Washington State University
MAJOR CURRICULAR CHANGE FORM - COURSE
(Submit original signed form and ten copies to the Registrar’s Office, zip 1035.)

Future Effective Date: 08/16/2013
(effective date cannot be retroactive)

☐ New course  ☐ Temporary course  ☐ Drop service course
☐ There is a course fee associated with this course (see instructions)

☐ Variable credit
☐ Increase credit (former credit ________)
☐ Number (former number ________)
☐ Crosslisting (between WSU departments)
(Must have both departmental signatures)

☐ Conjoint listing (400/500)

☐ Repeat credit (cumulative maximum ________ hours)
☐ Lecture-lab ratio (former ratio ________)
☐ Prefix (former prefix ________)
☐ Cooperative listing (UI prefix and number ________ taught by: WSU ☐  UI ☐ jointly taught ☐

☐ S, F grading

☐ Request to meet Writing in the Major [M] requirement (Must have All-University Writing Committee Approval)

☐ Request to meet GER in ________ (Must have GenEd Committee Approval)  ☐ Fulfills GER lab (L) requirement

☐ Professional course (Pharmacy & Vet Med only)  ☐ Graduate credit (professional programs only)

☐ Other (please list request)

T&L 531 Frameworks for Research in Mathematics and Science Education

course prefix  course no.

3 None

credit lecture hrs lab hrs studio hrs prerequisite
per week per week per week

Description (20 words or less)
Exploration of research frameworks and methodologies specific to mathematics and science education.

Instructor: Tamara Holmlund Nelson  Phone number: (360) 546-9663  Email: tnelson1@vancouver.wsu.edu
Contact: Debra Barnett  Phone number: (360) 546-9660  Email: debarnett@vancouver.wsu.edu

Campus Zip Code: 9660

- Please attach rationale for your request, a current and complete syllabus, and explain how this impacts other units in Pullman and other branches (if applicable).
- Secure all required signatures and provide 10 copies to the Registrar’s Office.

Chair/Date:  Dean/Date:  General Education Com/date:

Chair (if crosslisted/interdisciplinary)*  Dean (if crosslisted/interdisciplinary)*  Graduate Studies Com/date

All-University Writing Com/date  Academic Affairs Com/date  Senate/date

‘If the proposed change impacts or involves collaboration with other units, use the additional signature lines provided for each impacted unit and college.'
Course Rationale

T & L 531: Frameworks for Research in Mathematics and Science Education

T&L 531 supplements the required research core of all PhD programs in the Department of Teaching & Learning. The course provides access to research methodologies specific to mathematics and science education, as well as access to key studies that have led to evolutions in the field.

The course will explore the most common and effective research methodologies in mathematics and science education. Current research frameworks and methods will be used to consider both the ways in which research is conducted and the findings that result from significant fields of research.

Students will develop a rich understanding of the role of theoretical frameworks in all aspects of research design, data analysis, and the representation of findings. Students will also become knowledgeable about current, central issues or problems of practice in mathematics and science education and multiple perspectives on those issues.

The course has no anticipated impacts on other units in Pullman. The course will be available to students at all campuses who are interested in mathematics and/or science educational research. The course will be taught on a rotating basis by faculty on the Pullman, Spokane, Tri-Cities and Vancouver campuses to ensure equitability in faculty load.
T&L 531: Frameworks for Research in Mathematics and Science Education

Dr. Tamara Holmlund Nelson
Office: VUCE 324
tnelson1@vancouver.wsu.edu
360-546-9653

Office hours available, by appointment, for students across campuses through email or phone

**Essential Questions for T&L 531 (STEM)**

? What can be learned from the top researchers in STEM education about research methods, including framing studies with a theoretical or conceptual framework, research design, data collection, data analysis, and presentation of findings?

? What are the fundamental documents shaping science and mathematics teaching and learning in the early 21st century? What is the research base for/on these? What perspectives are predominant in the research and popular communities?

? What are the key areas of research in STEM education currently? What perspectives are represented? What tensions exist? How do these inform your own work?

**Course Overview**

This course will explore various research paradigms related to the STEM disciplines. While attention is increasingly given to K-12 STEM education, mathematics and science receive most of the research and everyday consideration; the research literature on K-12 engineering education (or “design technology”) is relatively new. Classroom use of technology for teaching and learning is also a critical, albeit emergent, area of research. As a starting point for this course, Bybee’s (2010) description of STEM literacy for K-12 is useful:

- Acquiring scientific, technological, engineering, and mathematical knowledge and using that knowledge to identify issues, acquire new knowledge, and apply the knowledge to STEM-related issues.
- Understanding the characteristic features of STEM disciplines as forms of human endeavors that include the processes of inquiry, design, and analysis.
- Recognizing how STEM disciplines shape our material, intellectual, and cultural world.
- Engaging in STEM-related issues and with the ideas of science, technology, engineering and mathematics as concerned, affective, and constructive citizens.
We will study historical and current research frameworks and methods in STEM education. We will consider both the ways in which research is conducted and the findings that result from significant fields of research. Readings will come from influential books, journal articles, and online sources. Our meetings will be supported by technology such as the AMS video system, an online real-time forum, and ANGEL.

Course Goals

- Develop a rich understanding of the role of theoretical frameworks in all aspects of research design, data analysis, and the representation of findings.
- Become knowledgeable about current, central issues or problems of practice in STEM education and multiple perspectives on those issues.
- Develop the knowledge and skills needed to construct a proposal suitable for a grant submission or an action research project.
- Further develop your own voice as an educational leader.

College of Education Conceptual Framework

The College of Education contributes to the theory and practice of the broad field of education, and dedicates itself to understanding and respecting learners in diverse cultural contexts. We facilitate engaged learning and ethical leadership in schools and clinical settings. We seek collaboration with diverse constituencies, recognizing our local and global responsibilities to communities, environments, and future generations.
Culminating Assignment

Proposal Development: Draw on experience, empirical research, and relevant theories to identify a “vexation” (issue, puzzle, problem, tension) relevant to STEM education and propose a “venture” (e.g., a new curriculum, teaching approach, intervention with target group, professional development project, etc.) to address this, and design two different approaches for research on the endeavor to understand its impact. Present your proposal to our group.

Other Course Assignments

A full description of expectations and criteria will be distributed for each assignment.

1. Professional Communication  
   http://www.changeteaching.com/  
   As educational leaders, it is important to bring the conversations about research to our colleagues. At three different points in the semester, you will be asked to create an original thread on the Change Teaching website, and to respond to others’ posts.

2. Reflections  
   Throughout the semester you will be asked to write reflections based upon our class discussions and readings. These will be short, pithy and pointed, and posted on ANGEL. You will also be asked to “tweet back” to the posts of others.

3. Participation in class and online, including possible in-class assignments and substantive discussion.

Grading & Expectations

<table>
<thead>
<tr>
<th>Assignment Title</th>
<th>Due Date(s)</th>
<th>Points Possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposal: Vexation (20) / Venture (25) / Research Designs (55)</td>
<td>April 20</td>
<td>100</td>
</tr>
<tr>
<td>Presentation of Proposal</td>
<td>April 27 &amp; May 4</td>
<td>10</td>
</tr>
<tr>
<td>Professional Communication and responses on Change Teaching website (3 @ 20 each)</td>
<td>Feb 16, Mar 9, Apr 7</td>
<td>60</td>
</tr>
<tr>
<td>Tweets and responses (5 @ 10 each)</td>
<td>On Occasion</td>
<td>50</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>94% or above</td>
<td>Exceptional; creative and original; goes beyond requirements and expectations; meets all criteria for a B.</td>
</tr>
<tr>
<td>A-</td>
<td>90-93%</td>
<td>Excellent; goes beyond requirements and expectations or has originality/creativity; meets all criteria for a B.</td>
</tr>
<tr>
<td>B+</td>
<td>88-89%</td>
<td>Very good; some creative or original elements; meets all criteria for a B.</td>
</tr>
<tr>
<td>B</td>
<td>84-87%</td>
<td>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.</td>
</tr>
<tr>
<td>B-</td>
<td>80-83%</td>
<td>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.</td>
</tr>
<tr>
<td>C</td>
<td>75-79%</td>
<td>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.</td>
</tr>
</tbody>
</table>
| D     | 70-74%     | Minimally satisfactory; minimal or partial requirements of the
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.

- As you have done in previous courses, I will ask you to write a short paragraph at the end of the semester in which you claim what your participation grade (out of 90 points) should be and justify it with evidence of your substantive contribution to the group. As such, you might make a note at the end of each class as to the nature of your participation that night.

Note: Attendance is important. 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 or two. Please plan to meet with me if you reach three absences or more. It is not possible to receive an A if four or more classes have been missed.

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

Use Word or an equivalent program.
Be professional in form (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!
Tweets are less formal in form, but should be professional, creative, original in thought.

Tentative Reading List
The following is a working list. Not all will be required; others may be added. All articles are available through the WSUV library system. I also have permission to make everything available
to you, as this is the first time the course has been taught. Readings will be on ANGEL at least three weeks prior to the week we discuss each. NOTE: You will each need to find additional literature to support the proposal you develop for the culminating assignment.

Main Source

Research Studies

Disability Accommodation: Reasonable accommodations are available for students with a documented disability. All accommodations must be approved through your WSU Disability Services office. If you have a disability and need accommodations, we recommend that you begin the process as soon as possible. All accommodations must be approved through Disability Services. For more information, contact a Disability Specialist on your home campus.
- **Spokane**: /students/current/StudentAffairs/disability/index.html
- **Pullman**: http://accesscenter.wsu.edu
- **Tri-Cities**: http://www.tricity.wsu.edu/disability/index.html
- **Vancouver**: http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services

Academic Integrity: Academic integrity is the cornerstone of the university and will be strongly enforced in this course. Any student found in violation of the academic integrity policy will be given an "F" for the course and will be referred to the Office of Student Conduct. Read [http://academicintegrity.wsu.edu/](http://academicintegrity.wsu.edu/)
For additional information about WSU's Academic Integrity policy, procedures, and definitions, please check online at http://www.conduct.wsu.edu/default.asp?PageID=338 and http://www.conduct.wsu.edu/.
Note: Plagiarism is a violation of academic integrity. Students sometimes do not realize what constitutes plagiarism. Please read the information at http://www.wsulibs.wsu.edu/plagiarism/what.html and associated links.

**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 on RONet. 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 appropriate WSU web page and/or http://www.flashalert.net/. Individual class cancellations may be made at the discretion of the instructor. Each individual is expected to make the best decision for their personal circumstances, taking safety into account.

**Audio, video, digital, commercial note-taking and other recording during class:** Copyright (insert year) (insert Faculty Name) as to this syllabus, all lectures, and course-related written materials. During this course students are prohibited from making audio, video, digital, or other recordings during class, or selling notes to or being paid for taking notes by any person or commercial firm without the express written permission of the faculty member teaching this course.
# T&L 531 STEM Schedule of Classes, Readings, Assignments

This is a working schedule; readings will be added or possibly changed for later sessions. You will receive notification at least 2 weeks in advance if there are changes related to reading. Readings will be discussed on the date they are listed.

<table>
<thead>
<tr>
<th>Date</th>
<th>Reading to be Discussed</th>
<th>Assignments Due</th>
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</thead>
<tbody>
<tr>
<td>Week 1</td>
<td><strong>Lesh &amp; Kelly, Ch 1 and 2</strong></td>
<td>Return information form to Tamara by Jan. 15</td>
</tr>
<tr>
<td></td>
<td>1 Purposes and Assumptions of This Book</td>
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<td></td>
<td>2 Trends and Shifts in Research Methods</td>
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</tr>
<tr>
<td>Week 2</td>
<td><strong>Lesh &amp; Kelly, Ch 3</strong></td>
<td>4 original tweets, 6 tweets in response to others. Complete before the next class</td>
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<tr>
<td></td>
<td>3 Research Agendas: Identifying Priority Problems and Developing Useful Theoretical Perspectives</td>
<td>Prompt: What do you notice about researchers' use of theoretical frameworks? What is puzzling, revealing, challenging your ideas? Evaluate, analyze, synthesize.</td>
</tr>
<tr>
<td>Week 3</td>
<td><strong>Lesh &amp; Kelly, Ch 4</strong></td>
<td>4 original tweets, 6 tweets in response to others. Complete before the next class</td>
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<tr>
<td></td>
<td>Schoenfeld, A. (2007). Method. In F. K. Lester (Ed.), <em>Second handbook of research on mathematics teaching and learning: A project of the National Council of Teachers of Mathematics</em> (pp. 69-107). Charlotte, NC: Information Age Publishing.</td>
<td>Prompt: Schoenfeld presents a schematic representation for the research process (fig. 3.1). How is this useful, befuddling, enlightening, provocative, connected to other ideas you have... Use this figure as a launching point for your tweet. Comment on some aspect of Brown's research in relation to either Schoenfeld or our ongoing conversation about the interrelationships amongst a theoretical framework - unit of analysis - research question - analysis - discussion of findings.</td>
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<tr>
<td></td>
<td>Framing Essential Question: What can be learned from the top researchers in STEM education about research methods, including framing studies with a theoretical or conceptual framework, research design, data collection, data analysis, and presentation of findings?</td>
<td></td>
</tr>
<tr>
<td>Week 4</td>
<td><strong>Lesh &amp; Kelly, Ch 6</strong></td>
<td>4 original tweets, 6 tweets in response to others. Complete before the next class</td>
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<tr>
<td></td>
<td>6 Formulating Operational Definitions of</td>
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<tr>
<td></td>
<td>Framing Essential Question: What are the fundamental documents shaping science and mathematics teaching and learning in the early 21st century? What is the research base for/on these? What perspectives are predominant in the research and popular communities?</td>
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<tr>
<td>Desired Outcomes of Instruction in Mathematics and Science Education</td>
<td>class</td>
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<tr>
<td>Prompt: Our focus is shifting from theoretical frameworks to the fundamental documents shaping science and mathematics research in the early 21st century, and the perspectives that are predominant in the research and popular communities.</td>
<td>Tweet about the ideas in these chapters that raise questions for you or are of particular interest.</td>
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<tr>
<th>Week 5</th>
<th>Lesh &amp; Kelly, Ch 7</th>
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<tbody>
<tr>
<td>7 Progress in Research: The Interplay Among Theory, Research Questions, and Measurement Techniques</td>
<td></td>
</tr>
<tr>
<td>Banilower, E., Cohen, K., Pasley, J., &amp; Weiss, I. (2008). Effective science instruction: What does research tell us? Portsmouth, NH: RMC Research Corporation, Center on Instruction.</td>
<td>4 original tweets, 6 tweets in response to others. Complete before the next class</td>
</tr>
<tr>
<td>Prompts: Identify a vexation or possible area of action research from Banilower, et al., and connect this to another reading (from this week or any other) to justify its importance to the field.</td>
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<tr>
<td>International test results stimulate a national dialogue that usually is not very flattering to educators. What do these test results say to you? How might you use research to respond to criticisms of education based upon these tests?</td>
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<thead>
<tr>
<th>Week 6</th>
<th>Lesh &amp; Kelly, Ch 9</th>
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<tbody>
<tr>
<td>9 Multitiered Teaching Experiments</td>
<td>Professional writing on Change Teaching website</td>
</tr>
<tr>
<td>Subject of your post should relate to one of our essential questions.</td>
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</table>

**Framing Essential Question:** What are key areas of research in STEM education currently? What perspectives are represented? What tensions exist? How do these inform your own work?

<table>
<thead>
<tr>
<th>Week 7</th>
<th>Lesh &amp; Kelly, Ch 11</th>
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</thead>
<tbody>
<tr>
<td>11 Teaching Experiment Methodology: Underlying Principles and Essential Elements</td>
<td></td>
</tr>
<tr>
<td>Williams, T. (2003). Six cases of change by design. In A. Gamoran, C. W. Anderson, P. A. Quiroz, W. G. Secada, T. Williams &amp; S. Ashmann (Eds.), Transforming teaching in math and</td>
<td><strong>In class:</strong> Be prepared to present your ideas for and facilitate a discussion about your vexation and venture for the culminating assignment.</td>
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<td>15 min/person</td>
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| Week 8 | Lesh & Kelly, Ch 14  
14 Working on the Inside: Using One's Own Practice as a Site for Studying Teaching and Learning  
Prompt: TBD |
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<tbody>
<tr>
<td>Week 9</td>
<td>Spring Break</td>
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</tbody>
</table>
| Week 10 | Lesh & Kelly, Ch 15  
15 Paradigms for Teacher-Centered, Classroom-Based Research  
| Week 11 | Lesh & Kelly, Ch 16  
16 Action Research as a Research Methodology for the Study of the Teaching and Learning of Science | In class: Discuss ideas for a theoretical framework & research design (4) |
| Week 12 | Lesh & Kelly, Ch 18  
18 Interpretive Research in Science Education  
| Week 13 | Lesh & Kelly, Ch 20  
20 Analysis of Clinical Interviews: Foundations and Model Viability | Professional writing on Change Teaching website  
Subject of your post should relate to one of our essential questions.  
Due on or before April 13 |
| Week 15 | No Readings Assigned | Culminating Assignment Due |
T&L 531: Frameworks for Research in Mathematics and Science Education

Dr. Tamara Holmlund Nelson
Office: VUCB 324
tnelson1@vancouver.wsu.edu
360-546-9663

Office hours available, by appointment, for students across campuses through email or phone

Essential Questions for T&L 531 (STEM)

? What can be learned from the top researchers in STEM education about research methods, including framing studies with a theoretical or conceptual framework, research design, data collection, data analysis, and presentation of findings?

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- **Spokane** /students/current/StudentAffairs/disability/index.html
- **Pullman** http://accesscenter.wsu.edu
- **Tri-Cities**: http://www.tricity.wsu.edu/disability/index.html
- **Vancouver**: http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services

Academic Integrity: Academic integrity is the cornerstone of the university and will be strongly enforced in this course. Any student found in violation of the academic integrity policy will be given an “F” for the course and will be referred to the Office of Student Conduct. Read http://academicintegrity.wsu.edu/
| Week 5 | Lesh & Kelly, Ch 7  
| 7 Progress in Research: The Interplay Among Theory, Research Questions, and Measurement Techniques  
| Portsmouth, NH: RMC Research Corporation, Center on Instruction.  
| Desired Outcomes of Instruction in Mathematics and Science Education  
| class  
| Prompt: Our focus is shifting from theoretical frameworks to the fundamental documents shaping science and mathematics research in the early 21st century, and the perspectives that are predominant in the research and popular communities.  
| Tweet about the ideas in these chapters that raise questions for you or are of particular interest.  
| Week 6 | Lesh & Kelly, Ch 9  
| 9 Multitiered Teaching Experiments  
| Professional writing on Change Teaching website  
| Subject of your post should relate to one of our essential questions.  
| Framing Essential Question: What are key areas of research in STEM education currently? What perspectives are represented? What tensions exist? How do these inform your own work?  
| Week 7 emluminate | Lesh & Kelly, Ch 11  
| 11 Teaching Experiment Methodology: Underlying Principles and Essential Elements  
| In class: Be prepared to present your ideas for and facilitate a discussion about your vexation and venture for the culminating assignment.  
| 15 min/person |
| Week 8 | Lesh & Kelly, Ch 14  
14 Working on the Inside: Using One’s Own Practice as a Site for Studying Teaching and Learning  
Prompt: TBD |
| Week 9 | **Spring Break** |
| Week 10 | Lesh & Kelly, Ch 15  
15 Paradigms for Teacher-Centered, Classroom-Based Research  
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| Week 12 | Lesh & Kelly, Ch 18  
18 Interpretive Research in Science Education  
| Week 13 | Lesh & Kelly, Ch 20  
20 Analysis of Clinical Interviews: Foundations and Model Viability |

*Note: The text in the table is extracted from the syllabus with some annotations and adjustments for clarity.*
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Week 16</td>
<td>No Readings Assigned</td>
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</tbody>
</table>