



In vigorating Statistics and Data Science
Teaching through Professional Learning

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A major goal of the InSTEP project is to support teachers' growth in knowledge and confidence to create effective statistical and data learning environments, classrooms where all students are learning about important statistical and data ideas and engaging in key practices and processes to make sense of data. The InSTEP project provides a scalable, accessible, and flexible approach that is aligned with research-based principles of effective professional learning. Our development uses design principles for online teacher learning, and our materials are based on research on students' and teachers' learning in statistics and data science education. Throughout our materials we use videos for a variety of purposes to support teachers' learning.

We have two models for providing online professional learning for mathematics teachers to develop their understandings and skills related to teaching statistics and data science.

Model 1: Our primary model for personalized learning

InSTEP is developing an online professional learning platform and materials for **In vigorating Statistics and Data Science Teaching Through Professional Learning**. The InSTEP platform and learning experience is designed to allow teachers to:

- Personalize learning to meet their professional needs through customized recommendations and collaborative spaces.
- Build skills in data investigations and innovative teaching approaches based on practices of data professionals and research on students' learning with data.
- Expand their professional collection of resources and technology vetted by experts in statistics and data science education.

See <http://instepwithdata.org>.

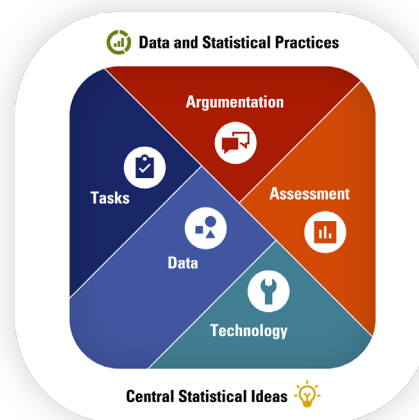
Our approach is grounded in authentic, active, and collaborative professional learning activities. The approach builds upon the following research-based design principles for teacher learning (e.g., Guo, Kim, & Rubin, 2014; Kleiman, Wolf, & Frye, 2015; Mayer & Moreno, 2003):

1. **Self-directed, job-connected, personalized learning** to enable teachers to focus their time and attention on what they will find most valuable, whether they want to learn more about developing pedagogical strategies for using an investigative process or try data investigations themselves with online technology tools.
2. **Multiple perspectives** including opportunities to learn from a variety of experts in statistics education, experienced teachers, and state and district leaders. Video resources not only focus on discussions with these educators but include videos featuring students and teachers in classrooms.
3. **Peer-supported learning** to enable teachers to learn from one another and to share ideas, questions, and experiences with online colleagues.

4. **Anywhere, anytime learning** so that teachers can use this professional learning experience as they plan to teach statistics and data science and continue their learning as they go without time-bound constraints of access.
5. **Integrate Multimedia** so that teachers can learn through diagrams, data visualization tools, videos, and audio.
6. **Organize with Framework** so that teachers' learning experiences are connected to a larger purpose for improving teaching of statistics and data science.

Organizational Framework

A major goal of the InSTEP project is to support teachers' growth in knowledge and confidence to create effective statistical and data learning environments, classrooms where all students are learning about important statistical and data ideas and engaging in key practices and processes to make sense of data. Central to our approach is building teachers' expertise in understanding **interrelated dimensions of statistics and data learning environments** (Ben-Zvi et al., 2018; Garfield & Ben-Zvi, 2009) that support students' reasoning about statistics and data. Thus, InSTEP professional learning is built on 7 interrelated dimensions of instructional design that develop learners' understanding of foundational practices, processes and ways of thinking related to statistics and data science. Teachers have opportunities to engage with InSTEP resources and tools, to build both content knowledge and expertise in teaching. To build teacher knowledge around these interrelated dimensions, InSTEP materials are organized by dimensions, where resources build knowledge around each dimension. Our approach is designed to support teachers in using well-designed **tasks** to support statistical thinking by engaging students in key **data and statistical practices** and processes to develop **central statistical ideas** about statistics and data. This approach involves using real, motivating **data** to engage in investigations using **technology tools** that allow learners to enact statistical and data practices and develop skills to apply tools. Finally, our approach helps teachers to learn to establish practice that promotes productive **argumentation and discourse**, which includes making and supporting data-based arguments, and use of **assessment** of students' thinking about statistics and data to inform instructional decisions.



Research Focus

We hypothesize that personalized online professional development focused on statistics content and pedagogy can effectively engage middle and high school teachers in advancing their ability to create meaningful statistical learning environments for their students. Our research is considered a Design and Development type to provide evidence of initial effectiveness and laying a foundation for *future* Effectiveness Research on impact on teachers' practices and students' learning (Institute of Education Sciences and National Science Foundation, 2013). In particular we are focused on two DRK12 research aims:

Research Aim 1 (DRK12-RA1): Providing a *solution* for in-service teachers to develop STEM content knowledge (statistics content knowledge) and pedagogical content knowledge (approaches to learning and teaching statistics) in ways that improve their instructional practice.

Research Aim 2 (DRK12-RA2): Develop, apply, and test *models* of PD through personalized online learning and microcredentials and examine if it is effective in improving statistics teaching.

The solution and models in the InSTEP project include a comprehensive database of resources that can be packaged into learning modules and microcredentials in which teachers can demonstrate their skills connected to practice--all within a system that provides opportunities for ongoing feedback, a community, and recommendations to support personalization. There are four research questions that will guide our work and can advance knowledge in the fields of statistics teacher education and online professional development.

RQ1. *In what ways can the InSTEP platform provide meaningful and personalized resources, modules, and microcredentials for teachers PD in teaching statistics? (DRK12-RA2)*

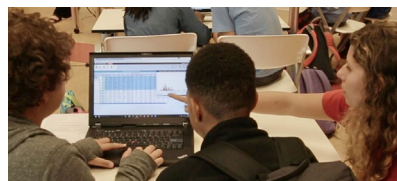
RQ2. *What is the nature of teachers' understandings of, and confidence in, content and pedagogical practices related to statistics, and how do these develop through engagement with InSTEP resources, modules, and microcredentials? (DRK12-RA1)*

RQ3. *What types of resources, modules and microcredentials best support mathematics teachers' learning and prepare them to teach statistics? (DRK12-RA1 & DRK12-RA2)*

RQ4. *What are promising models for the ways the InSTEP online platform can be used to support PD for teachers, either individually, through organizations, or local school/district efforts? (DRK12-RA2)*

Model 2: An alternative model for on-demand self-directed learning

There has been an increased need for professional development for mathematics teachers of grades 6-12 in statistics and data science education; however, the InSTEP platform is in the design stage and will likely not be publicly available until 2023. Thus, we are creating an alternative model to support teacher learning that consists of on-demand professional development modules and microcredentials to meet teachers' needs until the platform is released. *Amplifying Statistics and Data Science in Classrooms* will open to the public in **June 2021**. This new open professional learning experience will include many resources and microcredentials that may eventually appear in the InSTEP platform. To begin to answer **RQ2** and **RQ3**, we will conduct research with a subgroup of 25 teachers as they use the *Amplifying Statistics* modules and microcredentials while working in small professional learning teams. Results from this research will inform design choices for microcredentials, resources, data investigations, and other learning experiences in the InSTEP platform (Model 1).



See: <http://go.ncsu.edu/amplifystats>.

May 2021 Project Status

- Over 100 resources have been created, adapted, or curated and organized into modules within seven dimensions (see figure on p. 2).
- Five modules, two data investigations, and two microcredentials are in various stages of design and development.
- The InSTEP platform has gone through several iterative designs. Wireframe designs have been used in different focus groups with various kinds of expert advisors (e.g., statistics education, online professional development), middle school and high school teachers, as well as district and state math leaders. Feedback and results have informed changes to the platform design.
- Several surveys have been designed to measure teachers' practice and beliefs about teaching statistics and data sciences.
- The project developed a new framework for engaging students in a data investigation process that incorporates research about practices of data scientists with well-known processes used to structure investigations in statistics education. This framework has been shared through several presentations, which include conference presentations and outreach to teachers, as well as the submission of a journal article. This framework is used to create data investigation experiences for teachers that will be included in the InSTEP platform.
- Year 2 progress was slowed due to COVID-19.

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