Theory and Research on the Development of Expertise in Science Teaching

ED832
Winter 2012
Tuesdays, 4-7 PM
2225 SEB

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Course Introduction

In this course, we will focus on the learning and development of preservice and inservice elementary and secondary science teachers. For those of you interested in doing research on teachers and teacher learning, the course will help you get grounded in relevant theoretical constructs and research approaches for this work. For those of you whose research interests rest in other areas within science education, the course should help you get a broader perspective and develop your own thinking as a science educator. Most of you will likely teach science methods courses and/or design or lead professional development for teachers at some point in your career, and the course should support you in preparing for those efforts.

We'll spend the first half of the course reading literature on teacher knowledge, beliefs, learning, vision, decision-making, and practice; developing a working definition of "expertise in science teaching" from the standpoint of which we'll consider what we read; and investigating how that expertise affects teachers' practice and students' learning. The second half of the course explores how we can promote the development of teachers' expertise. We'll read conceptual work as well as research articles demonstrating how different strategies play out in practice. At the same time, we'll consider similarities and differences between different types of teachers, through reading some reviews about and empirical work on teacher education, professional development, and teachers.

In both portions of the course, we'll read primarily science-focused work, though some more general pieces and some pieces focused on other subject areas are included to provide a strong foundation for our thinking about science-specific issues. The reading is about equally split between issues in teacher education (for preservice teachers) and professional development (for inservice teachers), and between issues having to do with elementary and secondary teachers. Of course, much of the reading crosses disciplinary, age-level, and years-in-service lines.

The readings are posted on CTools.
Assignments

Weekly reading and participation (20%)  
You will be expected to read and carefully consider each of the weekly reading assignments and to participate in class discussions of the readings each week. You will be expected to justify your ideas with relevant literature in these discussions. Each week one student will be responsible for developing annotations of the readings, posting the annotations to CTools, and taking some leadership for the discussion of the readings; each student will be responsible for two weeks during the term. I will provide instructions for and models of the annotations. Annotations should be posted by noon on the Sunday before the class and should be revised as appropriate after the class. If you are unable to attend class, you must turn in a short written reaction to the readings for that class.

Mid-semester “teacher expertise” paper (30%)  
Using the literature we’ve explored thus far, first define “expertise in science teaching.” What does a teacher need to know and be able to do? Be sure you are drawing on and synthesizing the literature we’ve read, not just going by your intuition as a teacher. Then, explore possible research directions in this area. What does your definition of expertise leave you wondering about?

This paper should be no more than 10 pages using 1-1/2 spacing. You may want to include diagrams, concept maps, or other visual representations of your ideas. You must use APA styles for this and all of your papers for this class. The paper is due February 14.

Final project (50%)  
For the final course project, you should choose an option that works best for you. It is appropriate to use this as an opportunity to develop ideas or materials you may use in your scholarly paper (Prelim Part A) or dissertation; anticipated overlaps and synergies should be made clear to all relevant faculty members at the outset. Options described here include a literature review or the design of a learning environment. Other options are possible but must be cleared in advance by the instructor. You must use APA styles for this and all of your papers for this class.

You will complete this paper in several phases:
   - a three-page outline is due March 6
   - an expanded outline is due March 20
   - the class poster fair is April 10
   - the final paper is due by noon on April 18

If you have special needs for which accommodations may be needed, please inform me as soon as possible.
Final Project Option 1: Literature Review

Develop a literature review analyzing a trend, issue, or concept relating to the development of expertise in science teaching. Possible focuses include:

- What is effective science teaching? How do you know it when you see it?
- How do (elementary, secondary, or both) preservice or inservice science teachers develop expertise in science teaching? What is the role of knowledge in science teacher development? What is the relationship among knowledge, beliefs, and practice?
- What are high-leverage teaching practices in science? How can or do we support preservice teachers in being able to engage in the high-leverage practices around which the UM teacher education program is organized?
- What is necessary in expert science teaching besides knowledge? How do teachers use their knowledge in the moments of teaching?
- How effective are various strategies for promoting expertise? What do we know about supporting teacher learning?
- What are the similarities and differences between preservice and inservice science teachers? among elementary, secondary, and post-secondary science teachers?
- What is the trajectory as science teachers develop from preservice teachers to new teachers? What characterizes the development of their expertise?
- How are new conceptualizations of knowledge for teaching influencing current literature on science teaching, science teacher education, or science teacher learning? How are new conceptualizations of teaching practice influencing these literatures?

Procedure for the literature review paper:
1. Choose a particular issue related to the development of expertise in science teaching, either one of those listed above or another of your own.
2. Using course readings, the references available through course and other readings, and resources, gather a set of approximately 10-15 papers that discuss your focus topic. Make sure you are drawing on some readings from the course and some that you've found on your own.
3. Read, review and take notes on these readings. What are some themes or areas of commonality? What are areas of conflict? Where are there holes?
4. Try to determine both the key ideas in the literature, and your own perspective on this topic. Where do your views lie relative to these readings, and why? What evidence or theories support your stance? Be sure to represent your original thinking in your final paper.
5. Begin to write only after careful planning. Plan for an organized and coherent document through revisions of outlines before you write. Think about how you can develop an argument. Make sure you're not just summarizing each paper.
**Final Project Option 2: Learning Environment**

For this assignment, you will develop or mock-up a **learning environment** (or component of a learning environment), intended to promote the development of expertise in one or more preservice or inservice teachers. It may be focused on an individual (e.g., a student teacher; a teacher involved in a professional development program) or a group (e.g., a science methods class; a community of teachers working on their own professional development). You can choose from the suggestions listed below, or propose your own alternative:

- develop curriculum materials or activities to use in a science methods class or course or a professional development session or program
- develop a technology-mediated learning experience to be used with teachers
- develop a text or video case to use with preservice or inservice teachers and an opportunity to reflect on the case
- design a series of approximations of practice for use with preservice teachers learning high-leverage science teaching practices
- make an existing set of curriculum materials "educative" for teachers or design a new educative feature for an existing set of educative curriculum materials
- develop a syllabus for a science methods class you intend to teach
- develop a library of materials for science teacher educators to use in supporting preservice teacher learning

For this option, your focus should be on describing the theoretical foundations of your design. However, to be successful at doing so, you will need to at least mock-up the learning environment or component. You are welcome to fully develop it, if that makes sense for your situation. Your design must address either preservice teacher education or inservice teacher professional development. The learning environment must address teacher expertise as you define it.

**Procedure for the learning environment paper:**

1. Think about, in some detail, the learning environment that you are focusing on. What aspect(s) of expertise will the learning environment address? Who is the target audience and what challenges might they face in learning the specific concepts? What learning objectives do you want teachers to meet?
2. Now select the key component(s) you will be developing. Gather a set of readings that can serve as foundational research to help guide your design (probably around 10-15 papers, many of which should be from ED832). Read, review and take notes on these readings. Develop key ideas for your design, including ideas for how your design builds on particular learning theories and research in science education and teacher education.
3. Outline the ideas and foundations on which your design will build to be explored in the paper.
4. Begin to design your learning environment only after careful planning. Make sure you have thought through relevant issues and are grounding your ideas in the literature.
5. Begin to write only after careful planning. Plan for an organized and coherent document through revisions of outlines before you write.
What is Expected in the Three Page Outline Due March 6?
Provide an approximately 3-page outline, concept map or plan that articulates the major components of your final research paper. Include

- a tentative title
- an initial abstract
- a note about which type of paper you are writing (lit review or learning environment)
- the outline itself
- a beginning references list

Be sure to describe the foundational research that serves as background for your ideas, including literature from ED832. Also address the following questions.

- What ideas will you present in the introduction to frame your study?
- What ideas and/or papers will you explore within the paper body?
- What summary, implications, or conclusions will wrap up your review or design?
- What remaining resources, questions, or concerns do you have at this point?

What is Expected in the Expanded Outline Due March 20?
This document should address any comments or ideas you've gotten from your peers and the instructor. This document should be more fully developed than the March 6 document, showing both organizational and conceptual development. Be sure to include or address all the items listed for the three page outline.

What is Expected on April 10, the Final Class Poster Session?
A poster or some other visual piece that you can share with the class on the final class session, based on your final paper. We will have a class poster fair to review everyone’s work. Please do not print a big, fancy poster like you might do for a conference.

What is Expected in the Final Paper Due by noon on April 18?
Papers will be judged on (a) quality and quantity of ideas presented, overall; (b) quality and quantity of literature discussed; (c) quality of original contributions; and (d) clarity of presentation and organization and coherence of ideas. All final papers must use APA styles and correct English grammar. Make sure it is clear which type of paper you are writing (lit review or learning environment). You must cite multiple papers read for class, and you must cite some literature not read for class, as well. (See the reading list at the end of this syllabus for pointers to literature that may be of interest.) It is entirely appropriate, and in fact encouraged, that you would cite literature from other science education courses in this paper. The final papers may be done individually or with one other person in the class. The papers should be approximately 15 pages in length, using 1-1/2 spacing. Make sure your paper contains:

- A title
- A 200 word or less abstract
- An introduction outlining the major ideas and major justification for these ideas
- Paper body with appropriate citations in APA format
- A conclusion including a discussion of educational implications of this work
- A reference list in APA format – full citations for all literature and documents discussed including web pages, journal articles, and curricula
Teacher Expertise

**Week 1 January 10**

*Introduction*

In class: Develop an initial definition of teacher expertise today. Return to this throughout course.

**Week 2 January 17**

*Developing Expertise: Starting Points*

Annotations: Betsy


**Week 3 January 24**

*PCK and Knowledge for Teaching*

Annotations: Michelle

In class: Return to ideas about teacher expertise.


Optional additional reading:

Week 4  January 31  Expertise for Teaching for Scientific Practices

Annotations: Carrie-Anne


Week 5  February 7  Teaching Practice

Annotations: Sania

Assignments and milestones: Come to class prepared to discuss your Teacher Expertise paper.

In class: Pairs of students will discuss your Expertise papers. Consider teacher knowledge and teacher practice.


Annotations: Anna

Assignments and milestones: Teacher Expertise paper is due.

In class: Return to ideas about teacher expertise.


In addition, choose to read one or more of the following. Please email Betsy by February 10 to let her know which one(s) you will be reading.


Promoting the Development of Expertise

Week 7  February 21  Teacher Education and Beginning Teachers

Annotations: Michelle

In class: Looking in depth at preservice teachers and teacher education—ED421 as an example.


February 28  No Class: Winter Break

Week 8  March 6  Induction and Beginning Teachers

Annotations: Carrie-Anne

Assignments and milestones: 3-page outline for final paper is due.

In class: Pairs of students will discuss ideas for final paper.


**Week 9  March 13**

**Supporting Practicing Teachers**

Annotations: Anna

In class: Return to ideas about expertise. Incorporate ideas about supporting the development of expertise.


**Week 10  March 20**

**Learning with Curriculum Materials**

Annotations: Sania

Assignments and milestones: Expanded outline for final paper is due.

In class: Pairs of students will share ideas and struggles with final paper.


**March 27**

**No Class: NARST**
**Week 11  April 3**  
*Preparing Teacher Educators*

Annotations: Betsy

In class: Return to ideas about expertise. Pull together ideas from across the course.


**Week 12  April 10**  
*Class Poster Fair*

In class: Class poster fair for final projects.

Assignments and milestones: Prepare poster describing final project for class on April 10.

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**April 17**  
*No Class: AERA*

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**April 18**  
*Final Paper Due*

Assignments and milestones: Final paper is due by noon on April 18.
# A Summary of Assignments

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<th>week</th>
<th>annotations</th>
<th>assignments</th>
<th>milestones / due dates</th>
<th>in class</th>
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<td>Introduction</td>
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<td>Practice</td>
<td>Be prepared to discuss expertise papers</td>
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<td>2/14</td>
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<td>Connecting</td>
<td>Expertise papers due!</td>
<td>Return to expertise</td>
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<td>Prep TE</td>
<td>Expanded outline of final papers due!</td>
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<td>4/18 (noon)</td>
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<td>Final papers due!</td>
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Other Related Reading Materials
(Or, papers I wish I could have included in the syllabus…)


