

TchLrn 584
Research in Teaching Mathematics & Science



Wednesdays, 5:45 – 8:30
 Vancouver: VECS 309
 Pullman:
 Tri-Cities:
 Vancouver:

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Office hours available by appointment for students across campuses through email, phone, Skype, or other communication apps.

Course Goals

- Become knowledgeable about current, central issues or *problems of practice* in science and mathematics teaching.
 - Know and appreciate the multiple perspectives that can guide research related to issues of science and mathematics teaching.
 - Develop a rich understanding of the role of theoretical frameworks in research as well as the knowledge and skills needed to construct a research proposal.
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In T&L 584 we will critically review research on teaching K-12 mathematics and science. In order to prepare you for your dissertation work, we will also study historical and current theoretical frameworks and research methods in mathematics and science education. We will consider both the ways in which research on teaching is conducted and the findings that result from significant areas of research. Readings will come from current and historically influential books, journal articles, and online sources. Essential questions that frame our exploration of research on teaching are:

- ? What is the research base that underpins current ideas about science and mathematics teaching?
- ? What are current key areas of research in mathematics and science teaching? What perspectives are represented? What tensions exist? How do these inform your own work?
- ? What can be learned from top researchers in science and mathematics education about problems of practice, theoretical or conceptual frameworks, and research design?

In preparation for your own research endeavor, you will have an opportunity to apply these ideas and methods by developing a research proposal based on your own interests. This is a discussion-based seminar style class with meetings held via AMS. In this course we will engage as a professional learning community and nurture a collective inquiry stance. Learning and enrichment occur as a result of the active and respectful participation of all members of our learning community. All students are expected to share insights and analyses, raise questions,

and apply a critical perspective to the ideas from course readings and our discussions in-class and online. We will use WSU email, Blackboard, and other online resources (e.g., padlets, google docs) for sharing/posting assignments and general course communication. Please check these regularly.

Grading

Detailed descriptions of each assignment and related expectations are provided separately.

<i>Assignment</i>	<i>Due Dates (may be revised)</i>	<i>Points Possible</i>
Online discussion board posts (5 @ 4 pts each) And responses to others' posts (10 @ 3 pts each):	See detailed course schedule	50
Post regarding initial area of research interest & problem statement	Sept. 16	5
Draft paper: Introduction (area of interest, research purpose & goals)	Sept. 28	15
Critical Review paper	Oct. 5	30
Visual representation of CF/TF & in-class explanation	Oct. 17	10
Draft paper: Conceptual / theoretical framework	Nov. 2	15
Lead class discussion (and pre-select article)	TBD	20
Presentation of research proposal	Nov. 28 / Dec. 5	15
Mini-research proposal	Dec. 7	100
Participation in weekly seminars (2 pts/week)	Weekly	30
TOTAL		290

Grading scale for the final grade, the culminating assignment, and other course assignments:

A	93% or above	Exceptional; creative and original; goes beyond requirements and expectations; meets all criteria for a B.
A-	90-92 %	Excellent; goes beyond requirements and expectations or has originality/creativity; meets all criteria for a B.
B+	88-89 %	Very good; some creative or original elements; meets all criteria for a B.
B	83-87 %	Good; all objectives for the course/assignment are reached; a complete understanding of the concepts, processes, theories, approaches of the course/assignment is clearly demonstrated.
B-	80-82 %	Good; some objectives for the course/assignment are not fully attained; understanding of most of the concepts, processes, theories, approaches of the course/assignment is clearly demonstrated.
C+	78-79 %	Acceptable; some objectives for the course/assignment are not fully attained; understanding of most of the concepts, processes, theories, approaches of the course/assignment is evident but not always clearly demonstrated.
C	73-77 %	Minimally satisfactory; minimal or partial requirements of the course/assignment objectives are accomplished; lack of evidence of understanding many of the concepts, processes, theories, approaches of the course/assignment.
F	72% or less	Unsatisfactory. Anything less than the criteria for a C will receive a failing grade.
I	Incomplete	Must be arranged with instructor prior to end of semester.

Expectations for Quality Work and Participation

- This is a doctoral level course grounded in social constructivist learning theory and a strong belief in collaborative learning through dialogue. We are all professionals and colleagues, with something to learn in all areas and with expertise in some areas. As such, be responsible to the group by actively and substantively participating in class (whether face-to-face, online, or on-screen). Practice active listening, and prepare to professionally challenge ideas and receive challenges to/questions about your own thinking.

Note: Attendance is important, given this is a seminar. We all will benefit from your ideas, your preparation in pre-reading and thinking about the materials, and your questions and experiences. Emergencies always arise, and you may have to miss a class, even two. Missing three or more classes becomes problematic, however. Please plan to meet with me if you reach three absences or more. It is not possible to receive an A if three or more classes have been missed.

General specifications for all written work (Professional Communication / Proposal/Other):

- Use Word or an equivalent program.
- Save all documents with your last name as the first word in the title.
- Be professional in form (APA format, spelling, syntax, and punctuation count).
- Be professional in thought—respecting others’ perspectives and experiences, citing the source for ideas that come from others, asserting your own ideas and warranting them.
- Be thorough – writing is an ongoing process, not a night-before-its-due event. Write early and often, and test your ideas with the group.
- Be creative and original!

General Information

Students with Disabilities: Reasonable accommodations are available for students with documented disabilities or chronic medical conditions. If you have a disability and need accommodations to fully participate in this class, please visit the Access Center website to follow published procedures to request accommodations: <https://studentaffairs.vancouver.wsu.edu/access-center>. Students may also either contact or visit the Access Center in-person to schedule an appointment with our Access Center Coordinator. Location: Classroom Building, Room 160; Phone: 360-546-9238; Email: van.access.center@wsu.edu. All disability related accommodations MUST be approved through the Access Center. Students with approved accommodations are strongly encouraged to visit with instructors early in the semester during office hours to discuss logistics.

WSU Academic Integrity Statement: Academic integrity is the cornerstone of higher education. As such, all members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Academic integrity will be strongly enforced in this course. Students who violate WSU’s Academic Integrity Policy (identified in Washington Administrative Code (WAC) 504-26-010(3) and -404) will receive academic sanctions that may include additional required assignments, a failing grade for an assignment(s), or failing the course. Students will not have the option to withdraw from the course pending an appeal, and will be reported to the Office of Student Conduct. Cheating includes, but is not limited to, plagiarism and unauthorized collaboration as defined in the Standards of Conduct for Students, WAC 504-26-010(3).

You need to read and understand all of the definitions of cheating:

<http://app.leg.wa.gov/WAC/default.aspx?cite=504-26-010>. If you have any questions about what is and is not allowed in this course, you should ask course instructors before proceeding. If you wish to appeal a faculty member's decision relating to academic integrity, please use the form available at <https://studentaffairs.vancouver.wsu.edu/student-affairs/student-conduct>. If you have any questions about the process on the Vancouver campus, please call Helen Gregory at 360-546-9573.

Emergency Notification System: WSU has made an emergency notification system available for faculty, students, and staff. Please register at myWSU with emergency contact information (cell, email, text, etc.). You may have been prompted to complete emergency contact information when registering for classes at myWSU. In the event of a building evacuation, a map at each classroom entrance shows the evacuation point for each building. Please refer to it. Finally, in case of class cancellation campus-wide, please check local media, the WSU Vancouver web page (<https://www.vancouver.wsu.edu>) and/or <http://www.flashalert.net/>. Individual class cancellations may be made at the discretion of the instructor.

Inclement weather policy: In the event that an adverse weather event (e.g., snow or ice) or natural hazard that poses a safety risk occurs, you should take personal safety into account when deciding whether you can travel safely to and from campus, taking local conditions into account. If campus remains open and your instructor decides to cancel the face-to-face meeting and substitute an alternative learning activity, you will be notified by your instructor via email or through Blackboard within a reasonable time after the decision to open or close campus has been made. Instructions regarding any alternative learning options or assignments will be communicated in a timely manner. If travel to campus is not possible due to adverse regional conditions, allowances to course attendance policy and scheduled assignments, including exams and quizzes, will be made. Students who attempt to gain advantage through abuse of this policy (e.g., by providing an instructor with false information) may be referred to the Office of Student Conduct for disciplinary action. If a student encounters an issue with an instructor, the student should first talk with the instructor. If the issue cannot be resolved, the student should follow the *reporting violations of policies outlined on the [student affairs website](#)*.

Guidelines for Online Discussion Posts

In our online discussions, please consider the following:

- *Make your posts substantive, yet limited in length*
- *Have a clear focus*
- *Respect and address others' perspectives, experiences, and ideas*
- *Respectfully question or challenge ideas (from the lit or others) that you would like to hear others' ideas about, don't understand, or have a differing understanding or perspective on*
- *Draw upon and reference ideas and examples from readings, class discussions, and other academic resources*
- *Raise new questions relevant to research on mathematics and science teaching*

Responses to others' original thoughts should **extend the conversation**; you might add your own ideas, raise issues that reveal different perspectives or understandings that are less than clear, present additional examples, or take the original ideas in some other direction. Responses should also be substantive and at higher levels of thinking. Avoid simple statements of agreement with or praise for another's comment.

NOTE: I do not expect to do this, but I reserve the right, as instructor and moderator of our group, to delete comments that are not respectful. If anyone has any issues with a comment or a response to one of your ideas, please discuss this with me privately. My hope is that we have open and honest communication where offense is not taken when one's ideas are questioned; instead, this is viewed as an opportunity to further negotiate understanding, to learn more deeply, and to use theory, research, and experience to support one's own ideas.

Evaluation Criteria

- 4 Excellent: Response includes original ideas, specifically references ideas from the readings, and is responsive to others' ideas from class or previous conversations. All posts/responses are substantive in that they are grounded in scholarly perspectives rather than only personal experiences, and synthesize, analyze, and evaluate ideas. Responses raise questions, stimulate others' ideas, raise/challenge/consider alternative perspectives.
- 3 Satisfactory: Response contributes substantively to the discussion and is thoughtful. Further development, depth, and/or specificity is needed in some areas, but overall the ideas are conveyed well. Ideas from readings need to be more explicitly considered.
- 2 Needs Development: Response is submitted but ideas are underdeveloped, unoriginal, and/or characterized by application to experience but not to scholarly ideas.
- 1 Expectations Not Met: Response is not substantive and/or not respectful.

Evaluation of Comments to Others' Responses

- 3 Comment contributes to ongoing conversation, is substantive, thoughtful, clear.
- 2 Comment contributes to ongoing conversation but lacks thoughtfulness and/or clarity.
- 1 Comment not substantive in furthering conversation or comment is not respectful of others.
- 0 Comment not provided.

Critical Reviews of Research Studies

Overview

- Your critical reviews will support your introduction section in the mini-research proposal.
- Based on your research area of interest and the initial list of research articles you have identified, select one article to critically review. The articles must be reports of empirical research, published in high quality research journals.
- Critically review this article in a 5-6 page paper. This is NOT merely a summary of the article!
- Submit your review and an electronic copy of the article via Blackboard. Use your last name as the first word of the document title.
- Use the paper components described below as a guideline for the class session you will lead on a different article.

Expectations for the paper: The written review should be about 5-6 pages, not including the reference list (1.5 line spacing; 1 inch margins; 12 point Times New Roman or equivalent font). Use APA style for formatting the paper (except line spacing), including section headers, running head and page numbers, citations, and reference list. The review should address the sections described below. All cited materials must be included in a reference section, including the article that you are reviewing. Refer to the rubric in addition to the guidelines below.

You can and should draw from other readings used in this class (or others) to construct your argument(s) and clarify your position.

Critical Review Paper Sections

1. Provide the **full reference** for the article before the following sections.
2. **Description of area of interest** (1-2 paragraphs): Briefly explain the focus of your critical review. This area of interest will be the same for your mini-research proposal, although you might refine it or come to understand it differently during the semester. Explain how the article connects to and/or informs your area of interest; i.e., why did you choose this article?
3. **Summary** (about one page, enough so that a reader can make sense of your critical review): Concisely summarize the main elements of the study discussed in the article. Briefly describe the following:
 - a. The research problem or area and the goals / purpose of the study
 - b. The main ideas addressed in the literature review
 - c. The conceptual or theoretical framework (there may not be one!)
 - d. The research design, including the participants, duration and context of the study, data collection and analysis methods (this may include an analytic framework)
 - e. The findings or results
 - f. The conclusion or implications
4. **Critique** (3-4.5 pages): A critique involves analytic, synthetic, evaluative, and creative thinking. (You might want to read a comparison of analytic and synthetic thinking at <http://www.gooisoft.com/articles/synthetictinkingvsanalytictinking.aspx>)

Your critique should be the bulk of your paper. Examine the elements of the article that you describe in the summary (see above). **Look across these elements** to identify strengths and weaknesses in the study overall, and/or in individual elements of the study. Compare elements of this study to other related studies. Use the following questions, as relevant, to look across the different aspects of the study (e.g., findings in relation to the theoretical framework, or methods in relation to the question) and guide your critique:

- a. What assumptions does the author make in defining the problem and in the research question(s)? Are these assumptions stated or implied?
- b. In what ways does the literature review situate this research in the existing body of research/knowledge; identify gaps or weaknesses in the existing body of research; provide a solid foundation that supports the study reported in this article; or inform your understanding of the study reported in this article? In what ways is the lit review a synthesis, or not, of important research related to the problem area?
- c. If there is a theoretical or conceptual framework (TF/CF), how does this help you in your understanding of the author's perspective on research, on the problem and on the conclusions/implications of the study? To what extent do you think the theoretical/conceptual framework shaped the interpretation of results? If there is no TF/CF, how does this impact your understanding of the author's conclusions/implications? Are there unstated assumptions, expectations, beliefs, or theories that should have been addressed through a TF/CF?
- d. Do you agree with the author's research methods? Why or why not? How do these methods compare with other studies in the same area? What weakness/strengths do you see in the research design?
- e. Do the findings/results respond adequately and clearly to the research questions? Are the findings believable? Are these supported with evidence that shows how the author came to specific claims? Do you have questions about the interpretation of the data presented? To what extent are all data addressed (e.g., is something obviously ignored)?
- f. Do the implications or conclusions make sense in relation to the findings, previous research, the theoretical framework, and the methods? What are the strengths or weaknesses of the implications of this research?

5. Application: How can the information presented in this article be applied to K -12 classrooms? Policy? Your area of research interest?

Your reviews should be thoughtful and well written in an academic register. You will be assessed on the content and academic tone (i.e., not colloquial or diary-like) of your response.

We may discuss these critical reviews in class, where all students will share a brief summary of their critical reviews and participate in a class discussion to explore the questions these reviews raise for us. Our objectives will be to look across the areas of interest in these reviews to raise questions and examine the strengths and weaknesses of the research approaches, frameworks, and common themes in research on teaching.

Rubric for Critical Article Reviews

	Expectations Not Met	Acceptable	Exemplary	Score
Article submitted; Full reference provided on paper	Neither included	Only 1 of 2 included	Both included	/ 2
Area of Interest Description & Article Choice:	Selected area of interest was not included or is not well-defined. Article was from a practitioner journal and/or did not represent a rigorous research study from a high quality, peer-reviewed journal and/or article was not relevant to area of interest (i.e., not a good choice for an article to review) 0-3.1	Selected area of interest was described and reasonable to pursue. Article was a research study reported in a high quality, peer-reviewed journal (or instructor approved book/chapter*), and/or article had some connections to area of interest but other articles offer greater relevance/connections (i.e., an acceptable topic and/or article, but not a great choice). 3.2-4.7	Selected area of interest was well-focused and defined clearly. Article was a research study reported in a high quality, peer-reviewed journal (or instructor approved book/chapter*), published after 2000*. Clear connections and relevance to area of interest (i.e., an excellent / superb choice for a topic an article). 4.8-5	/ 8
Summary:	Does not include all of the required elements for summarizing the research study. 0-4.9	Each element is summarized. A reader can gain a general sense of the study. 5-8	Concisely summarized for each element. A reader can easily gain a clear sense of the study and the salient features, as reported by the researchers/ authors. 8.1-9	/ 10
Critique & Application to Practice:	Critique is merely a summary of the article and/or connections to practice are not made. 0-4.9	All critical elements are included but some arguments/connections/ applications were not fully developed and/or well articulated. 5-8	Succinctly written critique with a thorough and scholarly analysis and evaluation of the study that connects to and compares/ contrasts the study with other readings & research to construct arguments and clarify position(s). Insightful applications to practice are discussed. 8.1-9	/ 10
General Criteria for Writing, including clarity, voice, writing conventions, APA style	Some significant problems 70-79% of points in each relevant section above	Approaches expectations 80-89% of points in each relevant section above	Meets expectations 90-100% of points in each relevant section above	Assessed across the paper
Total				/ 30

* Some influential studies that were published prior to 2000, book chapters, or portions of books may be considered as “exemplary” articles. However, in these cases, the manuscript must be a formal report of a research study (not a literature review or other type of book chapter) and you must receive prior approval (i.e., do not assume that an older article or book chapter meets requirements).

Culminating Assignment: Mini Research Proposal Description & Guidelines 2018

The development of this proposal provides you with an opportunity to engage in some of the thinking and practices involved in research on teaching mathematics or science. It is a “mini” proposal as it is limited in scope in relation to your eventual dissertation research proposal. However, the work you do will be authentic to the process and may serve to frame an actual research project you will carry out in the future.

Your final paper will include the introduction (including a brief literature review to situation your research problem), a conceptual/theoretical framework, your research design (including research question, methods for data collection and analysis), and potential threats to the validity/credibility of your study. You will get feedback from Professor Nelson and your peers on drafts of your introduction and your conceptual / theoretical framework (CF/TF). All elements of this paper should be well-supported with relevant literature. APA style (6th edition) is required for all formatting. The final paper will be somewhere in the range of 11-16 pages, plus references and figures.

Elements of the Mini-Proposal

- A. Introduction: area of interest, research purpose and goals
1. Identify a problem, issue, or phenomenon in mathematics or science teaching that you are interested in and that will be of interest to others (in this field). It should be a worthwhile problem! This area of interest may stem from personal experience, observations of others’ experiences or a phenomenon, or something you’ve read about and are interested in. Discuss why it is a worthwhile area for study.
 2. State a clear purpose and goals for the research. You may just want to know for your own curiosity. Better, you may want to contribute to an understanding of this phenomenon or problem. (Maxwell, 2005, calls this an intellectual goal.) You may want to inform practitioners and/or policy.
 3. What do we already know or do? Situate your area of interest in what is known, how what is known is not sufficient to satisfy your specific interest, and what you hope to figure out by pursuing this puzzle. Synthesize across **at least six articles** that connect this prior research to your area of interest.
 4. State a research question(s). Be clear about how this question relates to what is already known (and not known) or done.
 5. This section will probably be about 3-4 pages long. (remember to use 1.5 spacing, not double)
- B. Conceptual or theoretical framework
1. Explain and discuss the “system of concepts, assumptions, expectations, beliefs, and theories that support and inform your research” (Maxwell, 2005, p. 33). In other words, what theories and other constructs help you understand your area of interest, shape how you will study the problem, and influence how you will interpret the data you collect? You might think about this as: what variables are of interest and why are these important? What are the relationships/interactions amongst/across these? What do you want to pay attention to in the study, and why?

2. Include a graphic depiction of your framework if that helps you and your audience better understand the relationship between constructs.
3. Cite relevant literature (**at least 3 references**) that informs your thinking.
4. This section will probably be about 2-4 pages long.

C. Research design

1. Methodology: What kind of study, what approach or strategy of inquiry (Creswell, 2003, p. 3) is reasonable given your research question(s)? Explain your selection.
 - a. Will you employ a qualitative, quantitative, or mixed approach? Why—i.e., what do you think about how and what you will learn from this study?
 - b. Within this broad methodology, what strategy or tradition of inquiry will you use: Case study? Narrative? Survey? Quasi-experimental? Some combination of these?
2. What specific data collection methods or procedures will you employ: Interviews (of whom)? Open-ended or close-ended? Observations of (what)? How? Pre and post tests (of what)? Collection of teacher-generated artifacts or student work?
Why do you think these methods will inform your understanding related to your research question(s)?
3. Who will your participants be? (I.e., who will you be collecting data from/on?) Why are these the right participants to help you answer your research questions? What is the setting? (e.g., middle school classroom(s), professional development institute, university science methods class, etc.)
4. How will you analyze the data you collect? Talk about both the process as well as how your conceptual framework shapes your analytic lens.
5. Reference literature on research methods as needed in this section.
6. This will probably be about 5-6 pages, in total.

D. Credibility, trustworthiness, validity threats

1. What might cause consumers of your research to question your results? These differ in qualitative and quantitative approaches. Examples: researcher bias, researcher influence, alternative explanations,
2. How will you try to deal with these threats to credibility?
Examples: rich, thick description (see Geertz); extended time; triangulation; comparison; negative cases or discrepant evidence; recognizing limitations.
3. Cite literature as relevant.
4. This will probably be 1-1.5 pages long.