NVTC 201 Knowing and Learning in Mathematics and Science

University of Nevada, Reno
NevadaTeach

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Office hours:	Monday 2:30 to 4:00 p.m. or by arrangement
Class schedule:	Section 1001: Monday and Wednesday: 1:00 to 2:15 PM
Catalog Description:	**3 credits.** NevadaTeach course focused on learning theories related to math and science education

Course Description: NVTC 201 focuses on knowing and learning in secondary mathematics and science as understood from a multidisciplinary perspective. NevadaTeach is committed to the idea that practice and theory build on each other. Any teaching practice is guided by a theory of how people learn. If students are not aware of this, they are likely to adopt teaching practices without considering the implications of the theories behind them. NevadaTeach expects its students to be thoughtful and reflective practitioners.

Central course topics include Procedural and Conceptual Understanding, Assessment, Learning Theories (e.g., Behaviorism, Cognitive, and Social Perspectives), and Equity. This course provides an introduction to the ways an in-depth understanding of how people know and learn can be used to help make the teaching and learning of mathematics and science more effective. To be useful, such a course needs to be both practical—by providing concrete details and examples of knowing or learning and ways to make students' thinking visible—and principled—by providing a basis in both evidence and theory to support the use of these practices and techniques.

With this in mind, NVTC 201 is designed to give students an opportunity to experience how these different practices and techniques work and to read the research literature that documents the effectiveness of these practices and outlines the rationale for using these techniques. Finally, students apply what has been learned to a specific teaching or research context.

Prerequisites for NVTC 201: NVTC 101 and NVTC 102

Required text:

There will be no textbook required. Students will read articles from various journals and chapters from different books throughout the course.

Course Objectives:

The primary goal of NVTC 201 is to provide students with the opportunity to identify a variety of learning theories and employ these theories to guide their own practice. The course will help mathematics and science educators develop the knowledge, dispositions, and skills needed to be effective teachers in middle and high schools. These objectives will be achieved within the context of the conceptual framework of the College of Education: (a) to possess a love of learning; (b) to develop a strong fund of knowledge; (c) to engage in reflective practice; and (d) to value democracy and diversity.

Student Learning Outcomes:

The student learning outcomes listed below will allow the course objectives to be met in a manner consistent with the College of Education's Conceptual Framework. Upon completion of this course, the student will be able to:

1. Articulate various standards documents, including the Common Core State Standards, the Nevada Academic Content Standards, and the Next Generation Science Standards that are critical to the knowing and learning of science and mathematics.
2. Explain the role of these various standards documents in the assessment process as they relate both to in-class and standardized testing.
3. Describe the various theories used to explain mathematical and scientific knowing and learning and apply these approaches to structure classroom practice.
4. Use the clinical interview method to make sense of someone's reasoning about a topic in mathematics or science.
5. Articulate what it means to know and learn relative to cognitive structures and describe how what people know changes and develops.
6. Explore the affordances offered by various technologies in supporting knowing and learning in mathematics and science.
7. Identify sources of educational inequity and describe strategies for fostering learning environments that are equitable for all students.
8. Express informed opinions on current issues and tensions in education, especially as they relate to mathematics and science instruction.

Course Expectations:

Regular ***attendance*** and ***active participation*** at all class sessions and in online assignments is required and will greatly enhance your ability to be successful. Regular attendance is expected with **no more than one unexcused absence** from class for the semester. You must provide, when possible, advance notice of absences as well as relevant documentation regarding absences to the instructor(s) as soon as possible following the illness or event that led to an absence. Regardless of whether an absence is excused or unexcused, you are responsible for making up all work that is missed. **Participation** in class includes, but is not limited to, coming to class prepared with the required assignments completed and engaging in thoughtful and reflective class discussion and activities. Violation of the attendance and participation policy will result in a grade reduction of 3 points from the final course grade per unexcused absence beyond the one "free" unexcused absence. Participation is assessed daily (see the Participation Rubric in the Grading/Evaluation section below).

Description of Assignments:

Course grades will be determined based on your performance in five categories:

1. Participation (includes daily attendance, engaging in class discussion, and research) & reading questions
2. Clinical Interview 1: Expert/novice interview
3. Clinical Interview 2: Mapping learning in a specific domain
4. Midterm examination
5. Final project: Lesson Design, Enactment, and Evaluation

1. Participation, Reading Questions, & Guiding Class Discussion (5 points per class meeting; 100 possible)

Your participation grade in this course is dependent on two activities:

a. **Daily active participation in all class sessions.** This class is a seminar. We will all contribute to the class. That means that it is necessary for us to read assigned and additional material of your choosing so that we can participate in the discussion. The quality of our learning depends, to a large extent, on the conversation that we have in class – conversation that is grounded in your research and reading. This means that each of you will provide comments that enhance our knowledge of the theories or provoke questions that cause us to think in a new way. This does not mean that we will always agree, but our conversations should be thought provoking and connected to our reading. **I know that I remember best what I read if I keep notes along the way – a reading trail.** Regular attendance is absolutely necessary. I expect you to be at all classes. In addition, I expect you will be on time and remain throughout the entire class. Aside from the attendance policy described above, part of the participation grade will be dependent on assessment of your classroom behaviors, using the Presentation Rubric below.

Participation Rubric

Points	Attendance	Preparedness	Participation
5	Present and prompt.	Has clearly read the reading assignments prior to class. Has reflected upon the assignments and is prepared to discuss them.	In small and large group discussions, participates frequently and appropriately. Comments are insightful and contribute positively to the perspectives and ideas of classmates.
3	Arrives within the first 10 minutes of class.	Has clearly read the reading assignments prior to class, though has not reflected on them or is only moderately prepared to discuss them.	In small and large group discussions, sometimes participates, and participation is generally appropriate. Comments are sometimes insightful and contribute positively to the discussion. Generally, though not always, respects and listens to the perspectives and ideas of classmates.
2	More than 10 minutes late to class.	Has skimmed the reading assignments or has not read them and is clearly unprepared to discuss them.	Does not participate in class discussions, or participation is inappropriate. Comments are off-topic or otherwise do not contribute positively to the class discussion.
0	Absent from class.		

b. **Reading questions & guiding class discussion.** Each class will have a set of questions to be answered regarding the assigned reading material. Coming to class prepared with answers to the questions is expected

and will be randomly collected. Also, you will be assigned class periods where you and a partner will lead the class discussion on the daily readings.

3. Midterm Exam (150 points)

At mid-semester, a formal midterm examination will be administered.

4. Clinical Interview 1: Expert/Novice Interview (100 points)

You will complete one clinical interview assignment in which you compare an expert's and a novice's knowledge and reasoning patterns. A clinical interview is an extensive process of formally interviewing a subject engaged in a problem-solving activity. You will record the interviews, transcribe them, and then analyze the activity using the theories introduced in class and supported by relevant academic literature.

5. Clinical Interview 2: Mapping Student Learning (100 points)

After selecting a topic and learning objectives, groups will use the relevant literature to design a set of interview questions that will access student knowledge and reasoning about this topic.

Two high school students will be selected for two interviews. Group members will record the interviews, transcribe, and analyze them. The **purpose** of this set of interviews is to analyze student knowledge using findings from the related literature to understand what students know about this topic to focus the target of lesson to be taught. The findings from this paper should heavily inform the design of the lesson for the **Lesson Design, Enactment, and Evaluation** project.

6. Final Project: Lesson Design, Enactment, and Evaluation (200 points)

To inform this final project, pairs or groups of three students will select a big idea from mathematics or science and choose a set of objectives that address this idea from the Common Core State Standards, the Nevada Academic Content Standards or the Next Generation Science Standards. These objectives will be investigated in light of what is known about student learning regarding this topic. The assignment will culminate in a search for effective ways to teach the topic. After selecting a topic and learning objectives, groups will design a whole class assessment of students' knowledge of this topic to be administered before and after instruction. Findings from the literature and analysis of the pre-assessments will be used to design an effective lesson that employs the learning theories discussed in the course. The paper created for this assignment will include the lesson plan, a rationale for the design of the plan using the relevant literature, the quantitative evaluation of the learning of the class with a discussion that employs the learning theories explored in the course, and a reflection on what was learned to inform future teaching. The purpose of this assignment is to investigate what is learned as a result of instruction, and these findings should be used to revise and explain students' knowledge of teaching.

****Grading: ** Points will be deducted for late and/or incomplete work. ****

Grading Scale:

		A	650 – 604	A-	603 – 584
B+	583 – 565	B	564 – 539	B-	538 – 519
C+	518 – 500	C	499 – 474	C-	473 – 454
D+	453 – 435	D	434 – 409	D-	408 – 389
F	<388				

Course Calendar:

Week	Topic	Assignments	Readings for This Class
week 1a **29 August**	Introduction to course	Clinical Interview 1 handed out today. Think about questions you want to ask, what you are interested learning about.	None. Survey taken prior to class
week 1b **31 August**	Testing Nature; SAT and ACT	Daily questions on readings due midnight prior to class.	Lemann "Behind the SAT" Newsweek. 9/6/1999, Vol. 134 Issue 10, p52 Atkinson and Geiser "Reflections on a Century of College Admissions Tests" pg 666 to 669 (testing for ability and stop before assessing achievement) Ginsburg: Guidelines for Clinical Interviews (2 articles)
Week 2a **5 September**	Class cancelled	Build / finalize questions for the Clinical Interview 1: Expert / Novice interview	
week 2b **7 September**	Testing Nurture	Daily questions on readings due midnight prior to class.	Sacks: Standardized Minds – Chapter 5 Popham: Why standardized tests don't measure educational quality Feynman: Surely You're Joking – The Brazil story
week 3a **12 September**	Measurement & Assessment; evidence of learning	Daily questions on readings due midnight prior to class.	Popham: The seductive allure of data Black & Wiliam: Inside the black box Dirksen: Hitting the reset button: using formative assessment to guide instruction
week 3b **14 September**	Biological perspectives of intelligence and learning	Daily questions on readings due midnight prior to class.	Gardner et al: Chapter 2, Origins of the scientific perspective Gardner et al: Chapter 3, The psychometric perspective
week 4a **19 September**	Tracking as a consequence of biological perspectives	Daily questions on readings due midnight prior to class.	Oakes: Keeping track: how schools structure inequality (chapter 4: Distributing Knowledge) Gardner et al: Chapter 5, Biological perspectives Heubert, J & Hauser – Chap 5-tracking 89-106

Week	Topic	Assignments	Readings for This Class
week 4b **21 September**	Nurture & Behaviorism	Daily questions on readings due midnight prior to class. Clinical Interview 1 paper due in class. Clinical Interview 2 handed out.	Skinner: Teaching machines Biography of Skinner: http://webspace.ship.edu/cgboer/skinner.html Earlwanger: Benny's rules and answers
week 5a **26 September**	Critiques of Behaviorism: Thinking about learner motivation	Daily questions on readings due midnight prior to class.	Ripley: Should kids be bribed to do well in school? http://content.time.com/time/magazine/article/0,9171,1978758,00.html Kohn: Hooked on learning: roots of motivation in the class.room Kohn: Lures for learning: Why behaviorism doesn't work in the class.room
week 5b **28 September**	Intelligence & Learning Styles	Daily questions on readings due midnight prior to class.	https://cft.vanderbilt.edu/guides-sub-pages/learning-styles-preferences/ Glenn: Customized teaching fails a test Curry: A critique of the research of learning styles http://www.educationplanner.org/students/self-assessments/learning-styles-quiz.shtml http://vark-learn.com/the-vark-questionnaire/
week 6a **3 October**	Multiple Intelligences I and 2	Daily questions on readings due midnight prior to class.	Gardner et al: Chapter 7, Recent Perspectives: 202-214 Gardner: Reflections on MI
week 6b **5 October**	The intersection of nature and nurture: nurturing intelligence	Daily questions on readings due midnight prior to class.	AAUW: Chapter 2: Beliefs about Intelligence Sternberg: Who are the bright children? The Cultural context of being and acting intelligent. McGlone and Pfiester: The generality and consequences of stereotype threat (p. 174 – 178)
week 7a **10 October**	Direct Instruction	Daily questions on readings due midnight prior to class.	Gagne: Some issues on the psychology of math instruction Hunter model of mastery learning (1-5)
week 7b **12 October**	The cognitive revolution: the mind is a computer	Daily questions on readings due midnight prior to class.	Gardner: Cognitive science Gardner: Chapter 6: The cognitive perspective Polya: How to solve it 112-115

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			Stroup: Notes on Polya and Eliza http://blog.oxforddictionaries.com/2012/06/turing-test/ http://www.psych.utoronto.ca/users/reingold/courses/ai/turing.html
week 8a **17 October**	Cognitive Revolution: the mind develops (Jean Piaget)	Daily questions on readings due midnight prior to class.	Gardner: The developmental perspective Munari: biography of Piaget Papert on Piaget http://www.papert.org/articles/Papertonpiaget.html
week 8b **19 October**	More on Constructivism	Daily questions on readings due midnight prior to class. Clinical Interview 2 due in class today.	Stroup: Learning the basics with calculus Piaget: Structuralism Papert: Mindstorms (excerpts) Duckworth: Piaget rediscovered
week 9a **24 October**	Review for Midterm		
week 9b **26 October**	Midterm		
week 10a **31 October**	Social Constructivism: Developing in groups/society	Daily questions on readings due midnight prior to class. Final project handed out.	Vygotsky: Mind in Society (selections from chapter 1, 4 & 6) Bigge and Shermis: Learning Theories for Teachers: (chapter 6)
week 10b **2 November**	Part 1: The importance of others in the process of learning: peers	Daily questions on readings due midnight prior to class.	Gilies: The effects of cooperative learning on junior high school students during small group learning (pp 197-201; 209-211) Marzano et al: Cooperative learning Chap 7 ONLY
week 11a **7 November**	Part 2: The importance of others in the process of learning: peers	Daily questions on readings due midnight prior to class.	Riegle-Crumb et al: The role of gender and friendship in advanced course taking (pp 206 – 210 RQ; 214 – 221) Matthew: Effort Optimism in the Class.room (pp 226 – 229; 234 -
week 11b **9 November**	The importance of others in the process of learning: parents & teachers	Daily questions on readings due midnight prior to class.	Ladson-Billings: The dreamkeepers (chapters 5 & 6; pp 81-101; 118-126) Beilock: Female teachers' math anxiety affects girl students (Discussion section only, p 1862) Ing: Gender differences in the influence of early perceived parental support (pp 1222 – 1224; 1233 – end)

Week	Topic	Assignments	Readings for This Class
Week 12a **14 November**	Design of Effective Teaching	Daily questions on readings due midnight prior to class.	Bransford et al: How People Learn, Chap 7 Effective Teaching: Examples from science, history, and mathematics
week 12b **16 November**	Challenges of Conceptual change and teaching	Daily questions on readings due midnight prior to class.	Schoenfeld: When good teaching leads to bad results McCloskey: Intuitive Physics Halloun & Hestenes: Misconceptions and the force concept inventory
Week 13a **21 November**	Mind is a computer – Experts, novices, cognitive architecture & schools for thought	Daily questions on readings due midnight prior to class.	Bransford et al: How experts differ from novices: From How people Learn (in How people learn, NAS, Chapter 2) Bruer: Schools for thought
week 13b **23 November**	Class. cancelled	Daily questions on readings due midnight prior to class.	
week 14a **28 November**	Participation, Agency, and social justice in education	Daily questions on readings due midnight prior to class.	Friere: Humanistic Education Willingham: What do students have against social justice education
week 14b **30 November**	Models for learning and life: vocationalism and academies	Daily questions on readings due midnight prior to class.	Grubb: The new vocationalism Conchas: The color of success Resnick: Learning School inside and out
week 15a **5 December**	Generative design and MEA's	Daily questions on readings due midnight prior to class.	Stroup et al: Diversity by Design Carmona & Greenstein: Investigating the relationship between the problem and the solver
week 15b **7 December**	Emergence, Systems, and understanding unintended consequences	Daily questions on readings due midnight prior to class.	Gee: Good Video Games Judson & Sawada: Learning from past and present: electronic response systems in college lecture halls
Week 16a **12 December**		Final project due in class.	
Week 16b **14 December**	Prep Day; No class.		

Week	Topic	Assignments	Readings for This Class
Week 17a **19 December** **Final Exam: 10:15 am – 12:15 pm**			

Statement on Academic Dishonesty: For example, "Cheating, plagiarism or otherwise obtaining grades under false pretenses" constitute academic dishonesty according to the code of this university. Academic dishonesty will not be tolerated and penalties can include canceling a student's enrollment without a grade, giving an F for the course or for the assignment. For more details, see the University of Nevada, Reno General Catalog.

Statement of Disability Services: For example, "Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the Disability Resource Center (Thompson Building, Suite 101) as soon as possible to arrange for appropriate accommodations."

Statement for Academic Success Services: For example, "Your student fees cover usage of the Math Center (784-4433 or www.unr.edu/mathcenter/), Tutoring Center (784-6801 or www.unr.edu/tutoring-center), and University Writing Center (784-6030 or http://www.unr.edu/writing-center). These centers support your class.room learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class. is the sign of a responsible and successful student."

Statement on Audio and Video Recording: Surreptitious or covert video-taping of class. or unauthorized audio recording of class. is prohibited by law and by Board of Regents policy. This class. may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class. lectures and discussions. Therefore, students should understand that their comments during class. may be recorded.