



Assessing Pedagogical Content Knowledge of Future Elementary Teachers

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This work is supported in part by U.S. National Science Foundation grant 1140855



INTRODUCTION

- Research shows that most elementary teachers feel they lack adequate knowledge to teach science.
- Curricula such as *Physics by Inquiry - Pbl* and *Physics for Elementary Teachers – PET* focus on students' learning the nature of science and facilitating reflection on their own learning.
- Research shows that activities, similar to those in *Pbl* and *PET* in which students discuss videos of elementary kids learning science can improve attitudes and beliefs about the nature of science.
- However, there has been little research on how these kinds of experiences facilitate future elementary teachers' knowledge of discipline-specific pedagogy.

THEORETICAL FRAMEWORK

Pedagogical Content Knowledge (PCK)

PCK includes knowledge of...

- how students learn the discipline,
- prior knowledge and ideas that they bring to bear on their learning, and
- age-appropriate strategies to facilitate their learning of the disciplinary content.

PCK is not solely pedagogical; rather it is intrinsically tied to discipline-specific content.

RESEARCH QUESTION

To what extent is the pedagogical content knowledge (PCK) of future elementary teachers' affected by interventions similar to those used in *PET*?

CONTEXT OF STUDY

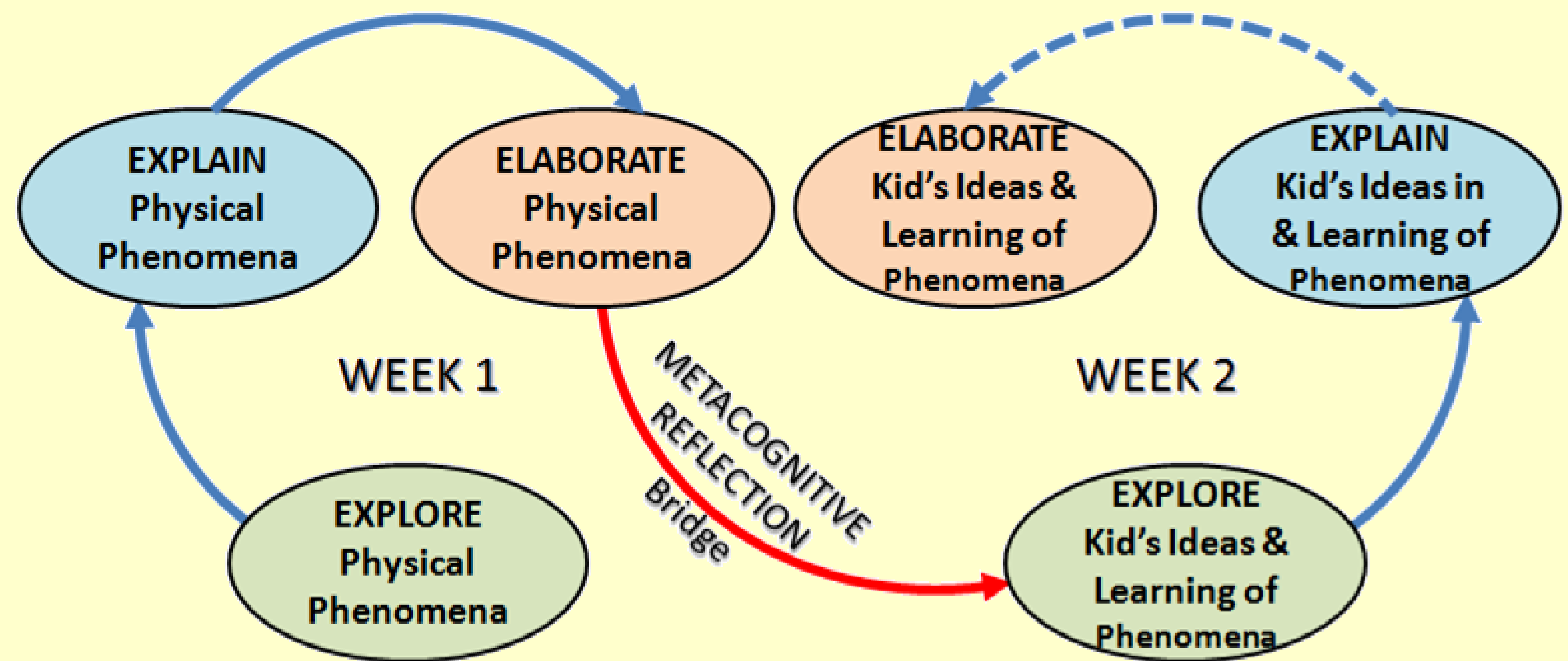
- Reformed a large-enrollment (N>100) conceptual physics course for future elementary teachers at a public U.S. Midwestern university .
- Instructional model – pedagogical learning bicycle (PLB) – an adapted two-layered 3E learning cycle.

ASSESSMENT

- **Task:** Work in groups to design a lesson for elementary kids incorporating kids' ideas of science.
- **Rubric:** Used scoring rubric below based on PCK.

Level	Description
0	No mention of children's prior ideas pertaining to the topic of the lesson.
1	Mentioned children's prior ideas pertaining to the topic, but did not address it in design of the activity.
2	Designed activity to address children's prior ideas pertaining to the topic, but did not address it in design of assessment.
3	Addressed children's prior ideas pertaining to the topic both in the design of the activity and the assessment.

PEDAGOGICAL LEARNING BICYCLE



WEEK 1

EXPLORE: Circulate through multiple stations completing hands-on explorations of physical phenomena – make observations, predictions.

EXPLAIN: Discuss exploration, learn of concepts to explain observations. May find that predictions are incorrect and why so.

ELABORATE: Apply concepts learned in explain phase to make predictions while revisiting some exploration activities and some new ones.

Reflect on what & how they learned in Week 1

WEEK 2

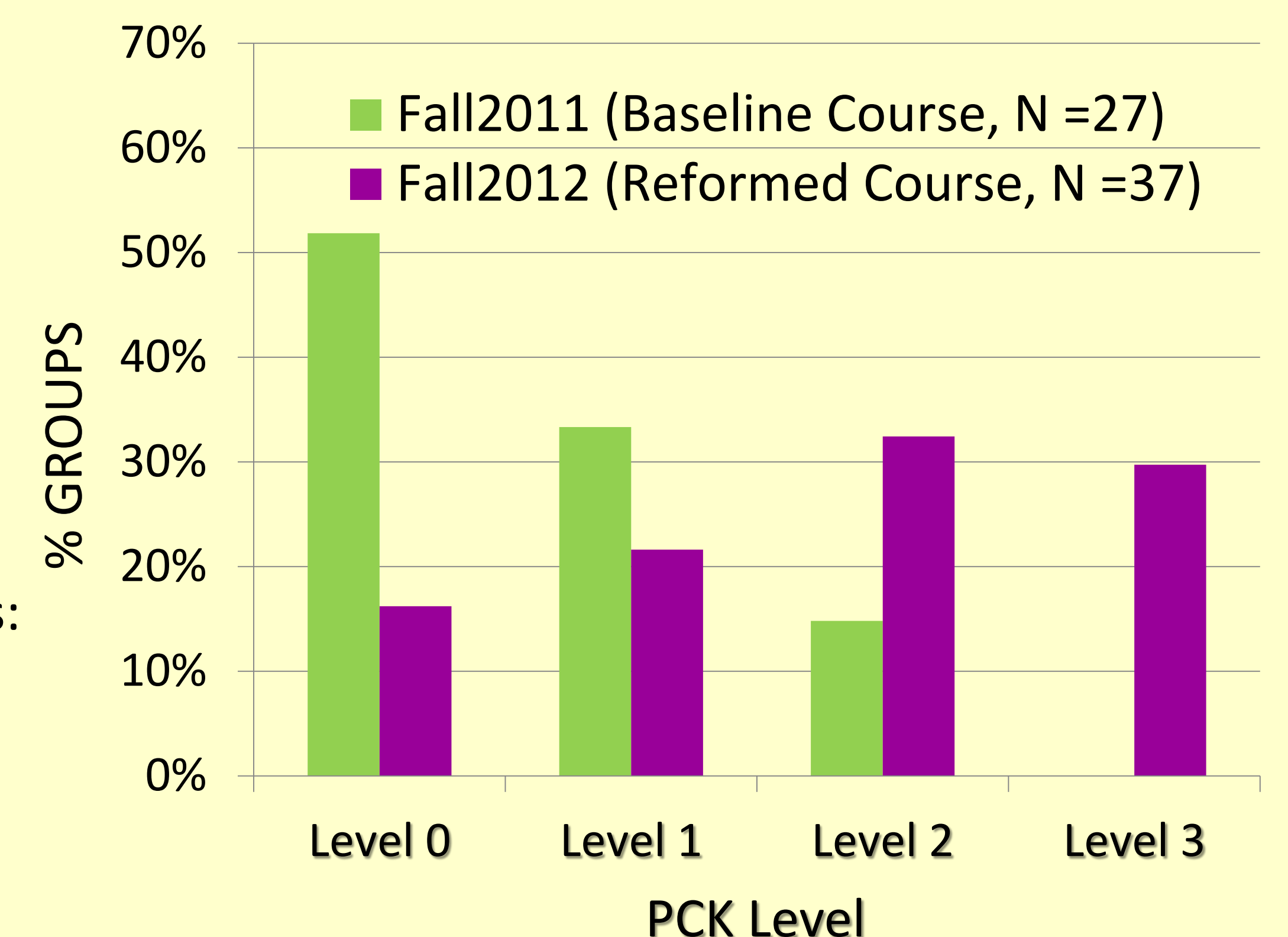
EXPLORE: Watch videos of elementary school kids, some with teachers, talking about science activities and ideas.

EXPLAIN: Discuss kids' videos in light of research on children's ideas of science. Compare their own ideas with those of the kids in the videos.

ELABORATE: Apply their learning about kids' ideas of science from videos and literature, as well as their own learning from Week 1 to design learning experiences for the kids.

ANALYSIS & RESULTS

- We compared rubric scores of students in the reformed course that used PLB (Fall 2012) with scores of students in a baseline course (Fall 2011) that used the 3E-learning cycle i.e. Week 1 only, without metacognitive reflection or Week 2.
- Fisher's Exact test indicates:
 - Statistically significant difference in distributions: $\chi^2(3,64)=18.10, p<.001$.
 - Reformed course more likely to be at Level 3, while baseline course more likely at Level 0.
 - Moderate effect size (Cramer's $V=0.517$).



CONCLUSIONS

- PCK of future elementary teachers was significantly improved compared to the previous course which did not use the PLB model. Students in the reformed course were significantly more likely to incorporate children's prior ideas into both the design of learning experiences as well as assessments.
- Instructional models such as the pedagogical learning bicycle (PLB) that explicitly combine learning of content and pedagogy may have promise in promoting PCK of future teachers.