Seminar on Scientific Research in Education 85-436 & 85-736 Sample

Tuesday - Thursday 4:30 – 5:50
Instructor
Professor---

OVERVIEW OF THIS SEMINAR

The most influential piece of education legislation passed in the last decade is the 2002 "No Child Left Behind Act" (NCLB) -- officially known as the *Elementary and Secondary Education Act*. One of the most widely-known features of the law is Its emphasis on assessment: an emphasis that has wide-spread implications for the way that American children are tested – and consequently, on the way they are taught -- and the way that states, schools, and teachers are evaluated and rewarded. Associated with these issues are some politically divisive questions about (a) who will pay for the testing, (b) the appropriate balance between federal, state, and local control of K-12 education in the US, and (c) the implications for teacher reward systems. These issues, although extremely important, will *not* be the primary focus of this seminar.

A second, and perhaps more far-reaching, feature of NCLB is its repeated call for *scientifically based education research*. Consequently, the opportunity has never been greater for basic research in the learning sciences to contribute to educational practice. ***That* is the topic of this seminar.**

Questions we will address:

A focus on turning educational research into a rigorous scientific endeavor raises many challenging questions:

1. What does "scientifically based education research" mean?
   - Does it mean the sort of studies that cognitive and developmental psychologists do when they are interested in how students think about math or science or reading?
   - Does it mean massive national randomized field trials on the effect of class size or teacher training or one commercially available curriculum versus another?
   - Does it have to include the kind of emphasis on underlying mechanisms that we (@CMU at least!) are so interested in discovering?
   - Can it include non-experimental, qualitative, case studies and field demonstrations?
   - Does it require statistical significance, or large effect sizes, or both?
   - Must it include new technologies that go beyond traditional teacher-student interactions?
2. What constitutes a treatment or an independent variable? Possible answers:
   lesson content, instructional method, teacher qualifications, student attributes, educational “philosophy” & “approach”
3. What is the appropriate grain size of the measurements and analyses: individual students, classrooms, teachers, schools, school districts, states, nations?
4. How can research in cognitive science contribute to improving the science of education?

5. Can we point to examples that warrant the label of "scientifically based education research", and can such research inform policy and practice in ways that have substantial impact?

6. What happens when other stakeholders, such as practitioners, academics from other disciplines (historians, philosophers, "hard" scientists), professional groups, advocacy groups, policymakers, politicians, issue-oriented “think-tanks”, and the media begin to assess and comment on what the research enterprise is producing?

Behavioral Objectives

By the end of this course, if you do all the readings, participate actively in all the discussions and make a serious effort to produce a good term project, you will be able to

1. Describe what the phrase "scientifically based education research" means and some of the controversy about it in the field, and Identify examples that warrant that label.

2. Review an educational research project and describe what constitutes a treatment or an independent variable and an outcome measure in that project.

3. Determine the appropriate grain size for different studies with different goals with respect to the measurements and analyses of individual students, classrooms, teachers, schools, school districts, states, nations.

4. Participate constructively in a discussion on how research in cognitive science can contribute to improving the science of education.

Process & Approach

Clearly, there is enough here to fill several semesters, if not years. The approach in this introductory seminar will be "a bit of breadth and a bit of depth". We will explore these questions by:

(a) looking briefly at the history of education research,

(b) reading and discussing some of the broad policy statements, as well as a few of the highly contentious debates in the literature about the nature of educational research;

(c) reading and discussing several of the more "conventional" studies -- i.e., articles that appear in the scholarly journals in psychology, cognitive science, and education and that focus on how children learn math and science. These different types of papers will be interleaved throughout the course so that we get a sense of the interaction between basic research in education and "hot" policy issues.

OVERALL ORGANIZATION OF TOPICS

Scientists, historians, and philosophers of science have debated the nature of "scientific research" in education for more than 100 years, and politicians have added their own twists whenever it suited them. This is quite a fascinating history, and could easily comprise a course of its own. We don't have time for that, but we will get oriented by starting with readings from *An Elusive Science: The Troubling History of Educational Research* (Lagemann, 2000). Next, we will read a recent publication based on the deliberations of a "blue-ribbon panel" commissioned by the National Academy of Science: Shavelson & Towne (2002) *Scientific Research in Education*, as well as some critiques and commentary from different perspectives within the education research community. You can get the Lageman book from Amazon and order *SRE* directly from the publisher.[1]

Following that, we will jump into a contentious and important topic, by reading a (strongly opinionated) assessment of state science standards. Then we will selectively review some of the empirical studies in cognitive psychology, cognitive science, and cognitive development whose results might be relevant to the problem of increasing the scientific basis of proposed improvements in teaching and learning in real classrooms. We will also look at studies dealing with the creation, implementation, and evaluation of new approaches to instruction. We will examine a variety of such interventions, ranging from specific topics to entire curricula. Our focus will be primarily, but not exclusively, on science and math in elementary and middle school instruction.

All readings will be posted on the Blackboard system for easy downloading, and we will use the discussion board. (http://www.cmu.edu/blackboard/)

CLASS DEMOGRAPHICS

This is a joint graduate/advanced undergraduate seminar. For most of the graduate students, this is a required "intro" course to their program in educational research (PIER)[2]. The grad students come from several departments, including Psychology, Statistics, HCII, and the Heinz School among others. Although some of the grads have psychology undergraduate degrees, some do not, in which case they may need to do a little background reading to make up for that lack. (If you have never had a psychology research methods course, you should, at the least, work your way through one of the many web-sites devoted to research design.[3])

COGNITIVELY ORIENTED RESEARCH IN EDUCATION: BACKGROUND

The broad vision of infusing educational research with the concepts and methods associated with the "cognitive revolution" has been around for decades, although it is just beginning to reach fruition. If you are interested in this history, you should peruse John Bruer's (1993) *Schools for Thought.* Bruer -- the president of the McDonnell Foundation -- was one of the founders of its program for Cognitive Studies in Educational Practice (CSEP), which was a highly influential effort, started in the 80's, to push cognitive researchers to work on educationally relevant problems, and which was the precursor to the current research program run by IES. Bruer's book, although addressed to readers without much background in psychology or education, makes excellent contact with the central issues in instruction as well as with basic ideas in cognitive psychology. For a sample of some more recent cognitively-

[1] http://www.nap.edu/catalog/10236.html

[2] http://www.cmu.edu/pier/

[3] This one is particularly good: http://www.socialresearchmethods.net/kb/index.php

oriented instructional research, you might want to look at Carver & Klahr (2001), and if you want to go back to around the time of the Dead Sea Scrolls, you can take a look at Klahr (1976).

FORMAT

The course will be run as a participatory seminar. Your responsibilities are:

1. For each class meeting: You should do all the assigned readings prior to the class, post your responses to the Blackboard questions before noon on the day of class, and be prepared to discuss them in class;

2. For 2 or 3 meetings during the semester: You will have responsibility for leading an in-class discussion of the reading for that class. You will be given at least a week's advance notice for your specific assignment. (If there are topics on the syllabus that you are particularly interested in, let me know.) For your sessions you will be expected to:

    a. Read the paper carefully, and post a few questions about the reading on Blackboard at least 24 hours prior to the class discussion that you will be leading.

    b. Keep track of the ensuing response postings from the rest of the class for inclusion in your presentation of the paper.

    c. Lead the class discussion.

3. Near the end of the course: Deliver an in-class presentation of your term project.

4. Complete a final paper: it will be in the form of a research proposal. (details later)

GUIDELINES FOR LEADING DISCUSSIONS

1. In preparation for the discussion(s) that you will lead:.

a. Read the assignment carefully! More than once, if necessary. Make sure you understand it.

b. Post some questions that you would like your classmates to think about. Remember, the course is about Scientific Research in Education, so when considering your postings, be sure that they are relevant to the paper being discussed, and not just some random musings or passionate advocacy on your part. (Education research is highly vulnerable to this problem!! ☺) The Blackboard discussion forums for this course should not be viewed as blogs.)

2. For the in-class discussion(s) that you will lead:

a. The first part of your presentation should summarize the main reading. Even though you can assume that everyone has done the reading, they have probably not read it as carefully as you have, so this is your chance to summarize and clarify:

What's the point of the paper?

What question is being addressed?

How was it answered? Summarize the following aspects of the paper:

Argument; Evidence & procedure; Conclusions; Importance/Relevance

b. The second part could be anything additional that you might bring to the discussion, e.g.:

Additional knowledge, experience, expertise. and personal perspective.

Your understanding of where the authors are "coming from".

You might want to organize an activity, some small discussion groups, a debate over an issue, etc. etc. As long as it is germane to the reading.

c. At some point during your class, you must include some discussion of your classmates' responses to your Blackboard questions.

Not necessarily in the order that they come up

Not every point: Seek some interesting points of agreement or conflict and air them in class.

GRADING

Your final grade for the course will be based on:

1. Class participation (25%): this includes posting your response to the "questions of the day" on Blackboard, attending class, and thoughtful and constructive participation in the class discussions.
2. Quality of your leading of class discussions (25%): based on a good review of its essential points, good questions about the paper, and good responses to other's questions about the topic.
3. In-class Presentation of final paper (15%)
4. Final Paper (35%)

Of course, the actual "scoring" of these activities will be a subjective judgment on my part, but I try to be fair and consistent. I do not grade on a curve, so it is possible for everyone in this course to get a very good grade.

Date	Topic	Readings (PRIOR to CLASS Meeting)
Tu 1/15	Seminar goals & procedures (PIER history and status) Students' interests and experience. A brief history of educational research (scientific or not?);	Miller (1999) Lagemann: ix-xvii, 1-22; 159-183
Th 1/17	"Troubling History" continued	Lagemann 184-230
Tu 1/22	The state of educational research: (intro) "Scientific Research in Education"	Shavelson & Towne (2000), SRE C1: Intro C2: Accumulation of Scientific Knowledge C3: Guiding Principles ….
Th 1/24	"Scientific Research in Education" ..continued	C4: Features of Ed. & Ed. Rsh. C5: Designs for conduct of SRE C6: Designs for Federal Research Agency
Tu 1/29	Reactions to SRE	a. Feuer, Towne, Shavelson, 2002; b. Pellegrino & Goldman, 2002; c. Berliner,2002; d. Erickson & Gutierrez, 2002; e. St. Pierre, 2002
Th 1/31	What are "The Learning Sciences"?	Nathan & Alibali (2010)
Tu 2/5	Reality tests: An example from the real world of State science standards	a. Fordham Institute (2005) thru p26, b. then: Alabama, California, and Pennsylvania reports. c. Pennsylvania Dept of Education (2002) d. Woolf (2007).
Th 2/7	Why not more use of Random Assignment in Ed Research?	Cook (2003)
Tu 2/12	Is the Gold Standard really gold?	McCall & Green (2004)
Th 2/14	Complex interventions: "Design Experiments"	Lehrer & Schauble (2004)
Tu 2/19	Analogical reasoning. in Science Instruction in Math Instruction	 Clement (1993) Richland, Holyoak, & Stigler, (2004
Th 2/21	Do lab effects scale up? • small studies (~40 students) • large studies (~40 classes)	a. Klahr & Nigam, 2004) b. Lorch, et al, (2010)
Tu 2/26	A "concrete" question with a variety of answers: do "manipulatives" help learning?	a. Brown, McNeil, & Glenberg (2009) b. Kaminski, Sloutsky & Heckler (2009) c. Martin (2009) d. McNeil & Uttal (2009) e. Sarama & Clements (2009)
Th 2/28	Hands on what?	a. Klahr, Triona, & Williams, 2007.

Tu 3/5	Gold standard exemplar: An RCT of a familiar friend Guest lecturer: **John Pane, RAND**	Pane, et al (2010) < RAND project assessing effectiveness of Carnegie Learning's Geometry Tutor>
Th 3/7	Intelligent Tutoring. Guest lecturer: **Steve Ritter, Carnegie Learning**	a. Koedinger, Anderson, et al 1997; b. Ritter, et al (2007)
3/12 & 3/14	**SPRING BREAK**	
Tu 3/19	Course Project Introduction: IES Request for Applications (Proposals) ("RFAs"): Course projects: Preliminary discussions	http://ies.ed.gov/funding/pdf/2013_84305A.pdf Cognition & Student Learning, Math & Science Education Technology
Th 3/21	"Official" criteria for 'Scientific' Educational Research: What Works Clearing House	WWCC link http://ies.ed.gov/ncee/wwc/
Tu 3/26	Presentation and preliminary discussion of possible term projects	Be prepared to discuss in class: two possible research proposals, about 150 words each.
Th 3/28	From research findings to practical help: "Practice Guides"	Halpern, et al. Girls in Math and Science (2007) http://ies.ed.gov/ncee/wwc/pdf/practice_guides/20072003.pdf
Tu 4/2	Practice guide #2	Pashler, et al (inc. K. Koedinger) (2007) Organizing Instruction & Study to Improve student learning http://ies.ed.gov/ncee/wwc/pdf/practice_guides/20072004.pdf
Th 4/4	Educational research in the commercial world.	Resendez & Azin (2006) { assessment of "Science Explorer".}
Tu 4/9	Teacher Certification Wars: science or politics?? The attack:	Walsh (2001a) pp 1-50; (Optional: Walsh (2001b);
Th 4/11		
Sunday 4/14	By Sunday midnight: Submit preliminary ideas on Term Projects. 2 – 3 page outline; at least 5 relevant references	
Tu 4/16	**The counter attack**	Darling-Hammond & Youngs (2002)
Th. 4/18	NO CLASS (Carnival)	
Tu. 4/23	A Blast at "Constructivist" approaches"	Kirschner, Sweller, & Clark (2006)
Th 4/25	… and a response on constructivism:	a. Hmelo-Silver, Duncan & Chinn,2007; b. Kuhn, 2007; c. Schmidt, Loyens, van Gog, & Paas, 2007; d. Sweller, Kirschner, & Clark, 2007
Sun 4/28	Project proposal drafts due by Sunday @5:00	
Tu 4/30	"Research proposals" for IES	Project presentations: 1 - 5
Th 5/2	"Research proposals" for IES	Project presentations: 6 - 10
Sun 5/12		Term Projects reports due by midnight

READINGS (bold items are required, all others are optional)

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