Linking Teaching Beliefs to Classroom Practice: A Profile of Three Physics Teachers

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Abstract: The study looked at beliefs about teaching Physics held by three faculty members of the Physics Department, College of Science, De La Salle University - Manila (Philippines) and determined how much of these beliefs find their way into actual classroom practice. Using the Maryland Physics Expectations Survey (MPEX), teachers' predispositions, values, and assumptions were documented. Classroom observation data, using the Reformed Teaching Observation Protocol (RTOP) form the "classroom practice" component of the study. These data will be a valuable input into a possible framework in teaching collegiate-level Physics in the Philippines.
Keywords: beliefs, Physics teachers, Reformed Teaching Observation Protocol, Maryland Physics Expectations Survey

Introduction

Research in math and science education suggests that "teacher beliefs about what mathematics and science is" and "what it means to know the content, do mathematical and scientific activities, and teach mathematics and the sciences" may be driving forces in the instruction of science and math ideas (Clark and Peterson, 1986). By challenging a teacher to explicitly state implicit beliefs, the teacher can question and critique her / his own teaching process.

Raymund and Santos (1995) cite Clark and Peterson's (1986) work on teachers' thought processes where they note the importance of understanding teachers' and preservice teachers' implicit theories and beliefs about education, as these beliefs have an impact on classroom teaching. The exploration of teachers' cognition has led to the development of innovative methods for collecting evidence about teaching (Calderhead, 1996). Teachers' thought processes have been "recorded" through think-aloud commentaries, structured interviews, and teacher's talk. Detailed case studies of teaching and interview protocols have resulted in well-documented and insightful accounts of teachers' thoughts and practice. Teachers' own accounts of their teaching, in the form of diaries, stories, or journal entries, have also been used increasingly to describe teachers' cognition.

In the Philippine setting, Bernardo, Prudente, and Limjap (2003) generated baseline data to describe current teaching practices in primary- and secondary-level mathematics and science classrooms. The data gathered using the survey instrument developed by the group indicated a leaning towards an inquiry-oriented approach to teaching mathematics and science. Classroom observation, however, painted a somewhat different picture. The teachers' questions reflected a transmissive classroom atmosphere that emphasized lower level types of knowledge and thinking processes. The teachers generally believed in the goals and features of an inquiry-oriented mathematics and science education, as reflected in their lessons plans; however, the implementation of the lesson plan was not always realized, as most of the time, the teacher seems unable to bring the students to a higher level of thinking and understanding.

The present study investigated the beliefs about Physics teaching held by three faculty members of the De La Salle University - Manila Physics Department and sought how much of these beliefs translate into classroom strategies and practices. Specifically, the study attempted to answer the following questions:

a) What are the pedagogical beliefs held by faculty members?
b) Are these pedagogical beliefs reflected in the faculty members' classroom practices?

Discussion

At the beginning of the third trimester of schoolyear 2005-2006, the faculty participants took the Maryland Physics Expectations (MPEX) Survey. The MPEX is a 34-item Likert-scale survey that probes attitudes, beliefs, and assumptions about Physics. The survey was developed by the Department of Physics, University of Maryland (Redish, et al., 1998). The six dimensions of learning Physics that is being probed by the MPEX include: Independence, Coherence, Concepts, Reality Link, Mathematics Link, and Effort Link.

Three dimensions of the survey are taken from David Hammer's research (1994) on epistemological beliefs. These dimensions are:

- Independence – beliefs about learning physics – the learner takes responsibility for constructing her/his own understanding or the learner takes what is given by authorities (teacher, textbook) without evaluation.
- Coherence – beliefs about the structure of physics knowledge – the learner believes physics needs to be considered as a connected consistent framework or the learner believes that parts of physics can be treated as unrelated facts or pieces.
- Concepts – beliefs about the content of physics knowledge – the learner attempts to understand the underlying ideas and concepts or the learner focuses on memorizing and using formulas.

The dimensions that the Maryland Physics Education Research Group (Redish, et al., 1998) added include:

- Reality Link – beliefs about the connection between physics and reality – the learner believes that ideas learned in physics are relevant and useful in a wide variety of real contexts or the learner believes that ideas learned in physics has little relation to experiences outside the classroom.

- Math Link – beliefs about the role of mathematics in learning physics – the learner considers mathematics as a convenient way of representing physical phenomena or the learner views physics and math as independent with little relationship between them.
- Effort Link – beliefs about the kind of activities and work necessary to make sense out of physics – the learner makes the effort to use available information and make sense out of it or the learner does not attempt to use available information effectively.

The atmosphere of the class, the teaching strategies used by the teacher, the level and types of questions raised in class, and the problem solving strategies presented by the teacher and the students were documented using the observation protocol, Reformed Teaching Observation Protocol (MacIsaac and Falconer, 2002). The instrument is designed to constructively critique details of classroom practice including cooperative learning, interactive engagements, and certain classes of Physics Education Research activities, as well as findings collectively known as pedagogical content knowledge. Wyckoff (2001) reported that teachers who have used the RTOP find that it is useful as a checklist for lesson planning purposes, in the mentoring and professional development of new or student teachers, and for the teacher's own pedagogical growth.

The RTOP instrument is divided into five major sections: (a) Lesson Design and Implementation, (b) Propositional Content Knowledge, (c) Procedural Content Knowledge, (d) Classroom Culture (Communicative Interactions), and (e) Classroom Culture (Student-Teacher Relationships). Each section includes five observable classroom behaviors or items scored from zero [not observed] to four [very descriptive] (Piburn, et. al., 2000). MacIsaac and Falconer (2002) report that any RTOP score greater than fifty (50) indicates a considerable presence of reformed teaching in a lesson.

The study documented how teacher's beliefs influence their actions and practices in the classroom. The teachers who participated in the study gave highest favorable responses on the Maryland Physics Expectations Survey (MPEX) Concepts cluster [see figure 1]. They view learning Physics as primarily understanding underlying ideas and concepts rather than simply focusing on memorizing equations and formulas. This view is supported by their classroom observation data, obtained using the Reformed Teaching Observation Protocol, where they scored highest in the Propositional Content Knowledge subscale [see figure 2]. Teachers ensured that lessons highlighted fundamental concepts by giving specific examples, showing relationship between concepts, and moving from simple to complex problems.

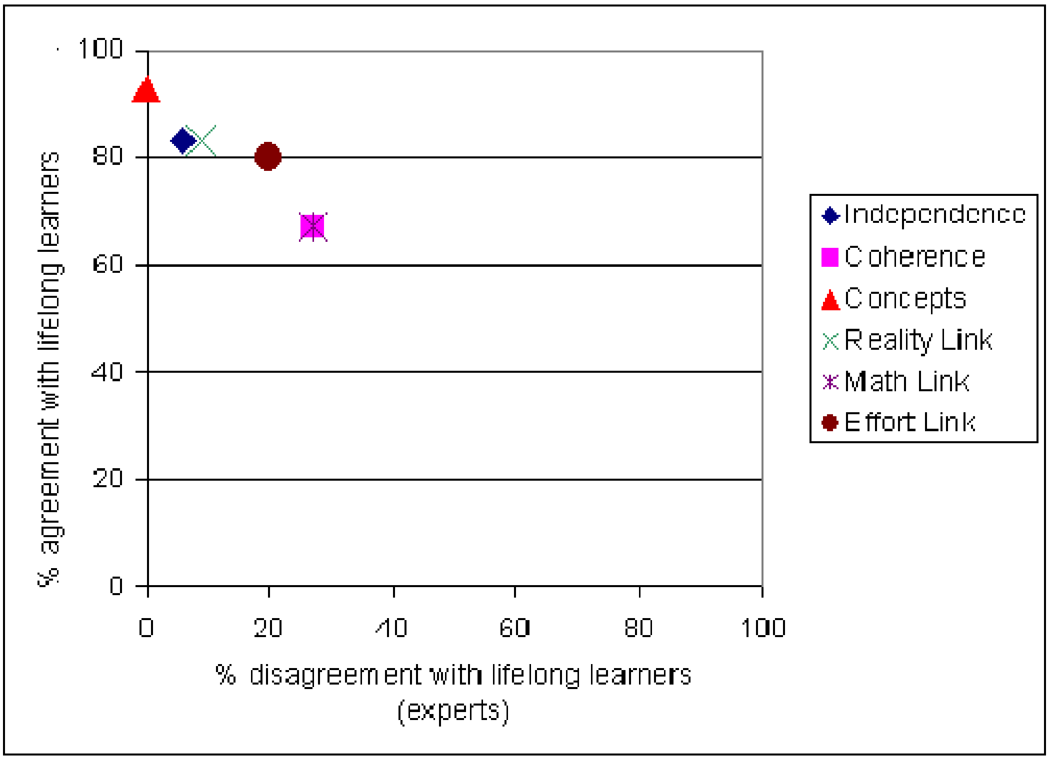

Figure 1: *MPEX Profile of the Teachers who Participated in the Study*

During classroom discussion, the teachers ensured that connections between physics content and real-world phenomena were made. This verified the teachers' beliefs about the value of the Reality Link dimension of MPEX.

The teachers view the process of learning Physics as not simply agreeing with everything that is written in the text. The MPEX Independence cluster advocates that the learner should take responsibility for constructing understanding. Classroom observation validated this view, wherein the design of the lesson (small group discussion) allowed students to actively participate in the "construction" of new knowledge.

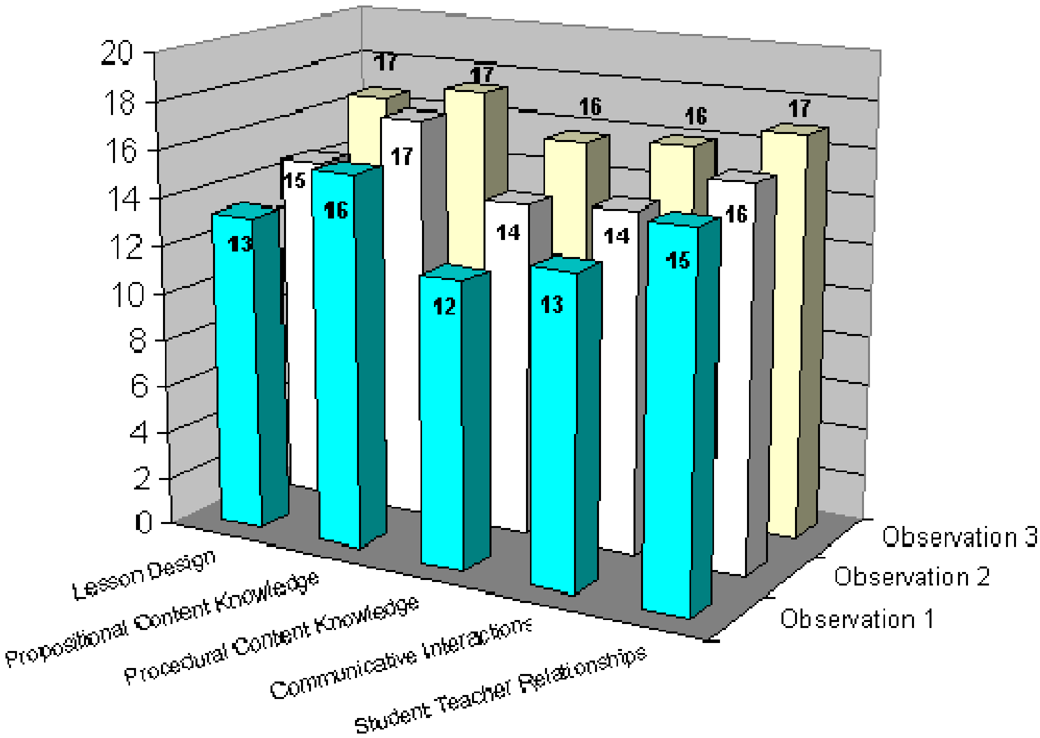

Figure 2: *RTOP Profile of the Teachers who Participated in the Study*

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