

INFUSING PEDAGOGICAL CONTENT KNOWLEDGE INTO A PHYSICS COURSE FOR FUTURE ELEMENTARY TEACHERS

PROJECT SUMMARY

There is widespread concern that children in the U.S. are being consistently outperformed on math and science tests by children in several other industrialized countries. Part of the reason for the relatively low performance of U.S. children on these tests has been attributed to the lack of preparation of math and science teachers. Thus, there is a dire need for educating larger numbers of teachers that are better prepared to teach math and science. This project is a small step toward addressing this national need.

The project is aimed at reforming a conceptual physics course for future elementary teachers. We integrate pedagogical content knowledge into the fabric of the course so that future elementary teachers can recognize the relevance of learning physics concepts and using reform-based pedagogy in their future roles in the classrooms of tomorrow.

The modified course is structured around an instructional model called the pedagogical learning bicycle (PLB) – an adapted two-layered 3E learning cycle. This model intertwines the construction of science content knowledge (CK) with the development of pedagogical content knowledge (PCK) using metacognitive reflection (MR) as a metaphorical bridge between learning content and pedagogy.

We promote active learning of both the science concepts and pedagogy. This effort goes beyond modeling inquiry-based teaching of science. More importantly, this course provides opportunities for future teachers to develop skills reflecting on their own learning of physical phenomena, understanding how children talk and learn about physical phenomena and learning how research literature describes ways in which children think about physical phenomena. It also expects future elementary teachers to apply their integrated understanding of CK and PCK to developing age-appropriate lesson plans to teach physical science concepts in an elementary science classroom.

The expected outcome of this project is that future teachers completing the course will be able to design lesson plans that demonstrate a deep understanding of both content and pedagogy. Further these future teachers will show positive improvements on surveys that measure their views about science and beliefs about learning science. As a result of this course we expect a statistically significant increase in the number of future elementary teachers concentrating in science at Kansas State University (KSU).

Intellectual Merit: The intellectual merit of this project lies in the following attributes. We:

- bring together a team of experienced discipline-based education researchers with researchers and teacher educators in the College of Education to develop strategies that integrate the learning of science and pedagogy in a single course;
- propose an instructional model – pedagogical learning bicycle (PLB) – that integrates the learning of science content with the learning of pedagogical content so that future teachers see a greater relevance of science in their future roles in an elementary classroom;
- provide opportunities for future elementary teachers to apply their conceptual content knowledge and pedagogical content knowledge to develop lesson plans and instructional strategies that can be implemented in a real classroom.

Broader Impacts: The project will have the following impact beyond its immediate scope.

- It will provide an effective and sustainable instructional model – PLB – that can be adapted to other large enrollment science classes for future elementary teachers.
- The research emerging from the evaluation of this project will shed new light on whether and how future elementary teachers develop PCK within the context of a science content course.
- The course in which this project is implemented will be sustained at KSU without the use of additional staff, so in future years beyond the project it will continue to produce a cadre of capable elementary teachers who choose to concentrate in science.