

cultivating 21st century skills in science learners

how systems of teacher preparation and PD will have to evolve

Mark Windschitl

Teachers' Learning Trajectories Initiative
University of Washington

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mapping
two sets of
learning
goals

reform science teaching is about:	21 st century skills are about:
fostering deep content knowledge through active intellectual engagement	developing broadly applicable capacities, habits of mind
emulating disciplinary practices and thinking	preparing knowledge-workers for a new economy



Most 21st century skills can be taught in the context of scientific inquiry or project-based learning

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ambitious
learning goals
require
ambitious
teaching



Teaching for 21st century skills:

- features learning how to problem-solve with others, and learning how to learn
- places learning decisions and activities in the hands of students that were formerly determined by the teacher
- success depends upon monitoring of student thinking about complex problems; relies on on-going targeted feedback to students.

And problematically for teachers:

- is unlike instruction most teachers have participated in or witnessed
- is underspecified (i.e. lacks detailed performance language that can act as a guide for planning, execution and reflection on teaching)

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modest track record
with reform efforts
over past 20 years

- | many teachers create dynamic, challenging lessons, but the broad trends indicate--
 - | a focus on activity rather than sense-making discourse
 - | pressing for explanations is rare
 - | questioning among weakest elements of instruction
 - | less than 1/3 of lessons take into account students' prior knowledge

Baldi et al, 2007; Banilower et al, 2006, Roth & Garnier 2007; Weiss et al, 2003; PISA studies

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What do we know about how teachers learn to teach science?



- content knowledge important, but PS teachers come in with silos of superficial knowledge (impacts teaching 21st century skills)
- all instruction filtered through tacit but durable theories about “good teaching”, what counts as learning
- have difficulty putting reform practices into play in classrooms
- don't have a sense of what kids are capable of

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characteristics of effective teacher preparation



- | Well-defined standards of practice and performance that are used to guide the design and assessment of coursework and clinical work.
 - | A common core curriculum grounded in substantial knowledge of child or adolescent development, learning, and subject matter pedagogy, taught in the context of practice.
 - | Extended clinical experiences (at least 30 weeks) that reflect the program's vision of good teaching, are interwoven with coursework, and carefully mentored.
 - | Extensive use of case study methods, teacher research, performance assessments, and portfolio examination that relate teachers' learning to classroom practice.”
- Darling-Hammond, 1999
- • non-generic: need fundamental understanding of core science ideas; of epistemic and methodological practices of science.

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Inclusion - setting patterns of performance for a career



- first two years a frenetic cycle of plan-teach-grade
- advanced practices from teacher prep often put on the shelf
- can be crucial opportunity maintain focus on 21st century skills in collaborative professional settings
- focus on evidence of student learning (part of what defines one as a teacher in Asian counties)
- subject-specific focus
- ongoing re-calibrations of expectations for students

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effective professional development



- | active learning opportunities focusing on science content, scientific practice, and evidence of student learning.
- | coherence of the professional development with teachers' existing knowledge, other development activities, with existing curriculum, and with standards in local contexts.
- | the collective development of an evidence-based "inquiry stance" by participants towards their practice.
- | the collective participation by teachers from same school, grade, or subject areas.
- | time is important, needed for planning and enacting new practice

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areas of recommendation

teacher prep

- Deep, connected content knowledge important
- Re-framing of tacit theories
- Extended clinical experiences with master teacher, coherent with reform-oriented program and 21st Century Skills

induction

- Not optional
- SM specific
- Focus on improving practice by examining evidence of student learning
- Builds upon best practices from teacher preparation

professional dev

- Focuses on big pedagogical ideas
- Time to plan for implementation
- Collective development of an inquiry stance to practice
- Active learning
- Coherence with teachers' knowledge, curricula

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seeking a science of performance improvement for educators

- | goal? generating systems capacity for continuous improvement around teachers' ability to foster 21st century skills
- | first step: longitudinal studies of teachers needed to open the novice-to-expert black box



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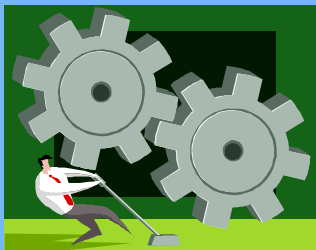
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- | followed 15 secondary science teachers, instructed in reform teaching for 3 years, some for 4.
- | provided induction coherent with pre-service and focused on evidence of student learning (evidence-based scientific explanation)

- about 1/3 developed expert-like practice
- tools played major role in teachers' understanding of reform practice and performance of students-- not just *any* tools: the ones they needed

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new tools for learning to teach 21st century skills

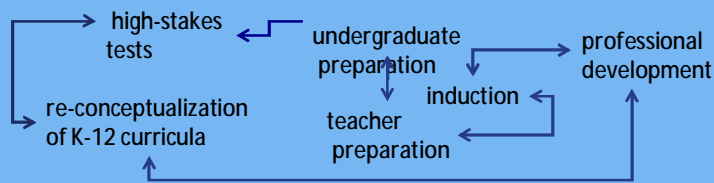


1. richly contextualized representations of practice – video-enhanced learning progressions (of self-management for example)
2. “big idea” tools (could help foster non-routine problem-solving)
3. rubrics for imagining and assessing student performance (such as systems thinking)
4. discourse tools (e.g. to support complex communication)
5. tools and routines for collaboratively analyzing effectiveness of instruction, based on evidence of student learning

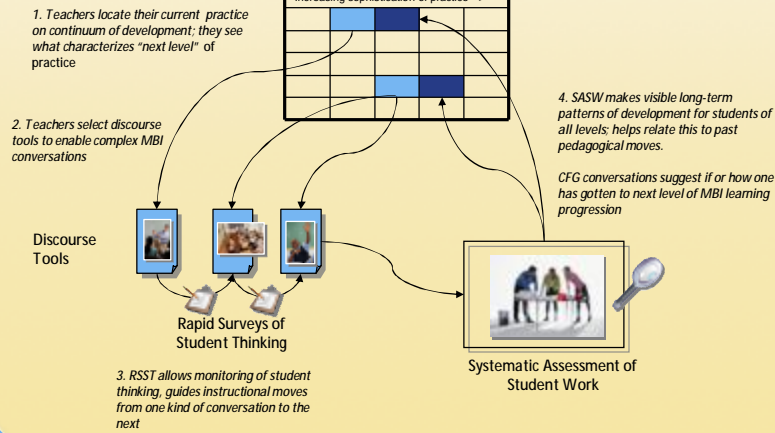
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scope of challenges

- teaching for 21st Century skills will be challenging in part because skills are under-specified—and because they call for a fundamentally different vision of “what counts” as learning
- teaching that can support 21st CSK’s requires a years-long continuum of experiences that cohere conceptually and build upon one another
- will require re-engineering inter-related components of our educational system to be successful



MBI Learning Progression



our tool system