Longitudinal Study of
FUTURE STEM SCHOLARS

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Key Points

In this research brief, we present the Pyramid Framework for Designing Effective Teaching Development Programs. We describe five major components of the Framework, which consist of ***people, content, process, context,*** and ***outcomes and impacts.*** We also provide two practical applications of the Framework.

LSFSS Study

The Longitudinal Study of Future STEM Scholars is exploring the short- and long-term impact of teaching-focused professional development on STEM doctoral students and early-career academics. Since 2009, the study is using repeated surveys and interviews to follow an initial cohort of 3,060 late stage doctoral students.

Essential Elements of Teaching Development Design[1]

In *LSFSS Brief* no. 2, we described 12 core features that can be used to classify teaching development (TD) programs for doctoral students and postdocs. We suggested that TD practitioners could use these features, such as funding, audience, duration, and content focus, to describe and compare TD programs, to improve programs, and to make strategic decisions regarding the use of campus resources to support doctoral student and postdoc teaching development.

There is a major difference, however, between *describing* TD programs and discussing what makes them more or less *effective*. Because the 12 core features are intended to holistically and neutrally describe a program's key features, we have developed a conceptual framework of TD design features related to program effectiveness that are based upon our work in the LSFSS and the literature on teaching professional development.[2] Specifically, we propose the Pyramid Framework for Designing Effective Teaching Development Programs. We argue that the TD design features in the pyramid framework may increase the likelihood of attaining important program learning outcomes.[3]

[1] This brief is based on the following conference paper: Barger, S., Connolly, M.R., & Savoy, J.N. (2010). *A model of highly effective teaching-focused professional development programs.* Paper presented at the annual meeting of the American Educational Research Association, Denver, CO.

[2] For example, see: (1) Guskey, T. R. (2000). *Evaluating professional development.* Thousand Oaks, CA: Corwin Press. (2) Desimone, L. M. (2009). Improving impact studies of teachers' professional development: toward better conceptualization and measures. *Educational Researcher, 38*(3), 181-199. (3) Border, L. L. B. (2006). Two inventories for best practice in graduate student development. *Journal on Excellence in College Teaching, 17* (1&2), 277-310.'

[3] To date, these features have not been not been measured empirically. We recommend that future work explore TD program effectiveness using our framework as a conceptual model.

Doctoral students learn about college teaching through both formal and informal ways. For the purposes of the LSFSS, we consider only formal TD programs. We define formal TD programs as workshops, seminars, courses, and other structured experiences for doctoral students created and implemented by a formal campus unit (e.g., department, graduate school, etc.) to train doctoral students as effective teachers for future academic careers. Although TD programs vary considerably, our framework can be applied to any type of TD program because the framework helps TD facilitators consider multiple programmatic factors. Thus, our approach to TD design can cover activities ranging from short one-hour workshops to intensive, multi-semester offerings.

Below, we describe the elements of the pyramid framework and then demonstrate how it can be used to design a new program and evaluate and improve existing programs.

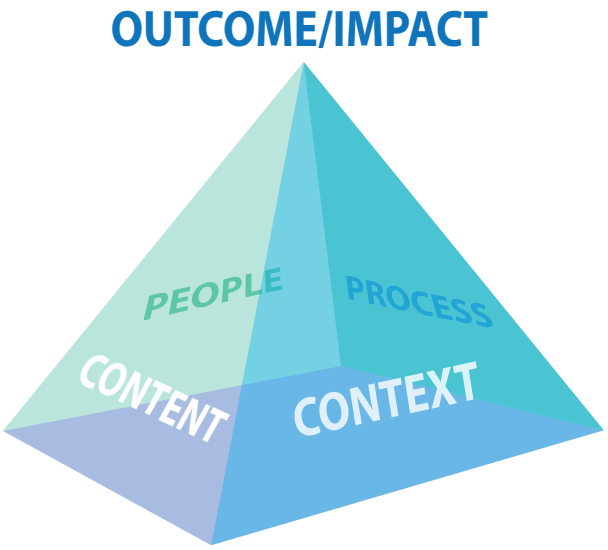
The Pyramid Framework for Designing Effective Teaching Development Programs

Apart from the LSFSS, there is limited large-scale research on TD programs and how they influence doctoral students' teaching development. Without the benefit of prior research, assessing the impact of TD programs requires the identification of key program features and their relationship to student outcomes.

Our first step in investigating key program features of TD programs was to construct a descriptive classification of TD programs (as described *LSFSS Brief* no. 2). Next, we examined TD programs as student learning experiences, drawing upon our classification scheme and a long tradition of scholarship related to course design and student learning.

Specifically, we approached TD program design from the perspective of *curriculum development,* which considers how learners, teachers, content, teaching methods, context, and learning outcomes interact in an effective learning environment.[4] The benefit of a curriculum development approach is that it includes the 12 core features of TD programs plus additional traits that contribute to effective program functioning. Below, we describe our Pyramid Framework for Designing Effective TD Programs, which is organized by five important themes: ***people, content, process, context,*** and ***outcomes and impacts.***

FIGURE #1: THE PYRAMID FRAMEWORK FOR DESIGNING EFFECTIVE TD PROGRAMS



Our framework is represented by a pyramid; the sides consist of the programmatic categories of ***people, content, process***, and ***context*** (see Figure 1). These four components then work collectively to support intended outcomes, represented by the pyramid's apex. If one or more of the pyramid's sides is absent or weakened, the pyramid loses its structural stability. In addition, if the outcomes of a program are not well

[4] Lattuca, L. R., & Stark, J. S. (2009). *Shaping the college curriculum: Academic plans in context.* (2nd ed.) San Francisco, CA: Jossey-Bass.

articulated, the base and sides of the pyramid may not coordinate towards common outcomes, which could further weaken the pyramid. Thus, a successful and structurally sound TD program should account for the following five categories:

1. People

From a curriculum development perspective, TD facilitators should carefully consider how the characteristics of both ***learners*** and ***instructors*** affect learning experiences. In the case of learners, TD facilitators should consider learners' motivations, learning goals, backgrounds, and prior understanding of teaching and learning to customize programs to better meet student learning needs.

Likewise, TD facilitators should recognize that instructors of TD programs influence learning not only through their content expertise, but also through other attributes, such as their prior teaching experience, use of effective pedagogical practices, commitment to inclusive student learning environments, familiarity with scholarly literature (e.g., content knowledge, pedagogy, student learning assessment), and practical knowledge as instructors.

An effective, ***learner-centered*** TD program may have the following attributes:

- Considers participants' goals, motivation, background, and prior knowledge of teaching and learning into program design and delivery.
- Employs committed instructors experienced in practical and scholarly aspects of teaching and learning.

2. Content

Content refers to the program's focus on professional knowledge, skills, and attitudes that are the basis of high quality teaching and learning. Content areas that TD programs typically cover include learning environments, course design, instructional practices (e. g., active and collaborative learning), supporting diverse learners, assessment and student learning improvement, instructional technology, and how other faculty responsibilities relate to teaching duties.

*The categories of **people, content, process,** and **context** are the foundation of an effective TD program and collectively support its intended outcomes.*

Beyond general teaching skills, the content of TD programs may also need to reflect the best teaching practices of particular disciplines. For example, biology education and engineering education involve similar yet different pedagogical strategies due to the specific content for each discipline.[5]

An effective TD program that takes into account ***content*** may have the following attributes:

- Addresses one or more key teaching and learning content areas.
- Clearly articulates the desired professional knowledge, skills, and attitudes that will be addressed by the content of the program.
- Considers disciplinary contexts.

3. Process

Process refers to two types of programmatic elements. The first, ***logistics,*** includes program format (i.e. in-person, online, hybrid), scope (which institutional units are involved), duration (program length), engagement (hours expected of participants),

[5] For example, see the following disciplinary STEM teaching and learning publications: (a) *CBE-Life Sciences Education,* (b) *Journal of Chemical Education,* (c) *Journal of Engineering Education,* and (d) *The Physics Teacher.* See also: (1) Singer, S. R., Nielson, N. R., & Schweingruber, H.A. (eds.) (2012). *Discipline-based education research: Understanding and improving learning in undergraduate science and engineering.* Washington, D.C.: National Research Council. (2) Gess-Newsome, J. (1999). Pedagogical content knowledge: An introduction and orientation. In J. Gess-Newsome and N. G. Lederman (Eds.), *Examining pedagogical content knowledge* (pp. 3-17). Dordrecht, The Netherlands: Kluwer Academic.

and selectivity (open to all or restricted access).[6] To achieve a program's intended purpose, TD facilitators must carefully plan how long an offering will last, what type of time commitment it will require, and so on. They must align each logistical component with other categories of the framework so as to support, not hinder, programmatic experiences and outcomes.

The second element, ***delivery***, consists of three things: the design of student learning experiences, the use of research-based instructional practices (i.e., instructional strategies that have been shown through empirical research to improve student learning), and formative and summative assessment of student learning. In short, delivery is comprised of key pedagogical decisions within the structural and logistical aspects of programmatic functioning. Such decisions must be closely aligned with what the program is trying to accomplish (i.e., its content) and should consider disciplinary context, since some teaching techniques are not universally effective.

An effective TD program that attends to ***process*** may have the following attributes:

- Addresses student learning needs and content focus by selecting an appropriate program format.
- Promotes student engagement, learning, and collaborative participation through thoughtful planning and research-based instructional practices within a defined disciplinary context.
- Uses formative and summative evaluation to enhance student learning and continuously improve the program.

4. Context

Context relates to environmental variables that could influence the people, content, processes, or outcomes of TD programs. There are five aspects of context that are particularly relevant to designing TD programs. As discussed above, ***disciplinary setting*** refers to the specific attributes of the discipline or disciplines of potential participants and how they may influence the planning, execution, and evaluation of TD programs. ***External support*** includes, among other things, funding, policy, and disciplinary commitment to improved teaching practices. ***Institutional support*** is how strongly key campus units (e.g., the president's office, departments) and stakeholders (e.g., department chairs, faculty) support and advocate for improved pedagogical practices. ***Historical context*** relates to the history of the program and how it shapes or affects current TD programming. Lastly, ***coherence*** refers to the degree that a TD program is aligned with, not orthogonal to, doctoral education and local and national attempts to advance teaching and learning.

An effective TD program that addresses contextual issues may have the following attributes:

- Addresses the unique needs of disciplinary context.
- Receives sufficient support from external and internal constituents in the form of policies, funding, and resources.
- Campus stakeholders (e.g., department chairs, faculty, graduate deans, etc.) value the program and demonstrate that value through support, advocacy, etc.
- Uses the history of the program to build on prior successes and overcome barriers.
- Aligns not only with traditional doctoral education but also with other teaching improvement efforts across campus.

5. Outcomes and Impacts

TD program ***outcomes*** for doctoral students are divided into three categories. First, TD participants increase their general and discipline-specific ***knowledge*** of teaching and learning topics and how to use effective pedagogical techniques. Second, they ***apply*** teaching knowledge and skills during doctoral

[6] See *LSFSS Brief* no. 2 for a detailed description of logistics features.

TD facilitators can use the pyramid framework to continuously evaluate and improve TD programs.

teaching experiences and as early career academics. Third, they change their ***attitudes***—their beliefs, values, and priorities—regarding teaching.

In addition to their effect on program participants, TD programs may also affect their institutions. First, TD programs may lead to the formation of ***learning communities*** among graduate students or between graduate students and faculty, since TD programs can connect like-minded peers interested in improved teaching within a discipline, across campus and between campuses. Second, TD programs may influence organizational ***culture***—the beliefs, norms, and actions of people in an organization—by increasing the value of teaching and learning among graduate students, faculty, and administrators. Lastly, TD programs could impact the degree of ***coherence*** across teaching professional development opportunities and doctoral programs.

An effective TD program might consider the following ***participant outcomes:***

- TD participants acquire general and discipline-specific knowledge and become aware of teaching and learning issues and research-based instructional practices.
- TD participants develop their teaching knowledge and skills by applying them in authentic teaching experiences.
- TD participants examine current attitudes, values, and priorities and possibly adopt new ones (e.g., placing a greater value on high-quality undergraduate teaching and learning).

An effective TD program might also consider the following ***institutional impacts:***

- Learning communities of individuals dedicated to improved teaching are formed and sustained within and across departments.
- Faculty, doctoral students, postdocs, and administrators take teaching more seriously.
- The TD program contributes to the connectivity between other teaching development offerings on campus.

Putting the Pyramid Framework to Work

Design New TD Programs

TD designers can use the pyramid framework as a blueprint for a new program. Designers might use the Framework to (1) define their target audience of intended learners and their teaching development needs, (2) articulate the content focus of the program, (3) develop desired learning outcomes and potential institutional impacts, (4) decide on program logistics and a delivery strategy, and lastly, (5) determine how contextual factors could influence the program.

Evaluate and Improve TD Programs

TD facilitators can also use each of the five categories of the pyramid framework and their attributes to identify areas of improvement for existing programs. In this section, we will present example rubrics that demonstrate the ways in which the pyramid framework can be used to evaluate and improve TD programs (See Table 1 & 2).

Applying the framework may reveal that a program has not taken into account participants' goals, interests, or prior experience in TD. Or, TD facilitators may find that a program does a great job of using questionnaires to assess participants' satisfaction, but overlooks other forms of program impact, such as whether participants apply teaching skills in real-world situations. Each of these examples implies a limitation that could be rectified through improved design.

TABLE #1: RUBRIC TYPE 1

Example Program Title	Learning to Teach: A Course on Effective Pedagogy			
Program Attribute	**Strong**	**Adequate**	**Poor**	**Comments**
Considers participants' goals, motivations, backgrounds, and prior knowledge of teaching and learning into program design and delivery.			X	We do not ask what students want from the course and what they already know. Our approach is to offer generic teaching and learning skills without first figuring out what our students want or need. Some of this information comes out naturally during the course but there is no way to record and review this information for future versions of the course. One possible solution would be to do a short survey of our students at the very beginning of the course and then make revisions.

TABLE #1: RUBRIC TYPE 2

Example Program Title	Learning to Teach: A Course on Effective Pedagogy.		
Program Attribute	**Progress**	**Evidence**	**Improvement**
Clearly articulates the desired professional knowledge, skills, and attitudes that will be addressed by the content of the program.	We currently have a detailed syllabus with clear learning outcomes. We also review the syllabus, learning outcomes, and content of the course with our students on the first day. However, we have 32 learning outcomes and students complain that there are too many and they are often redundant. In addition, the instructors have mentioned how they have a hard time accomplishing all 32 by the end of the course.	1. We have received informal student comments (good and bad) in class and through the course management system. 2. Instructors have commented that they are rarely ever able to accomplish all 32 outcomes. 3. In course evaluations, students have mentioned issues with the number of outcomes and that they are often redundant.	Improvement ideas: 1. Condense and revise the learning outcomes by taking into account learner needs and the time available for the course. 2. Talk with students informally during a class meeting to get their take on the content and learning outcomes.

To evaluate TD programs, TD facilitators can use the pyramid framework to develop an evaluation rubric. For instance, one possible rubric could consist of key program attributes in the first column of a grid. The attributes would be based upon the ideal attributes noted above. TD facilitators can customize the rubric to match unique disciplinary, institutional and programmatic contexts.

Next, TD evaluators can decide the scale on the scale they will use to describe programmatic effectiveness for each ideal program attribute. For example, they may use scales such as high, medium, and low or strong, adequate, and poor. We encourage the reader to select a scale that (a) has distinct and mutually exclusive categories, (2) does not have too many categories (we recommend between 3-5), and (c) is meaningful and useful to the user in capturing the current state of any given program.

Once a scale is selected, TD evaluators can go through each item and mark the scale accordingly. We recommend that TD evaluators create an additional column to add comments on why they selected the scale item, evidence they have for their selection, and any other relevant information that may aid programmatic improvement (see Table 1).

TD facilitators can also create a rubric without scales by utilizing three columns. In the first column, the TD professional describes how well a program meets the proposed ideal for each row. In the second column, they describe what evidence they used to make their observation. Lastly, in the third column, they describe ways to improve the program as well as evidence they would need to measure success[7] (see Table 2).

Conclusion

The pyramid framework is a useful tool for designing TD programs and guiding evaluation efforts. By paying close attention to ***people, content, process, context,*** and ***outcomes and impacts,*** TD designers and evaluators will be able to strengthen their existing programs and design new programs that will help doctoral students seeking academic positions develop strong pedagogical knowledge, skills, habits, and values.

[7] For additional examples of programmatic evaluation, see Border, 2006.

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AUTHORS

Lucas Hill, Assistant Researcher, Michigan State University

Mark R. Connolly (Principal Investigator), Associate Research Scientist, Wisconsin Center for Education Research (WCER) at the University of Wisconsin–Madison

Julia N. Savoy, Assistant Researcher, WCER, UW–Madison

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FOR MORE INFORMATION ABOUT THIS STUDY

Dr. Mark R. Connolly
Wisconsin Center for Education Research
University of Wisconsin–Madison
570A Education Sciences Building
1025 W. Johnson St., Madison, WI 53706-1706
mrconnolly@wisc.edu ~ (608) 263-4233
Project Website: lsfss.wceruw.org

Wisconsin Center for Education Research
SCHOOL OF EDUCATION
UNIVERSITY OF WISCONSIN–MADISON