GEORGE MASON UNIVERSITY
COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT

EDCI 811
Current Trends in Science Education Research
Fall, 2013

Instructor:	Erin E. Peters-Burton, PhD, NBCT
Date and Time:	August 26th – December 18, 2013 (Mondays, 4:30 – 7:10 pm)
Class Location:	**Innovation Hall 139**
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Office:	Thompson 1404
Office Hours:	By appointment

COURSE DESCRIPTION:

Prerequisite: EDCI 810
EDCI 811 provides an in-depth examination and analysis of literature and research in science education. Examines theoretical foundations of research studies in science education, discusses methodologies of research, critique research, and examines trends in emerging science education research. Includes presentations by science education researchers as well as opportunities for graduate students to explore research ideas with colleagues within the class.

NATURE OF COURSE DELIVERY:

This class will be delivered through face-to-face where class will meet in person. The instructor will determine the amount and delivery strategy for online learning. Course contents will be available through Blackboard as well as through synchronous platforms.

National Science Teachers Association STANDARDS: All of the standards below are addressed by building foundational knowledge regarding the emerging educational research for K-16 science in the relevant areas.
Standard 1: Content
Standard 2: Nature of Science
Standard 3: Inquiry
Standard 4: Issues
Standard 5: General teaching skills
Standard 6: Curriculum
Standard 7: Science in the community
Standard 8: Assessment
Standard 10: Professional growth

LEARNER OUTCOMES:
This course is designed to enable students to:

- Describe the role of research in science education reform.
- Describe the assumptions and epistemological underpinnings of different types of science education research.
- Describe the role of hypothesis generation in research.
- Identify the essential components of quality research in manuscript review.
- Discuss validity and reliability across different forms of science education research.
- Distinguish different forms of research and identify associated assumptions.
- Critique correlational, policy, case, ethnographic, quasi-experimental, mixed-methods, and experimental designs of research in science education.
- Identify the essential components of quality research in through NARST presentation proceedings.
- Identify personal assumptions and values related to designing science education research.

REQUIRED TEXTS:
This course will use contemporary literature found in science education journals available through the library. Readings for this course are included in the class schedule.

COURSE REQUIREMENTS AND EVALUATION CRITERIA:

A. Discussion of readings/class participation (20%)
You will discuss each week's readings through a discussion board set up for the class on Blackboard. Your postings each week should be well thought out and you should critically review each article written for the following areas:
* Summary of the article
* Quality of Abstract
* Timeliness and relevance of literature cited (how old are the citations and do they either support or refute the research questions)
* Type of research method and design
* Do results answer the research question?
* Are there implications for teacher practice and/or policy?

B. Writing Abstracts (15%)

For conference papers, research papers, theses and dissertations, you will almost always be asked to write an abstract. The main point to remember is that it must be short, because it should give a summary of your research. In fact, not only are abstracts short, they must almost always be a certain, specified length. I will give you three articles to read throughout the semester (each without an abstract) and you will need to write the abstract for each article. You will need to succinctly address the following in your abstracts:

* Establish the topic of the research.
* Give the research problem and/or main objective of the research.
* Indicate the methodology used.
* Present the main findings.
* Present the main conclusions

C. Research Design Discussion Facilitator (15%)

Locate one or more recent examples of three different research designs from current science education journals. Analyze the study and describe the following:

1. How does the case illustrate (or not) the major components of the presented research design?
2. How do the research questions facilitate the design used in the study? Could a different design have been used to answer the question(s) of interest to the research(s)?
3. What assumptions did the researcher(s) make in the process of conducting the study?
4. Are the conclusions and implications for practice appropriate for the presented data?
5. What concerns or questions do you have about this study?

Be prepared to share your overview of the analyses with a small group (about 5-10 minutes). Prior to your presentation list the reference to your study in APA format on the discussion board so interested students can locate the research.

Select three designs from the following:

*Experimental Designs
*Correlational Designs
*Survey Designs
*Case Studies
*Action Research (May be used as qualitative)
*Qualitative Designs (required as one of the three for all students)

D. Looking Forward-Looking Back Historical Report (15%)

Using current science education research journals (i.e., Journal of Research in Science Teaching, Science Education, or the International Journal of Science Education), analyze the research designs and topics used in the past year and compare the currently used designs and topics to those found in the same journal more than 15 years ago. Each student will create a matrix comparing designs for the two time periods, as well as write a brief discussion of the changes in the research directions that have taken place in the field of science education.

E. Presentation of Research (10%)

From your literature review (Historical Science Education Research & LF-LB), consider the critical ideas, trends in research, and assessment issues that are present for your area of inquiry. What are the theoretical frameworks that are used in these studies? What unanswered questions remain and what are some fruitful areas for future research? The presentation should be 10 minutes with 5 minutes for questions. Each student should be prepared to ask/challenge the presenter during those last 5 minutes.

F. Design Presentation and Written Plan (25%)

During the last quarter of the course you will apply a research design to a current science education problem in your area of interest. Students are encouraged to work with a faculty member as you frame your inquiry. You will present your design to the class in an oral presentation AND as a poster and you should submit a written research plan (10-15 pages) as the final project of this class.

G. **Grading scale**

Letter grades will be assigned as follows:

A+	97.5 - 100%,	**A**	92.5 - 97.49%,	**A-**	89.5 - 92.49%,
B+	87.5 - 89.49%,	**B**	82.5 - 87.49%,	**B-**	79.5 - 82.49%,
C	70-79.49%, and				
F	below 70%				

COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT

1. GMU Policies and Resources for students
    a. Students must adhere to the guidelines of the George Mason University Honor Code [See **http://oai.gmu.edu/honor-code/**].
    b. Students must follow the university policy for Responsible Use of Computing [See **http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/**].
    c. Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check It regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account.
    d. The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See **http://caps.gmu.edu/**].
    e. Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See **http://ods.gmu.edu/**].

f. Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
g. The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing [See **http://writingcenter.gmu.edu/**].

2. Professional Dispositions
   Students are expected to exhibit professional behaviors and dispositions at all times.
3. Core Values Commitment
   The College of Education & Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles. **http://cehd.gmu.edu/values/**

For additional information on the College of Education and Human Development, Graduate School of Education, please visit our website [See **http://gse.gmu.edu/**]

PROPOSED CLASS SCHEDULE

Class Meeting	Topic	Assignment Due	Reading Due
August 26	Introduction to class Overview and Introduction to Research in Science Education, Purposes of Research Online environment Sign up for discussion facilitation		Johnson, R.B., & Onwuegbuzie, A.J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33* (7), 14-26 Cobb, P., Confrey, J., diSessa, A., Lehrer, R., & Schauble, L. (2003). Design experiments in educational research. *Educational Researcher. 32* (1), 9-13 White, P. (2013). Who's afraid of research questions? The neglect of research question in the methods literature and a call for question-led methods teaching. *International Journal of Research & Method in Education, 36,* 213-227.
Monday, September 2 – Labor day – No class			
September 9	Purposes of Research	Blackboard posting from weekly readings	Alonzo, A. C., Kobarg, M. & Seidel, T. (2012). Pedagogical content knowledge as reflected in teacher-student interactions: Analysis of two video cases. *Journal of Research in Science Teaching, 49,* 1211-1239. Tao, Y., Oliver, M. & Venville, G. (2013). A comparison of approaches to the teaching and learning of science in Chinese and Australian elementary classrooms: Cultural and socioeconomic complexities. *Journal of Research in Science Teaching, 50,* 33-61. Osborne, J., Simon, S., Christodoulou, A., Howell-Richardson, C., & Richardson, D. 2013). Learning to argue: A study of four schools and their attempt to develop the use of argumentation as a common instructional practice and its impact on students. *Journal of Research in Science*

			Teaching, 50, 315- 347.
September 16	Science As A Way of Knowing Epistemological Frameworks- Empiricism and Rationalism The Conceptual Framework Writing an abstract	Blackboard posting from weekly readings	Zeineddin, A. & Abd-El-Khalick, F. (2010). Scientific reasoning and epistemological commitments: Coordination of theory and evidence among college science students. *Journal of Research in Science Teaching, 47,* 1964-1093. Wan, Z. H., Wong, S. L., & Zhan, Y. (2013). When nature of science meets Marxism: Aspects of nature of science taught by Chinese science teachers educators to prospective science teachers. *Science & Education, 22,* 1115-1140. Peters-Burton, E. E. & Baynard, L. R. (2012). Network analysis of beliefs about the scientific enterprise: A comparison of scientists, middle school science teachers and eighth-grade science students. *International Journal of Science Education, iFirst,* 1-37. For an overview of how to develop conceptual frameworks, see **http://www.duluth.umn.edu/~hrallis/guides/researching/litreview.html** For APA instructions on how to write an abstract, see about 2/3 down the page **http://owl.english.purdue.edu/owl/resource/560/01/**
September 23	Experimental Designs Measurement scales Quasi-Experimental Designs Non-parametric	Blackboard posting from weekly readings Abstract 1	Randler, C. & Bogner, F. X. (2008). Planning experiments in science education research: Comparison of a quasi-experimental approach with a matched pair tandem design. *International Journal of Experimental & Science Education, 3,* 95-103. Hutchison, D. & Styles, B. (2010). *A guide to running randomized controlled*

			trials for educational researchers. Slough: NFER. Read front matter on Blackboard from: Corder, G. W. & Foreman, D. I. (2009). *Nonparametric statistics for non-statisticians: A step-by-step approach.* Hoboken, NJ: Wiley.
September 30	Correlational Research Human Subjects and Research, IRB-Human Subjects Review, Sensitivity of Research With Children, Conflicts of Interest, Ethics	Blackboard posting from weekly readings Abstract 2	A graduate student's guide to determining authorship credit and authorship order. **http://www.apa.org/science/leadership/students/authorship-paper.pdf** Swarat, S., Ortony, A., & Revelle, W. (2012). Activity matters: Understanding student interest in school science. *Journal of Research in Science Teaching, 49,* 515-537. Beghetto, R. A. & Baxter, J. A. (2012). Exploring student beliefs and understanding in elementary science and mathematics. *Journal of Research in Science Teaching, 49,* 942-960. Lopez, E. J., Nandagopal, K., Shavelson, R. J., Szu, E., & Penn, J. (2013). Self-regulated learning study strategies and academic performance in undergraduate organic chemistry: An investigation examining ethnically diverse students. *Journal of Research in Science Teaching, 50,* 660-676.
October 7	Survey Research (design, validity and reliability) correlational research designs Developing a survey; In class assignment	Blackboard posting from weekly readings Survey Design for your topic of interest	Ali, M. M., Yager, R., Hacieminoglu, E., Caliskan, I. (2013). Changes in student attitudes regarding science when taught by teachers without experiences with a model professional development program. *School Science and Mathematics, 113,* 109-119. Sampson, V., Enderle, P., Grooms, J. (2013). Development and initial validation

	Basic Item Analysis for Multiple-Choice Tests Test Item Analysis Using Microsoft Excel Spreadsheet Program		of the beliefs about reformed science teaching and learning (BARSTL) questionnaire. *School Science and Mathematics, 113*, 3 – 15.
Tuesday, October 15 – Columbus Day - Monday classes meet on Tuesday	Qualitative Research: Descriptive and Theory Building Approaches, Case Studies, Ethnography Small group work of Survey	Blackboard posting from weekly readings	Price, J. F. & McNeill, K. L. (2013). Toward a lived science curriculum in intersecting figured worlds: An exploration of individual meanings in science education. *Journal of Research in Science Teaching, 50*, 501-529. Lehesvuori, S., Viiri, J., Rasku-Puttonen, H., Moate, J., & Helaakoski, J. (2013). Visualizing communication structures in science classrooms: Tracing cumulativity in teacher-led whole class discussions. *Journal of Research in Science Teaching, online advance manuscript.*
October 21	Longitudinal Research	Blackboard posting from weekly readings	Alexander, J. M., Johnson, K. E., & Kelley, K. (2012). Longitudinal analysis of the relations between opportunities to learn about science and the development of interests related to science. *Science Education, 96,* 763-786. Nashon, S. M. & Anderson, D. (2013). Interpreting student views of learning experiences in a contextualized science discourse in Kenya. *Journal of Research in Science Teaching, 50,* 381-407.
October 28	Narrative research Looking Forward -- Looking Back Share your overview of the analyses (about	Blackboard posting from weekly readings Abstract 3	Craig, C.J. (2007). Story constellations: A narrative approach to contextualizing teachers' knowledge of school reform. *Teaching and Teacher Education, 23,* 173-188. Johnson, C.C., Kahle, J.B., & Fargo, J.D. (2007). A study of the effect of sustained,

	5-10 minutes)		whole-school professional development on student achievement in science. *Journal of Research in Science Teaching. 44*, 775-786.
November 4	Intervention research Work on Survey Design	Blackboard posting from weekly readings	De Anda, D. (2007). Intervention research and program evaluation in the school setting: Issues and alternative research designs. *Children & Schools, 29*, 87-94. Peters, E. E. (2012). Developing content knowledge in students through explicit teaching of the nature of science: Influences of goal setting and self-monitoring. *Science & Education, 21,* 881-898.
November 11	Designing Research in Science Education: Applying Designs to Research Small group work of Survey Design and an Analysis	Blackboard posting from weekly readings Looking Forward-Looking Back: Presentation	work to refine your design and/or with your faculty chair/advisor outside of class
November 18	Policy Research, Meta-Analysis, Action Research	Blackboard posting from weekly readings	National Research Council. (2011). *Successful K-12 STEM education: Identifying effective approaches in science, technology, engineering, and mathematics.* Washington, DC: National Academies Press Schroeder, C. M., Scott, T. P., Tolson, H., Huang, T., & Lee, Y. (2007). A meta-analysis of national research: Effects of teaching strategies on student achievement in science in the United States. *Journal of Research in Science Teaching, 44,* 1436– 1460.

November 25	Survey Presentations	Presentation of Survey Research	work on final design project and presentation
December 2	Presentations Evaluations	Presentation of research and written plan	Poster presentation

ASSESSMENT RUBRIC(S)

Design Project: During the last quarter of the course, you will apply a research design to a current science education problem. You have the option of doing this as a team of 2 students, or as an individual. You will present your design to the class in an oral presentation (20 minutes) and you will submit a written research plan.

Item	0 points	1 point	2 points
Research Question(s)	No research questions presented	Research questions are presented but lack clarity	Research questions presented and are clearly stated; Research questions match the design
Variables (based in the literature)	No variables defined	Variables are identified but identification of their role (independent/dependent) or their value are not indicated	Variables are identified and the role and value of the variables are clearly stated
Assessment/instrument(s)	No assessment strategies identified	Assessment strategies are identified but do not measure the research question(s)	Assessment strategies are identified and measure the research question(s)

Sample/participants	No sample/participant description and No sample size defined	Either sample is not described or the sample size is not defined; OR participants described but no rationale for selection	Both the sample is clearly articulated and sample size is defined; OR participants have been purposefully selected
Analysis	No analysis procedure stated	The analysis does not measure the research question(s)	The analysis is clearly stated and appropriately measures the research question(s)
Length	< 10 pages	10 pages	10-15 pages