Teacher Pedagogical Content Knowledge for Using Learning Progressions

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Learning Progressions

Curriculum

Assessment

Instruction

Reasoning Tools for Understanding Water Systems
Content Knowledge (CK)

Pedagogical Content Knowledge (PCK)
Water Systems Learning Progression

Level 1 – Simple Force Dynamic Accounts
Water in isolated locations
Human-centric

Level 2 – Force Dynamic with Mechanisms
Actors, enablers, antagonists
Macroscopic only

Level 3 – Phenomenological Reasoning
Events in order, Names processes
Microscopic to landscape scales

Level 4 – Qualitative Model-Based Reasoning
Driving Forces & Constraining Factors
Atomic-Molecular to Landscape Scales
Reasoning Tools for Understanding Water Systems

Knowledge of Curriculum (KC-LG)

Knowledge of Students (KS)

Knowledge of Instruction (KI)

Water Systems Learning Progression

KC – Challenging Goals

KS – Assessing & Building on Student Ideas

KI – Appropriate Experience w/ Phenomena

Pedagogical Content Knowledge for Water in Environmental Systems
Research Questions

• What is the status of teachers CK and PCK relevant to teaching about water?
• How does using LP-based curriculum materials support teachers in developing relevant CK and PCK?
• Is there a relationship between teacher CK/PCK and student learning about water?
Methods

• Middle and high school teachers
• Assessments of CK & PCK prior to PD and following teaching using LP-based curriculum materials
• 54 teachers had matching pre-post assessments; 37 teachers also had student pre-post assessments (CK only).
PCK Assessment Item Types

**KC-LG**
- Write learning goals

**KS**
- Interpret student response

**KI**
- Choose next instructional move
A

- **KC-LG:** Disconnected Facts
- **KS:** Content Knowledge Interferes
- **KI:** Activities are fun or just hands-on

Knowledge for Level 2

B

- **KC-LG:** Naming Processes & vocabulary
- **KS:** Ideas right or wrong
- **KI:** Transmitting explanations

Knowledge for Level 3

C

- **KC-LG:** Challenging goals for MBR
- **KS:** Interprets reasoning based on LP
- **KI:** Appropriate experiences w/ phenomena based on LP

Knowledge for Level 4

Reasoning Tools for Understanding Water Systems
Overall PCK

Percent of Teachers

PCK Category

A
B
C

Pre
Post

Reasoning Tools for Understanding Water Systems
Knowledge of Curriculum

Percent of Teachers

PCK Category

Pre

Post

Reasoning Tools for Understanding Water Systems
Knowledge of Students

Percent of Teachers

PCK Category

Pre
Post

A
B
C
Knowledge of Instruction

Percent of Teachers

PCK Category

A

B

C

Pre

Post

Reasoning Tools for Understanding Water Systems
### Teacher CK & PCK Correlation to Effect Size

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Pearson’s r (df)</th>
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</thead>
<tbody>
<tr>
<td>CK and effect size</td>
<td>0.254 (35)</td>
</tr>
<tr>
<td>Overall PCK and effect size</td>
<td>0.406 (35)*</td>
</tr>
<tr>
<td>KC-LG and effect size</td>
<td>0.399 (35)*</td>
</tr>
<tr>
<td>KS and effect size</td>
<td>0.310 (35)</td>
</tr>
<tr>
<td>KI and effect size</td>
<td>0.288 (35)</td>
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</tbody>
</table>

* p<.05
Discussion

Discourse of School Science (phenomenological reasoning) limits teachers’ instructional potential and caps student understanding at level 3 (phenomenological reasoning).
Discussion

Using LP-based curriculum materials may support teachers in developing more sophisticated content knowledge and PCK, but may require more than 1 year.
Discussion

Knowledge of curriculum (learning goals) may develop first, followed by knowledge of students, then knowledge of instruction.
Paper available at

http://www.pathwaysproject.kbs.msu.edu/?page_id=499

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