North Dakota State University STEM Classroom Building
William Martin (William.martin@ndsu.edu) and Paul Kelter (paul.kelter@ndsu.edu)

NDSU has recently and substantially increased its focus on high-quality STEM education at the institution and in its service region through funded NSF education-related projects and strategic hiring of discipline-based educational research (DBER) faculty in the STEM fields. An early Collaborative for Excellence in Teacher Preparation grant led to the creation of our Center for Science and Mathematics Education (CSME) and a series of annual North Dakota state conferences on Science and Mathematics Education Reform targeting STEM discipline-based postsecondary faculty. Involvement of these faculty with middle and high school teachers increased with two GK-12 projects placing STEM graduate students in K-12 classrooms.

These successes led to a STEM Education PhD program that included hiring of five new DBER faculty in STEM and a senior hire as Director of a new Office of Teaching and Learning, a home for multiple instructional initiatives on campus. A new STEM classroom building, constructed specifically to include active, student-centered teaching labs and classrooms of various sizes, will be open for the 2016 spring semester, providing the impetus for a campus-wide effort to mandate student-centered instructional approaches that are supported by the new, state of the art facilities.

Information about the STEM classroom building is available on this website:

http://www.ndsu.edu/facilities/constructionrenovationandproject/stem_building/

With opportunity comes challenge. How do we ensure that these facilities are actually used for the intended (active-learning) purpose? The campus leadership has directed professional development to ensure that instructors in this new building will be qualified, supported and committed to implementing and evaluating student-centered instructional practices in the service of deeper conceptual learning. We further expect that we will also have the opportunity to model these practices across campus and beyond STEM disciplines. As such, education, social science, and arts and humanities faculty have participated in the planning of professional development in three groups: Graduate teaching assistants (TA), faculty who are novices with the facilities
and student-focused practices (Tier 1), and faculty who are already experienced with these areas (Tier 2). This professional development component and its potential cross campus impact will be the main focus of this session. That professional development will include elements including information and demonstrations of the facilities, summer and start-of-semester workshops, professional learning communities, peer review of teaching, and mini-lessons. Our broadest goal is to build the capacity of our instructional staff to deliver student-centered instruction, and to support others in doing so.

There are 11 outcomes for the Training for All Instructional Staff. Among these are:
1. Compare and contrast characteristics of teacher-centered learning and student-centered learning
2. Design a discipline-specific, student-centered learning activity
3. Describe the difference between formative and summative assessments
4. Identify appropriate technologies for active learning in their discipline
5. Teach and assess demonstrating the core principles of student-centered learning
6. Teach a student-centered lesson demonstrating appropriate use of technology

All instructional staff will be required to show evidence of their capacity and their commitment to teach in an active, student-centered way. In this session, we will discuss the relevant criteria and additional expectations.

Gateways-ND is a funded, full design and development project that provides tools, resources, and methods documented to improve student-learning outcomes to faculty members who teach gateway STEM courses at North Dakota State University (NDSU). Gateways-ND also seeks to examine the relationship between use of high-impact teaching practices and improved student. Faculty members will participate in a two-year professional development (PD) series that includes a one-week intensive workshop with experts in innovative teaching practices; monthly Faculty Learning Community (FLC) meetings; use of early warning system tools including predictive analytics; mid-year follow-up; and a second year of advanced development, with disciplinary FLCs. To assess the impacts of course redesign, we will examine student learning outcomes, retention in STEM fields, and attitudes toward STEM learning.

Gateways-ND will examine beliefs about teaching and learning held by faculty and students in gateway courses undergoing instructional improvement with the understanding that beliefs shape behaviors. Project-based research questions include examining beliefs held by faculty members regarding teaching strategies (before and after participation in PD) and measuring the success of students enrolled in courses in which learner-focused practices are newly employed. We seek to change the culture of STEM Education at NDSU by:

- providing professional development for gateway course faculty focusing on the use of active and collaborative learning strategies
- cultivating faculty learning communities, thereby creating a long-term, supportive campus-wide community of engaged faculty
- generating cohorts of faculty practicing learner-focused teaching that will define NDSU’s instructional culture
- becoming a model institutional STEM education training program for sharing best practices of institutional development at a national level
Building on and understanding existing institutional culture is key to pedagogical transformation, and bottom-up initiatives rooted in existing teacher practices tend to be more effective than top-down initiatives. Our professional-development model starts with teaching and student identified needs and beliefs and existing faculty curricular materials to change long-term teaching culture and practice. This table provides an overview timeline of the five-year professional development cycles. Each cohort will begin with a version of the summer year one training, moving the following summer to year two training. In between, all will participate in the faculty learning communities with increasing disciplinary specificity over time. In year two, we will begin to offer both the summer year one and the summer year two training to allow new cohorts to begin each August. Some summer workshop sessions will be shared by both year one and year two participants to create productive dialogue among advanced and newer instructors.

<table>
<thead>
<tr>
<th>Professional Development</th>
<th>Pre-Year 1</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Years 3, 4, 5 Repeat Years 1 and 2</th>
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<td>Spring</td>
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<td>Recruitment</td>
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<td>FLC monthly meetings</td>
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<td>Observations</td>
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Each year, the longest professional development workshop—one business week—will occur in the summer, prior to the start of fall semester. The following tables detail the content and structure of the two year cycle of these summer training sessions, which will repeat in subsequent years with appropriate modifications based on our ongoing research and feedback from participants.

Gateways-ND Summer Training: YEAR ONE

<table>
<thead>
<tr>
<th>Time (8:00-4:00)</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
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<tbody>
<tr>
<td>8:00-9:00</td>
<td>Pre-surveys (baseline of instructor beliefs), introductions</td>
<td>Structured reflection on implications of the training and goals for the day</td>
<td>Reflection and discussion: results of the belief survey</td>
<td>Reflection</td>
<td>Reflection: case study discussion</td>
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<tr>
<td>9:00-12:00</td>
<td>Backward design basics</td>
<td>Backward design (summative assessment)</td>
<td>Student-faculty interaction</td>
<td>Flipped classroom</td>
<td>SCALE-UP teaching</td>
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<tr>
<td>1:00-3:00</td>
<td>Backward design basics</td>
<td>Backward design (formative assessment)</td>
<td>Individual work time, support provided</td>
<td>Predictive analytics</td>
<td>PD evaluation, discussion, and post-surveys (instructor beliefs)</td>
</tr>
<tr>
<td>3:00-4:00</td>
<td>Individual work time, support provided</td>
<td>Microteaching</td>
<td>Individual work time, support provided</td>
<td>Microteaching</td>
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Gateways-ND *ADVANCED* Summer Training: YEAR TWO

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<tr>
<th>Time (8:00-4:00)</th>
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<th>Friday</th>
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</thead>
<tbody>
<tr>
<td>8:00-9:00</td>
<td>Pre-surveys (baseline of instructor beliefs), introductions</td>
<td>Structured reflection re: Day 1 training and goals for the day</td>
<td>Reflection and discussion: results of the belief survey</td>
<td>Reflection</td>
<td>Reflection: case study discussion</td>
</tr>
<tr>
<td>9:00-12:00</td>
<td>Active-learning – the ABCs</td>
<td>Cooperative learning</td>
<td>Problem-based learning (scaffolded)</td>
<td>Using models</td>
<td>Teaching for and with diversity</td>
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| 1:00-3:00        | Using flexible classroom space | Problem-based learning (open inquiry) | Individual work time, support provided | Surveying and clickers | PD evaluation, discussion, and post-
Key features of the summer professional development

- Workshop of teaching materials: mentors work with faculty groups to develop goals, materials, and assessments using sample curriculum from their courses.
- Emphasis on the importance of measurable outcomes at multiple levels of Bloom’s taxonomy to help participants to shape their assessments in light of related program goals, such as the new NDSU General Education outcomes.
- Each participant will create or re-create a teachable unit
- In year two of each cohort cycle, advanced participants will share their developing knowledge with new participants through session leadership, materials sharing, and mentorship.

Spring professional development

Each January, the Gateways-ND team will facilitate a one-day pre-semester professional development session similar to its summer workshop in structure. That intensive one-day workshop will focus in year one on refining use of data analytics and early response to identify and support at-risk students. In subsequent years, members of the FLCs will present to the group as a whole regarding practices and materials developed and used as a result of their ongoing professional development.

Key features of the FLCs

All participants in the FLCs will observe peers to both provide a research and pedagogical data set and also cross-pollinate teaching and learning methods and will provide feedback to teachers as they implement new strategies. FLCs will meet monthly to collectively solve problems and share information. The FLCs will provide the backbone for sustainable professional development at NDSU.

Gateways-ND ongoing mentorship and support.

The Gateways-ND leadership team will support FLCs through additional peer review classroom observations and gathering, organizing, featuring, and sharing teaching materials relevant to their professional development and pedagogical change. A Blackboard organization site will serve as the preliminary repository for relevant materials. The goal is to provide feedback and continue to support each participant’s growth. Project leaders will attend disciplinary FLC meetings on a bimonthly basis to monitor and support their work.

Contact Information

NDSU Center for Science and Mathematics Education (www.ndsu.edu/csme)
NDSU STEM Education PhD (http://www.ndsu.edu/csme/step_education_graduate_programs/)

Bill Martin, Professor & Head
School of Education
Department of Mathematics
210F Family Life Center Dept. 2625
PO Box 6050 North Dakota State University
Fargo, ND 58108-6050 USA
Tel: (701) 231-7104
William.martin@ndsu.edu

Paul Kelter, Professor & Director
Center for Instructional Excellence & Innovation
Center for Science & Math Education
314A Family Life Center Dept. 2780
PO Box 6050 North Dakota State University
Fargo, ND 58108-6050 USA
Tel: (701) 231-6336
Paul.kelter@ndsu.edu