Learning to Teach Elementary Mathematics and Science: A Global Learning Dimension

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Abstract
Research and experience suggest that structured reflections and metacognitive thinking positively influence prospective teachers’ pedagogical content knowledge (PCK), and beliefs and attitudes (dispositions) about mathematics and science learning and teaching. To provide a motivating learning environment for such activities, prospective teachers from different educational cultures will be paired in a global learning project. They will (1) engage in interactive (online) reflective journaling based on experiences that combine content and pedagogy and (2) have an opportunity to design a sequence of activities to teach a mathematics and science concept that will be displayed on joint web pages. The project is guided by a series of questions about the effects of cross-cultural shared experiences on the development of specific PCK and on prospective teachers’ dispositions?

Introduction
There is a need to develop a greater self-efficacy related to mathematics and science learning and teaching in elementary teachers. Many have negative beliefs, attitudes and anxieties about learning mathematics and science that constitute a significant barrier to teaching these subjects in a meaningful way. They developed their beliefs over time before entering the university. Changing these undesirable dispositions takes time ([5]) and teacher educators in the USA and Australia are making efforts to overcome this barrier ([7], [8], [9], [10]).

Reflective teacher educators positively affect the education experiences of their students both in the development of positive dispositions and PCK ([2], [3], [4], [5]). Abell and Bryan ([1]) designed their elementary science methods course around “(t)he reflection orientation ... grounded in the belief that learning to teach science, like learning science itself, is a process of re-evaluating and reforming one’s existing theories in light of perturbing evidence (p.154).”

The aim of this project ([6]) is to enrich the diversity of cultural perspectives to which students of elementary education are exposed by teaming them with their counterparts in sister classes at collaborating overseas institutions. Students at Wichita State University (WSU) in the USA are sharing learning experiences with their counterparts at Queensland University of Technology (QUT) in Australia.

Learning Environment
At WSU, students of elementary education take an integrated mathematics and science methods class in the first semester of their senior year, just prior to their student teaching semester. Reflective practice is nurtured to ensure a supportive environment that addresses the barrier of teachers’ negative beliefs, attitudes and anxieties. Student responses to weekly online reflective questions focus attention on a number of issues related to teacher dispositions and topics arising from classroom activities. Reflections allow faculty to gain insight into the thinking of students, and these insights guide their efforts to cultivate effective mathematics and science teaching. In addition, students have increased opportunities to form the habit of reflective journaling. Anecdotal evidence suggests that students are particularly motivated to examine their thoughts in relation to those of their classmates. Online synopses of their responses often raise the level of interest and result in further discussions about students’ positive growth in PCK and dispositions.

Reflective thinking is fostered in lesson preparation and teaching assignments. Lesson planning and peer teaching requires a reflection on the process and product. The course culminates in a five-week field experience with opportunities that demand reflection on teaching in the elementary classroom. For most of the students, the primary concern expressed in the latter reflections is about classroom management, but there are always some who recognize the need to reflect more directly on their mathematics and science related PCK.

To encourage more students to recognize this need, Teacher’s Inquiry into Children’s Knowledge and Learning Evolvement (TICKLE) was designed as a set of assignments to make the connection between content learning and teaching practice more apparent to the
A New Dimension: Global Learning

Global learning is more than merely distance learning, more than just the application of communication technology. It is concerned with learning at a distance plus diverse cultural perspectives, language differences, time zone differences and making the best use of innovative pedagogical strategies along with appropriate enabling communication technologies. The students achieve global awareness for the topic being studied moving from the number and nature of perspectives encountered on one campus or in one region or country to the global arena.

Diversity of learners, even within a single classroom, demands a diversity of teaching approaches. As expected in the presence of student diversity, multiple strategies have met with mixed success. Some students respond to a given strategy and others respond to significantly different ones. However, the common thread among successful strategies has been an emphasis on reflective thinking about learning, and learning to teach mathematics and science. With this in mind, this project is attempting to extend the reflective, metacognitive environment by pairing students at WSU with their counterparts at QUT to determine how cross-cultural reflection and communication affect students’ learning and dispositions.

To be acquainted with each other’s dispositions, paired students co-reflect via email. They engage in guided reflections centered on questions related to their personal beliefs about teaching and learning mathematics and science. This ongoing reflective practice provides a supportive learning environment to encourage the changing of undesirable dispositions and the development of mathematics and science activities for teaching with understanding ([3]). The project is an integral part of the course throughout the semester in the form of discussion groups and specific assignments in content and pedagogy.

Students at both universities have an opportunity to work with the same mathematics and science curriculum. Based on this curriculum, pairs of students develop and may publish on the web a collection of activities. In the process of designing these activities, students are exchanging guided reflections on their individual learning as well as the collaborative, creative process in order to support meta-cognitive thinking and learning in the development of PCK and positive dispositions.

Expectations

For WSU and QUT faculty and students, a global learning environment designed in this manner provides reflective opportunities through content-specific dialogue. These cross-cultural shared experiences should positively affect students’ development of PCK and bring about positive changes in their evolving dispositions. Through reflective dialogue the self-efficacy of students and their appreciation of learning in other cultures should be enhanced. It is also expected that students will gain an appreciation that some elements of mathematics/science anxiety are universal across cultures while others are dependent on the cultural context. This supports a major goal of the teacher education program to prepare students to teach in a multicultural, global community.

References