WASHINGTON STATE UNIVERSITY
College of Education
Course Syllabus

TCH LRN 581: Learning and Development in Mathematics and Science (3 credits)
Fall 2019

Instructor: Amy Roth McDuffie, Professor of Mathematics Education
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Phone: (509) 335-8395 (Office)
Classroom: SPARK 212 Pullman campus - other campus locations via AMS and Zoom.
Day/time: Wednesday, 5:45-8:30 pm
Office Hours & Communication: Virtual and face-to-face office hours available by appointment. Email communication is always welcome. Typically, I respond within one business day. If you do not hear back within one business day, please resend. Please check your WSU email daily – I will use it for class and assignment updates, as well as changes due to severe weather.

Course Readings:
- Locke, L., Spiduso, W. & Sliverman, S. (2014). *Proposals that work: A guide for planning dissertations and grant proposals*. Thousand Oaks, CA: Sage.
- Other readings are available on the course website (Blackboard; learn.wsu.edu)

OVERVIEW
The major aims of this course are to develop analytic skills, knowledge, and abilities to: 1) use relevant literature to understand learning in mathematics and science; 2) critically evaluate key research related to how students learn and how students demonstrates learning of particular mathematics and science content; 3) coherently synthesize a point of view using evidence-based and theoretical arguments relevant to learning; and 4) increase understandings of educational research methods, advantages and limitations of research methods, and reasons for selecting methods that align with a specific research purpose and questions.

The readings for the course provide an overview of various theoretical and philosophical approaches, and in combination with course discussions, they are planned to for students to understand and explore: 1) current knowledge and gaps in the field regarding learning, as well as foundational research; 2) educational research designs and methods, and 3) learning theories/perspectives that guide practice and research in mathematics and science education. A central premise of this course is that there is no single or correct way to view learning, nor is there a single best research method. However, some bodies of research are more settled than others, and some research designs and methods align with specific research questions better than others. In addition, the underlying epistemologies, perspectives, and traditions behind these theories are important to understand in order to evaluate their usefulness and appropriateness for particular research purposes and questions.

COURSE GOALS AND LEARNING OUTCOMES
Consistent with the College of Education's Conceptual Framework (see below), this course will provide opportunities for students to:
1. *Explore theories of learning in mathematics and science education* and reflect upon students' own implicit and explicit perspectives on learning.
2. *Summarize and apply current research and theory about learning* in mathematics and science at the K-12 level, as well as what it means to understand math and science.

3. *Evaluate and select appropriate research designs and methods* in mathematics and science education, and consider these methodologies in relation to underlying perspectives on learning, as well as research purposes and questions.
4. Apply learning from this course and previous COE courses to *develop a preliminary research proposal and a pilot study*. This proposal and pilot study will focus on *research design and methods*, as well as aligning the choice of design and methods with the research purpose, questions, and theoretical perspective.

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.

COURSE ASSIGNMENTS and COMPONENTS OF THE COURSE GRADE
The course assignments work in tandem with class sessions to meet the above goals. An **overview** of course assignments and components of your course grade is described below, with the percentage of your course grade indicated, as well as a point value (out of a possible 1,000 points). **Go to the course Blackboard site for specific instructions and grading criteria for each assignment**.

Commentaries on Research Study Readings (20%, 200 points). For five specified weeks throughout the semester (40 points per commentary), you are expected to prepare **1-2 page, double spaced** commentaries on one of the assigned research-based readings.
Notes: Do not submit a commentary the weeks you are facilitating the discussion (as described next)**.** Please see the *Commentaries* assignment on Blackboard for details on this assignment, and please note that the prompts for Commentary 1 are different from the other Commentaries.

Facilitating Class Article Discussions and Activities (20%, 200 points). Consistent with a seminar format, everyone is responsible for facilitating a session of the class **twice** during the semester (100 points per session facilitated). For each session, you will work with a partner(s) (depending on class size), but not necessarily the same partner(s) for both classes. You will facilitate a session on an article that is either assigned (first round) or selected (second round).*You do not need to submit a commentary for the classes you facilitate*.
Please see the *Facilitating Class Discussions Instructions* on Blackboard for details on this assignment.

Research Methods Proposal and Presentation (30%, 300 points). This project will be submitted in **two parts**: 1) a pre-proposal outline of your plans, before piloting one or more of your planned methods (50 points); and 2) a final proposal and presentation that includes a description and analysis of your pilot, and reflections for potential revisions (250 points). The final proposal will be an 8-10 page paper and class presentation that connects course readings to your own research interests, with a focus on learning in mathematics and/or science. In this paper, you will describe a research project related to learning in mathematics or science that you envision undertaking in the future. For context, you will describe a brief survey of relevant literature on your topic (not a full literature review) and a brief overview of the theoretical perspective(s) underlying your interests

and methods. The focus of this proposal is on *research questions* (related to learning) and the *research design and methods* you plan to employ, as well as *a rationale for why your design and methods are appropriate* for studying your questions (including a comparison/contrast with others designs and methods discussed in class). You may propose to work with a partner or a group. Each member of a collaborative project will be expected to produce work equivalent to an individual proposal, and please talk to your instructor prior to submitting a collaborative pre-proposal to discuss plans. Please see the *Research Methods Assignment* on Blackboard for details on this assignment.

Comparing, Contrasting, and Combining Perspectives on Learning (10%/ 100 points). For this final paper of the semester, you will reflect on course readings, commentaries, discussions, research proposals, and class presentations and activities. The goals of this paper are to: 1) Synthesize work and learning across the semester, with attention to the course goals; and 2) Prepare for the type of thinking and writing that you will need to do for a Masters 702 exam/thesis, doctoral preliminary exam, and/or doctoral dissertation. Please see the *Comparing Perspectives Assignment* on Blackboard for details on this assignment.

Professionalism and Class participation (20%/ 200 points). This class is a seminar format and discussion-oriented, and your preparation for and involvement in the class is a key part of your learning. Your participation grade is based on more than attending class. Your learning depends on careful reading of the assigned articles prior to class and active participation in class activities and discussions. Enter class ready for in-depth discussions about the readings for that date and for connecting to prior course readings and discussions. Although other sources or personal experiences will be relevant, discussions will focus on scholarly perspectives and considerations of the readings, with attention to theoretical frameworks, research designs and methods, and research results. At the end of the semester, you may provide input regarding your participation in class. I value your input in determining your grade, and I cannot always hear or observe small group work during class activities. At end of the semester, you may opt to write approximately one paragraph explaining what you believe your participation grade should be for the semester and why. To ensure that you can provide evidence for your contributions to class, I suggest you keep a log of substantive contributions you add to each class meeting and attach this log to your participation grade statement. *The Participation Rubric* is shown below. If you believe you should receive a certain grade, but do not meet the stated criteria, please present your case for why you might be an exception to the guidelines below.

Professionalism and Class Participation Rubric
97-100% Exceptional: Truly outstanding in all areas.
90-97%   Excellent: You have not missed class, arrived late to class, OR left class early *on more than one occasion*. You maintained professional behavior in your approach and attitude toward class activities and discussions and you prepared for classes well (completed readings and commentaries, etc.). You were actively involved in all classes and made significant and substantive contributions (in groups and/or class discussion). Note: I consider significant and substantive contributions to be questions or comments that reflected on readings, brought about further discussion, and/or caused the class to think deeply or in a way they had not previously thought. In addition, you actively and respectfully listened to (and perhaps responded to) others.
80-89%   Good to Very Good: You have not missed class, arrived late to class, or left class early *on more than one occasion*. For most classes, you met criteria described above for "Excellent," but occasionally you did not actively contribute to class activities and discussions and/or your preparation for class was not evident.
70-79%   Satisfactory: (1) You have not missed class, arrived late to class, or left class early *on more than two occasions*, and otherwise, you met the criteria described for "Good"; OR (2) You have not missed class, arrived late to class, or left class early on more than one occasion, but frequently did not evidence engagement in and/or preparation for class.

Participation Rubric (Continued)

60-69% Not Meeting Expectations: You have not missed class, arrived late to class, or left class early *on more than two occasions*. For most classes, your contributions to class activities and discussions were minimal and/or your preparation for class was not evident.

< 60% Failing: You consistently do not contribute to class and your preparation for class is not evident.

Note: Missing several classes has a cumulative effect great than the sum of the classes. Thus, *missing three classes results in a maximum participation score of 50%* (assuming all other expectations are fully met – which would be difficult with this number of absences) and missing 4 classes or more will result in a 0, and you should consider re-taking the course.

GRADING

The **final course grade** and **individual course assignment scores** will be determined using the following grading scale. There will be no curve for grades in this class. Students should attend to the assignment instructions and grading indicators as provided for each assignment on the course Blackboard site. The grading levels will be the following, with percentage values ending in .5 or higher rounded up to the next whole number:

Excellent:	A (94-100%)		A- (90-93%)
Good:	B+ (87-89%)	B (84-86%)	B- (80-83%)
Satisfactory:	C+ (77-79%)	C (74-76%)	C- (70-73%)
Not meeting expectations:	D+ (67-69%)	D (64-66%)	D- (60-63%)
Failing:	F < 60%		

An Incomplete (I) must be approved and arranged with instructor prior to the end of the semester.

Note: **All written work should adhere to standard conventions and APA Style.** If written work does not adhere to the conventions of writing (e.g. grammatical and/or spelling errors, misused words or phrases, not organized or clearly presented, lack of flow of ideas), **a full grade reduction will result.**

GENERAL EXPECTATIONS FOR THIS COURSE

1. The instructor will use the course web site (on Blackboard) and email to communicate with you during the semester. You must **check your WSU email and Blackboard regularly**. Make sure that your contact information in Blackboard (and on myWSU) is correct and sign up for emergency contact through your myWSU account.
2. **Submit each assignment through Blackboard** (word-processed, *double spaced*, 12-pt font, and in APA style, unless otherwise indicated). Typically, your graded assignment (with feedback) will be returned to you within a week. If you do not receive it, contact the instructor.
3. **Late assignments:** This course is designed for students to develop and build understandings through assignments that are connected to course activities and interactions with other students and the instructor. This process requires that students submit all assignments on time. Unless explicitly stated otherwise, assignments are **due at the start of class on posted due dates**, and **late assignments will not be accepted**. Exceptions to this policy will be granted *only in extenuating situations*, and every effort must be made to *make arrangements for extensions in advance of due dates*. **If you are absent from class on a due date, due dates still apply**.
4. You are responsible for all information discussed in every class. If you must miss class, notify the instructor in advance and **ask a classmate for notes.** Review **PowerPoint slides that are posted on the Blackboard site**.

WSU POLICIES AND REQUIRED STATEMENTS

Workload. It is WSU policy that for every hour in class students should expect a minimum of two hours of work outside of class. Depending on your skills and knowledge as a learner, it may take you more time. Also, there may be some weeks that take more time than the previous week and vice versa.

Academic Integrity. 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. Students are responsible for understanding the full Academic Integrity statement found online at vpue.wsu.edu/policies/statements/#academic-integrity. Students who viols WSU's Academic Integrity Policy (identified in Washington Administrative Code (WAC) 504-26-010(3) and -404) and will receive an "F" for the assignment, will be reported to the Office of Student Conduct. If you have any questions about what is and is not allowed in this course, you should ask the course instructor.

Students with Disabilities*.* Reasonable accommodations are available for students with a documented disability. All accommodations must be approved. For more information, contact a disability specialist on your campus: vpue.wsu.edu/policies/statements/#reasonable-accommodation.

Safety and Emergency Notification. Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the "***Alert, Assess, Act***," protocol for all types of emergencies and the *"Run, Hide, Fight"* response for an active shooter incident. Remain **ALERT** (through direct observation or emergency notification), **ASSESS** your specific situation, and **ACT** in the most appropriate way to assure your own safety (and the safety of others if you are able). Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the *FBI's Run, Hide, Fight video* and visit the *WSU safety portal*.

Important Dates and Deadlines. Students are encouraged to refer to the academic calendar often to be aware of critical deadlines throughout the semester. The academic calendar can be found at http://registrar.wsu.edu/academic-calendar/.

Severe Weather. For severe weather alerts, see: http://alert.wsu.edu/ and https://oem.wsu.edu/emergency-procedures/severe-weather/. In the event of severe weather affecting university operations, guidance will be issued through the alert system. In addition, if possible, the instructor will email updates on plans for the class. Please check your WSU email.

COURSE SCHEDULE

Week	Date	Topics	Tentative Readings*
1	Aug. 21	*Course Introduction; What is Learning?*	*How People Learn II* (NAS, 2018) – ALL: pp. 1-133; skim pp. 11-20.
2	Aug. 28	*What is Learning in Math?*	*How Students Learn: Math* (Bransford, et al., 2005) – ALL: Ch. 1 (pp. 1-25); Ch 5. (pp. 217-246). AND CHOOSE one of the following: • Ch. 6 (elementary); • Ch. 7 (middle); or • Ch. 8 (high) ALL: Read the **syllabus** and all *assignment instructions* in the *Assignment Instruction Folder* on Blackboard. *Presentation Pairs 1-8 Assigned* *Commentary Groups A & B Assigned*
3	Sept. 4	*What is Learning in Science?*	*How Students Learn: Science* (Bransford, et al., 2005) – ALL: Ch. 9 (pp. 397-415). AND CHOOSE one of the following: • Ch. 10 (elementary); • Ch. 11 (secondary); or • Ch. 12 (secondary) **Commentary 1 Due (All)**
4	Sept. 11	*Writing Proposals for Educational Research; Cognitive Research and Theory; Constructivism*	ALL: Locke et al. (2014) – pp. 7-21; pp. 42-126. AND CHOOSE one of the following: • Driver et al. (1994) - science • Fennema et al. (1996) - math **Presentations, Pairs 1 & 2 (Slides due 9/10, noon)** **Commentary 2 Due for Group B**
5	Sept. 18	*Students' Conceptions and Conceptual Change*	All: Handbook of Research on Science Education (HRSE, 2014), Ch. 4 AND CHOOSE one of the following: • Graeber & Tirosh (1990) - math • Hazma & Wickman (2008) - science **Presentations, Pairs 3 & 4 (Slides due 9/17, noon)** **Commentary 2 Due for Group A** **Pre-Proposals Due for Group B** *Presentation Pairs 9-16 Assigned. Articles will be due for approval by noon on the Tuesday that is 15 days prior to presentation dates for Pairs 9-16.*

6	Sept. 25	*Learning Trajectories and Progressions in Math*	All: Compendium for Research in Mathematics Education (CRME, 2017), Ch. 4 AND CHOOSE one of the following: - Hackenberg (2013) - fractions - Kobiela & Lehrer (2015) – geometry concepts & defining **Presentations, Pairs 5 & 6 (Slides due 9/24, noon)** **Commentary 3 Due for Group B** **Pre-Proposals Due for Group A** *Commentary Groups C & D Assigned*
7	Oct. 2	*Learning Progressions in Science*	All: HRSE (2014), Ch. 8 AND CHOOSE one of the following: - Duncan et al. (2009) - genetics - Schwarz et al. (2009) – scientific modeling **Presentations, Pairs 7 & 8 (Slides due 10/1, noon)** **Commentary 3 Due for Group A**
8	Oct. 9	*Design-Based Research Methods to Investigate and Support Learning*	All: CRME (2017), Ch. 9 AND Revisit Fennema et al. (1996). **Presentations, Pairs 9 & 10 (Slides due 10/8, noon)** **Commentary 4 Due for Group C on Fennema**
9	Oct. 16	*Learning Environments*	All: HRSE (2014), Ch. 6 AND CHOOSE one of the following: - Calabrese Barton et al. (2017(- Watt (2017) **Presentations, Pairs 11 & 12 (Slides due 10/15, noon)** **Commentary 4 Due for Group D** *Peer-Review Partners Assigned for Research Methods Proposals*
10	Oct. 23	*Socio-cultural Perspectives and English Learners*	All: HRSE (2014), Ch. 11 AND CHOOSE one of the following: - Buxton et al. (2008) - Moschkovich (2013) **Presentations, Pairs 13 & 14 (Slides due 10/15, noon)** **Commentary 5 Due for Group C**
11	Oct. 30	*Socio-cultural Perspectives and Identity*	All: CRME (2017), Ch. 23 AND CHOOSE one of the following: - Brown et al. (2019) - Gutierraz (2013) **Presentations, Pairs 15 & 16 (Slides due 10/15, noon)** **Commentary 5 Due for Group D**
12	Nov. 6	*Attitudes and Engagement; Research*	All: HRSE (2014), Ch. 5 AND TBD **Email Amy plans for meeting with peer-review partner between 11/6/19 and 11/13/19 (inclusive).**

13	Nov. 13	*Use class time to work with peer-review partner on research proposals.*	**Commentary Due for All: Provide feedback in track-changes to peer-review-partner by Wednesday November 13, 9:00 PM and CC Amy** (or earlier as arranged with partner). **RESEARCH METHODS PROPOSAL DUE by Wednesday November 20, 11:00 PM.**
14	Nov. 20	*Supporting Student Learning with Cognitive Perspectives; Research Proposal Presentations*	All: CRME (2017), Ch. 12 AND TBD **RESEARCH PROPOSALS DUE** **RESEARCH PROPOSAL PRESENTATIONS:** 5-8 minutes per presenter – firm time limits.
	Nov. 27	NO CLASS	*Thanksgiving Break*
15	Dec. 6	*Exploring a Well-Developed Body of Research on Learning: Number &Operations; Reflecting on Learning Perspectives; Sharing Final Papers*	All: CRME (2017), Ch. 13 AND TBD **COMPARING, CONTRASTING, AND COMBINING PERSPECTIVES PAPER DUE** **PARTICIPATION INPUT DUE** (optional)
16	Dec. 13	Finals Week. Wrap Up.	

***The instructor reserves the right to change course readings based on students' learning and interests during the semester, and this is also accounted for in readings listed as "to be determined" (TBD) in the final weeks of the semester. In addition, several weeks include TBD readings to be selected by students. Consistent with the seminar format, students will select and facilitate discussions for some readings. Please see the "Facilitating Article Discussions and Activities" assignment for additional details.*