

Mathematics Teacher Education and Professional Development

Practice-based Teacher Education at the University of Michigan (with resources from *TeachingWorks*)

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Redesigning teacher education at the University of Michigan 2005 - 2010

We sought to develop a program focused on **practice**:

1. **Curriculum:** Focused on specific skills and practices of teaching, and on the knowledge and orientations that support them
2. **Instructional activities and settings:** Repeated opportunities to practice specific teaching skills, with close, detailed coaching, in settings that support professional learning
3. **Assessment:** Periodic and culminating performance assessments that provide information about novices' developing competence

Inspired by features of preparation for responsible independent practice in other skilled professions

- 1. Clear specification of knowledge, skills, capabilities, and qualities of performance necessary for independent practice**
- 2. Detailed developmental clinical training, progressing from observing to simulations to apprenticeship to supervised independent practice; including attention to role of experienced practitioners in novices' learning**
- 3. Performance assessment of individual competence before allowing independent practice**

Pillars of the University of Michigan elementary teacher education program

Practice-based teacher education



1. The 19 High Leverage Practices (HLPs)

1. Explaining core content
2. Posing questions about content
3. Choosing and using examples of content
4. **Leading whole class discussions**
5. Working with individual students
6. Setting up and managing small-group work
7. Engaging students in managerial routines
8. Establishing norms and routines
9. Recognizing and identifying common patterns of student thinking
10. Composing, selecting, adapting quizzes, tests, and other methods of assessing students' learning
11. Selecting and using specific methods on an ongoing basis within and between lessons
12. Identifying and implementing an instructional strategy or intervention in response to common patterns of student thinking
13. Choosing, appraising, and modifying tasks, texts, and materials
14. Enacting a task to support a specific learning goal
15. Designing a sequence of lessons
16. Enacting a sequence of lessons on a core topic
17. Conducting a meeting about a student with caregivers
18. Writing correct, comprehensible, and professional messages to colleagues or parents
19. Analyzing and improving specific elements of one's own teaching

How did we decide on the High-leverage practices?

- Iterative collective work by the faculty across 3 years
- Three sources:
 - (1) Logic of practice (i.e., what do teachers have to do every day for students to learn?)
 - (2) Research on instruction, classrooms, student learning
 - (3) Wisdom of practitioners (i.e., what accomplished teachers identify)

One Example: The HLP **Leading a discussion**

Description: In a whole-class discussion, the teacher and all of the students work on specific content together, using one another's ideas as resources. The purposes of a discussion are to build collective knowledge and capability in relation to specific instructional goals and to allow students to practice listening, speaking, and interpreting. In instructionally productive discussions, the teacher and a wide range of students contribute orally, listen actively, and respond to and learn from others' contributions. (*TeachingWorks*)

Parts of leading one type of discussion:
a problem-based mathematics discussion

Parts of the work for novices to learn

- Setting up the mathematics problem
- Monitoring as students work independently on the problem
- Launching the discussion
- Orchestrating the discussion
- Concluding the discussion

Instructional activities for teaching candidates to lead a discussion

- View examples and discuss parts of the work
- Participate in discussions in class
- See modeling of parts of the work
- Practice specific parts in class (rehearsal) and in school classroom; self video record
- Instructor examines candidates' video records and annotations and provides specific feedback and coaching

2. Content knowledge for teaching

- **Accuracy**- Clearly and accurately communicates and represents the subject's ideas, practices, and principles.
- **Disciplinary practices**- Conveys understanding of the ways in which complex disciplinary practices work.
- **Integrity of subject matter**- Supports learning experiences that make the subject matter accessible and preserve its disciplinary integrity.
- **Patterns of student thinking**- Accounts for patterns of student thinking about the content.
- **Follow through on objective**- Steers ongoing learning toward subject matter learning goals.
- **Other notable content knowledge issues**- Teaches in ways that are likely to provide a firm disciplinary foundation for subsequent learning.

3. Ethical obligations for teaching

- Care for and commitment to every student
- Professionally competent teaching practice
- Equitable access to learning
- Appreciation of difference and diversity
- Belief in the capacity for learning
- Personal responsibility for overcoming obstacles to student success
- Carefully exercise the power and authority of the teaching role
- Respect for and generosity towards others
- Integrity of academic subjects in teaching

Program structure and key features

- Curriculum: Subject matters and high-leverage practices recur throughout the program (*see following slides for a glimpse*)
- School-based opportunities to develop skills: Candidates are in schools two days a week for three semesters, and five days in fourth semester; staged opportunities to develop skill
- Programmatic performance assessments punctuated throughout the program

Instructors

- University faculty, school teachers
- Graduate students apprenticing to learn to teach teaching and content knowledge for teaching
- Use common syllabi and assessments (instructors do not make up their own courses or lessons; these are developed in detail together)

Considering Future Mathematics Teacher Education based on Japanese Approach

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Teacher education, both preservice and inservice.

- Phase 1 professional development focuses on developing the knowledge for teaching mathematics,
 - through reading books and resources, listening to lectures, and watching visual resources such as video and demonstration lessons.
- Phase 2 professional development focuses on developing expertise for teaching mathematics
 - teachers should plan lessons carefully, teach the lessons based on the lesson plans, and reflect upon the teaching and learning based on the careful observation. Japanese teachers and educators usually go through this process using **Lesson Study**

Effective teaching to support students to develop essential mathematics

Japanese mathematics educators and teachers identify three levels of expertise of mathematics teaching:

- **Level 1:** The teacher can tell students the important basic ideas of mathematics such as facts, concepts, and procedures, and practices.
- **Level 2:** The teacher can explain the meanings and reasons of the important basic content and practices of mathematics in order for students to understand them.
- **Level 3:** The teacher can provide students with opportunities to understand these basic mathematical content and practices, and support their learning so that the students become independent learners.

(Sugiyama, Y. 2008, Trans. Takahashi, A., 2011a)

Table 1: A framework for developing programs and resources for mathematics teacher education

	To establish knowledge and expertise for Level 2 teaching	To establish knowledge and expertise for Level 3 teaching
Phase 1 Professional Development	Acquire knowledge of mathematics teaching and learning— <ul style="list-style-type: none"> • Pedagogical content knowledge • Knowledge of the curriculum • Knowledge of the students • Knowledge of pedagogy... ...through: <ul style="list-style-type: none"> • University courses • Professional development workshops • Online resources • Classroom videos • Classroom observations, including participating in research lessons 	Update knowledge of mathematics teaching and learning... ...through: <ul style="list-style-type: none"> • Workshops • Evening and summer coursework
Phase 2 Professional Development	Develop ability to explain mathematics concepts and procedures effectively ...through: <ul style="list-style-type: none"> • Designing lesson plans • Examine effectiveness of the plan using mock-up lessons • Learn basics for Lesson study during student teaching 	Develop expertise for designing lesson, monitoring student learning process, and evaluate the effectiveness of the lesson: ...through: <ul style="list-style-type: none"> • Designing lesson plans • Examine effectiveness of the lessons by observing student learning process

Two sets of student teaching opportunities in Japanese teacher preparation program

- The first set of the student teaching
 - In the middle of the third year of the four year program
 - Intensive training for teacher candidates to develop basics of Lesson Study at university attached schools
- The second set of the student teaching
 - In the middle of the fourth year of the four year program
 - Placed in a public schools to gain the knowledge and expertise for becoming a classroom teacher

However.....

- Not all teacher preparation programs in Japan have two sets of student teaching.
- Some researchers argue that Lesson Study in Japan may not be so effective anymore. (e.g. Nishimura et. al. 2013)
- Although many schools and teachers have tried to use ideas from Lesson Study in various ways, only a few cases have been documented in which there was strong evidence of impact on teaching and learning (e.g., Gersten, Taylor, Keys, Rolfhus, & Newman-Gonchar, 2014; Lewis, Perry, Hurd, & O'Connell, 2006).

Redefining *Jyugyou Kenkyuu* Collaborative Lesson Research (CLR)

- A research theme and hypothesis
- A topic worthy of investigation
- *Kyouzai kenkyuu*
- A lesson research proposal, including a unit plan
- A live research lesson and discussion
- Knowledgeable others
- Sharing of results

Emphasis of mathematics teacher education

- Opportunities for learning ways to conduct *Kyouzai Kenkyuu* to establish and maintain robust understanding of mathematics for teaching.
- Opportunities for analyzing student learning process.
- Opportunity for collaboration to design unit and lesson with reflection.
- Opportunities for receiving and providing critical feedbacks on teaching.
- Opportunities for reflecting teaching based on the evidence of student learning.