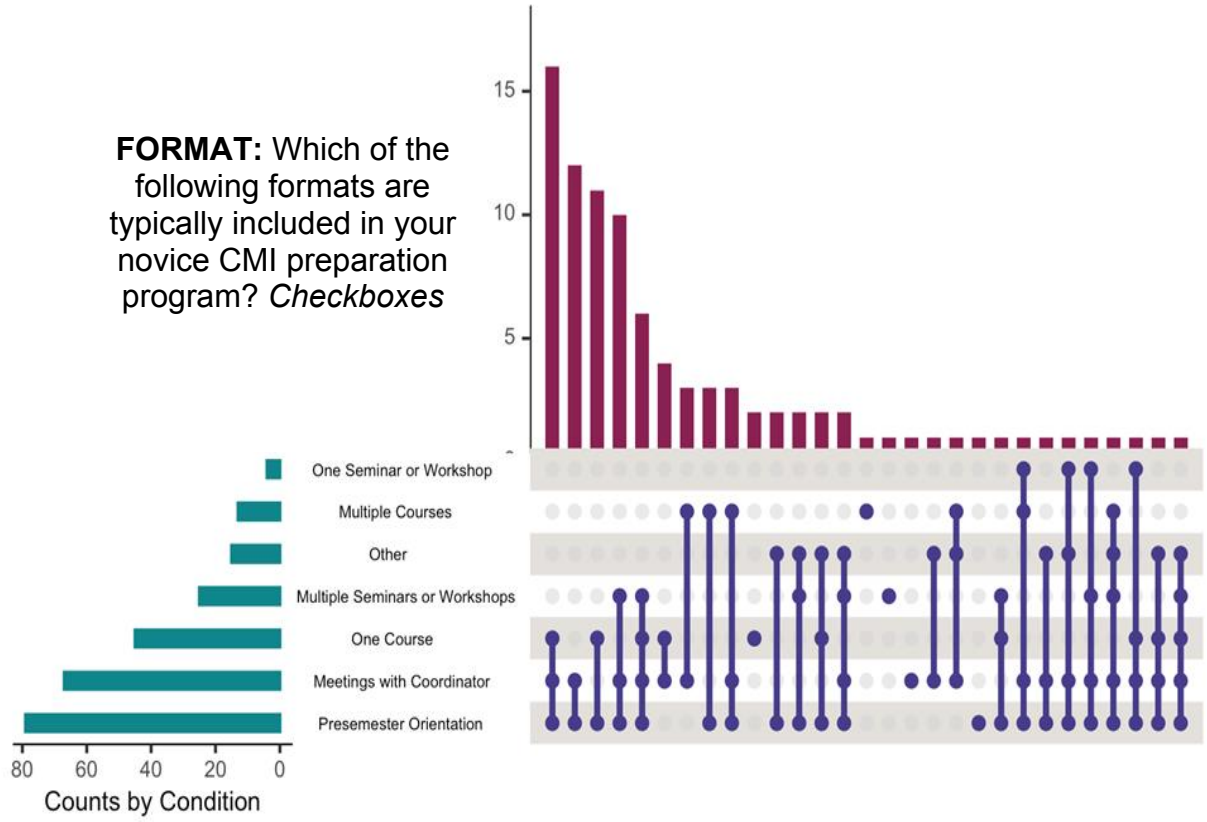

Figure 1. Formats of TPD reported by Providers.

Topics

Providers indicated their use of eight different topics (seven were described, the eighth was "other" and had room for the respondent to describe it). As illustrated in Figure 2 (next page), in order of frequency these were:

(1) university and departmental policies (90) chosen by nearly all participants,
(2) active learning (78),
(3) learning management systems such as Canvas (63),
(4) grading strategies (58),
(5) formative assessment (53).

Twenty respondents described other topics, including particular teaching techniques, (e.g., lecturing was written in by 4), student-centered teaching (3), and equitable practices (2).

A majority selected topics aligned with the topics suggested in the IPG (MAA, 2018). Combinations of topics among more than three respondents had many of the five most popular topics (policies, active learning, learning management systems, grading strategies, and formative assessment). Notable is the pattern of exclusion for two topics: generally, those who did not select active learning also did not select formative assessment. A majority selected five of the seven possible choices, with IBL the least commonly selected.

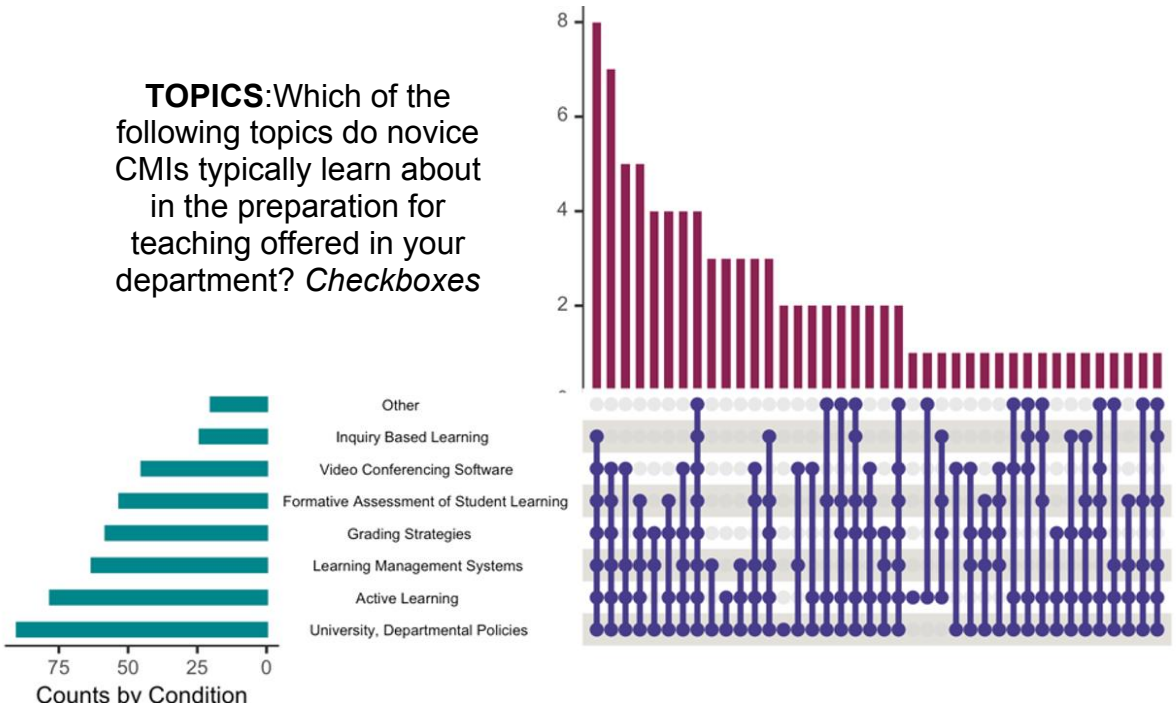

Figure 2. Topics in TPD reported by Providers.

Activities

As seen in Figure 3, (next page) the most frequently selected activities were:

(1) listen to presenters (74),
(2) discuss example cases of teaching and learning (69),
(3) read provided articles or other information (64),
(4) present a practice lecture (59), and
(5) practice assessing a student assignment (52).

Despite the knowledge in the field of the value of student-centered instruction, "listen to presenter" was chosen alongside "discussion of example cases" by more than half of respondents (52). The 30 responses about "other activities" included peer and instructor observations (6), collaborative learning (e.g., about facilitating discussions and writing lesson plans; 6), practice with teaching (e.g. "mini-lecture," "co-teaching"; 5). Six respondents only included "other" activities and did not select any of the seven given types of activity suggested as effective by the literature. Finally, it is worth noting that the most common combinations *excluded* developing a course website or delivering a non-lecture-based practice lesson.

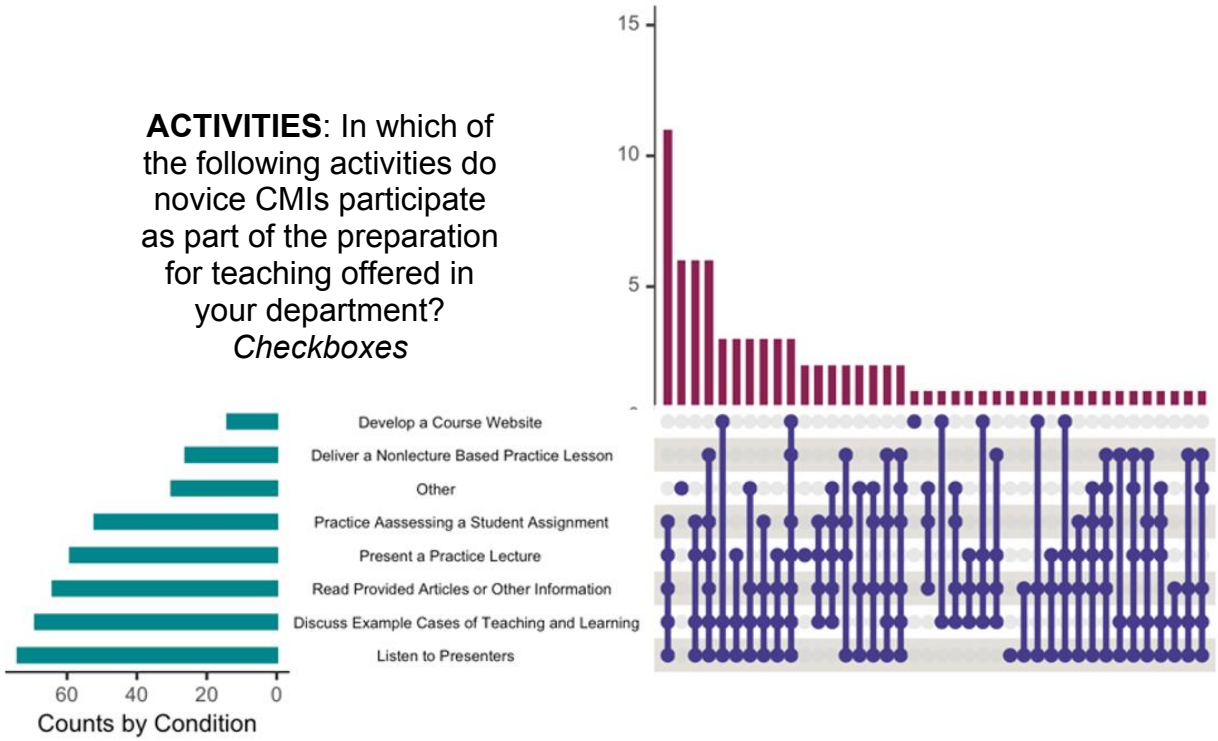

Figure 3. Activities in TPD reported by Providers

Comparative Analysis with Providers and Providees

Given that Providers were teaching faculty (42%) or research faculty (35%) and providees were split between GSIs and LabTAs, analysis included examination of variation in Formats, Topics, and Activities depending on faculty role and whether providees were GSIs or LabTAs. Analysis of Variance indicated there were no significant or practical differences in formats among Provider type (teaching versus research faculty). Additionally, there were no differences larger than 5% among activities, and only one difference among topics around video conferencing software. The existing slight differences follow from preferences of meeting the needs of particular providees. For example, pre-semester orientation was 10 percentage points higher as a format for Providers focusing on LabTAs instead of GSIs (37% vs. 27%). This coincided with one course being more commonly used when providees were GSIs (23% versus 15%). GSI-focused Providers chose coordinator meetings more than LabTA-focused (29% vs. 22%).

Conclusion and Discussion

The purpose of this study was to learn more about (1) Who Providers and their target TPD audiences are (2) What formats, topics, and activities Providers use in their TPD. Information on the first question suggests most Providers were as likely to self-identify as teaching faculty as they are as research faculty (~45% and 35% respectively) with the balance of Providers reporting roles as adjunct or time-limited faculty (e.g., postdoc). The target audiences (the "providees") for most respondents (~86%) were LabTAs and/or GSIs, with novice faculty indicated by fewer than 10% of respondents and undergraduate learning assistants by only 1%. The results from this study suggest that graduate students are the primary focus for most Providers of TPD in doctoral- and masters-granting departments.

What Providers provide in TPD was explored in terms of the formats, topics, and activities reported. Three *formats* of TPD were the most popular with the combination of these three also being the most commonly indicated by respondents: pre-semester orientation, course coordination, and a single course about teaching college mathematics. This supports Hauk and Speer's (2023) work that most doctoral and master's programs have multiple structures available to help novice instructors. The most frequently selected *topics* for TPD were university and departmental policies, active learning, learning management systems, and grading policies. A majority of respondents asserted these four topics were part of their department's TPD offerings. Inquiry-based learning was the least frequently chosen. The *activities* Providers reported using in TPD were most frequently listening to presenters and discussions of teaching examples, followed by reading/discussing articles. The Upset graph in Figure 3 showed how a majority of respondents had a combination of at least two of these three activities.

Implications and Impact

The finding that active learning was reported as a dominant topic, but not a part of TPD activity itself is worth exploring in further research. Do Providers practice what they preach? For example, activity-based learning about teaching such as "practice assessing a student assignment" or "practice a lecture" or "practice a non-lecture activity" might be expected to be more frequently reported than they were if active learning *in TPD* was highly valued. The field of college mathematics TPD is still striving to implement evidence-based teaching practices in a way that is meaningful for instructors and meaningful for TPD itself. Just as student-centered classrooms focus on student involvement and engagement, TPD can productively focus on novice instructor/LabTA/GSI involvement and engagement (in addition to listening and reading). More broadly, this indicates a need for assessment of the effectiveness of TPD. Such assessment would provide indicators and standards for the ways in which TPD is accomplishing intended goals for instructional development (Hauk & Speer, 2023; MAA 2020).

Limitations and Future Studies

Limitations of this study include the fact that this study's sample provides a national picture rather than a more granular understanding of the program. For example, this study collected survey data where respondents chose what they did according to our pre-defined categories. Although this gave us a broad national picture, it limits the understanding of how specific activities are enacted for each topic. For example, for the selection "reading articles" within the survey did not gather information on what occurred after the reading of the articles. Current projects are underway to better understand exemplar programs (Yee et al., 2022), and future studies could use the results of this study to further detail how U.S. mathematics departments implement activities within topics and within formats of TPD.

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