

## Third Misconceptions Seminar Proceedings (1993)

Paper Title: **The Application of "Misconception" Research Experiences in Teacher Education: Integrating Misconception Research into the Classroom**

Author: Furuness, Linda K.B.

Abstract: Much misconception research has been published since the mid 1970's. And, some of the suggested "treatments" have been tested in classrooms. However, there appears to be very little published about how teachers have come to understand the misconception literature and how successful they have been in implementing this knowledge in their classrooms. In truth, getting teachers to understand the research itself and then integrating it into their classroom curricula is the most difficult aspect of bringing about conceptual change in students. This paper outlines a graduate science education course for teachers offered at Indiana University Purdue University Indianapolis (IUPUI) that attempts to address the above problem.

Keywords: teacher education, educational methods, concept formation, teaching for conceptual change, instructional development, misconceptions, constructivist teaching,,

General School Subject: all sciences

Specific School Subject:

Students: graduate (teachers)

Macintosh File Name: Furuness - Teacher Education

Release Date: 2-9-1994 E, 11-7-1994 I

Publisher: Misconceptions Trust

Publisher Location: Ithaca, NY

Volume Name: The Proceedings of the Third International Seminar on Misconceptions and Educational Strategies in Science and Mathematics

Publication Year: 1993

Conference Date: August 1-4, 1993

Contact Information (correct as of 12-23-2010):

Web: [www.mlrg.org](http://www.mlrg.org)

Email: [info@mlrg.org](mailto:info@mlrg.org)

A Correct Reference Format: Author, Paper Title in The Proceedings of the Third International Seminar on Misconceptions and Educational Strategies in Science and Mathematics, Misconceptions Trust: Ithaca, NY (1993).

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# **The Application of "Misconception" Research Experiences in Teacher Education: Integrating Misconception Research into the Classroom**

Linda K.B. Furuness, Indiana University-Purdue University Indianapolis, Indiana, U.S.A.

Much misconception research has been published since the mid 1970's. And, some of the suggested "treatments" have been tested in classrooms. However, there appears to be very little published about how teachers have come to understand the misconception literature and how successful they have been in implementing this knowledge in their classrooms. In truth, getting teachers to understand the research itself and then integrating it into their classroom curricula is the most difficult aspect of bringing about conceptual change in students. This paper outlines a graduate science education course for teachers offered at Indiana University Purdue University Indianapolis (IUPUI) that attempts to address the above problem.

## **COURSE RATIONALE**

IUPUI's graduate education program includes not only graduate course work, but also a master's thesis or practicum. Graduate students must engage in original research in order to complete either of these latter requirements. Most of the university's undergraduate science education programs focus on science content, teaching methodology such as the learning cycle, and the science process skills. As a result, few teachers are aware of the impact misconceptions have on their teaching science. In order for teachers to understand the constructivist paradigm and the impact that their students' conceptions have on learning it is important for them to become acquainted with the research supporting these ideas and experience first-hand the effects of the misconceptions of their students.

## **COURSE OUTLINE**

The 3 credit hour course is held one night a week for a full semester. It is open to elementary and secondary school teachers and prospective teachers. Most of the graduate students are currently teaching in one of the area school systems. Those who are not are usually working with a school system as aides. (In order to distinguish between the graduate students participating in the class and their own students, this paper will refer to the graduate students as teachers.)

The goals of the course are to 1) understand what a science concept is and be able to identify science concepts; 2) gain knowledge about the misconception research literature; 3) develop skills in identifying student misconceptions, constructing instructional tools to address these misconceptions, and assessing conceptual learning; and 4) gain an understanding of the constructivist paradigm and associated theories.

The course content relies heavily on the Osborne and Freyberg (1985) book, *Learning in Science: The implications of children's science* as well as original articles by Gilbert and Watts (1983), Clough and Driver (1985), Erickson (1979), and Shapiro (1989), to name but a few. The format of the class provides hands-on examples of typical science activities that illustrate misconceptions as well as discussions of the constructivist paradigm, interview techniques, analysis methodologies, implications of the research for teaching and other related reading topics.

Course assignments in addition to the readings are three-fold:

1) The teachers are to choose a science concept that they will be teaching to their own students later on in the semester and research the misconception literature pertaining to it. They are to write a paper reporting on and evaluating this research.

This aspect of the course encourages the teachers to use the university library to a much greater extent than do other courses because much of the published research is in foreign journals or on ERIC documents. Some of the research is unpublished. Other information must be requested through interlibrary loans. Hence, they develop the skill to pursue information that may not be readily available, but none the less valuable.

2) The teachers are to conduct clinical interviews with ten of their own students using two different interview techniques (five students for each technique) on the concept that they have chosen to study. The interview techniques may be drawn from the literature readings or creations of the teacher's own choosing. In the past the teachers have used a variety of techniques ranging from open format questionnaires to Interview-about-Instances or Events (Osborne and Freyberg (1985) to Draw and Describe (Furness, 1992) to actual demonstrations or hands-on activities. One teacher who was studying projectile motion devised a tandem bicycle so that the interviewees could experience the concept while being interviewed. The interviews are generally audiorecorded (but may be videorecorded) and analyzed for conceptual understanding.

The teachers learn how to develop a grid to analyze the interviews and then how to correlate similar statements or meanings into broader conceptual understandings or misunderstandings. These are then compared with the literature review results in paper #1.

3) The teachers develop a unit or series of lesson plans that can address the misconceptions that they have learned about through their research. These include activities, content, and assessment techniques. These lesson plans are then tested out in the teachers' own classrooms

and evaluated as to their effectiveness. This final assignment is shared either in a classroom presentation or in a paper.

### **OBSERVED EFFECTS OF THIS TYPE OF COURSE**

It is interesting to note that although most teachers are in agreement with the constructivist approach to learning, they are initially skeptical of the research data on misconceptions. It appears to be difficult for them to believe that their students hold the kinds of misconceptions that are reported. In most cases, their interview data confirmed the research data that the teachers had previously collected. They were amazed not only at what they had discovered that their students believed, but that the research in most cases was actually true. It seems to say something about the way that science education research is viewed in the practicing community!

A second aspect of the course that has proven to be interesting is that during the interviews the teachers frequently ask their students questions that they would never consider asking in the classroom setting, for example, "Why do you think . . .?" The interviews seemed to encourage the teachers to ask more open-ended questions of their students during class sessions once they had practiced this technique with the interviews.

For a number of the teachers there occurred a change in the relationship that they had with their students. Participating interviewees were told that they were not going to be graded on their responses and that the teacher was just trying to find out what they thought or understood about a particular idea or concept. Frequently, the teachers told their interviewees that the interview was for a class that they were taking. That a teacher would be really interested in what a student thought and not just whether he had the right answer seemed to encourage a more open, trusting relationship between students and the classroom teacher. Several of the teachers have reported that this change in relationship occurred.

Finally, the teachers generally appeared to value the work that they did and expressed a desire to try some of the research and student interviewing with other science concepts that they teach in their classroom. Obviously, this process is very time consuming in that each interview usually lasts approximately 15 minutes. This does not include the additional time spent in analyzing the responses. But the teachers concluded that what they learned about their students' conceptual understanding was well worth the time. Certainly, this is one way the valuable research can be integrated in positive teaching methodology.

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