T-543: Applying Cognitive Science Research Principles to Learning and Teaching
Spring 2018

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Course Times: Fridays 9:00 a.m. to 12:00 p.m.
One Mandatory Weekly Section Meeting: TBA
Office Hours: By Appt.

Course Overview:

Purpose: This is a survey course that aims to help participants develop understanding of and the ability to apply principles from research on learning and cognitive science that interact with designing instruction.

Who is it for? It is primarily intended for those who want to develop thoughtful instructional designs for learning. These designs can be in the form of traditional lesson plans or in forms for a variety of other contexts, formal or informal, including MOOCs, on-line learning, computer programs, children's television, professional development, museums, and so on. Many of the course examples are drawn from a K-12 context, but the principles apply broadly to life-long learning. Secondarily, some students choose the course to learn important principles from cognitive science but the focus is on application rather than the academic debates in the research literature. The research findings are drawn from research on learning in general, but a greater proportion of the findings have been tested in the context of science (where there has traditionally been proportionately more funding.)

Essential Questions:

1. What are our implicit pedagogies and how might they impact the instruction that we design?
2. How does who the learner is (developmentally and culturally) interact with learning?
3. What is involved in generating understanding goals and helping learners meet them?
4. What is known from cognitive science that informs instructional schemas and specific instructional decisions? How can we leverage this knowledge to create powerful learning opportunities?

Content: This course presents research-based pedagogies and explores cognitive science principles that have important implications for instructional approach and curriculum design. It asks about the nature of deep understanding—both cognitively and affectively. It considers schemas for instruction that reflect broad assumptions about the nature of learning and the nature of learners. It contrasts older schemas such as behaviorism and didactic teaching to more recent schemas such as conceptual change, teaching for deep understanding, problem and project-based learning and considers fit for instructional purpose. It explores cognitive science principles and research findings on topics such as transfer, analogy, metacognition, conceptual change, causal explanation, mental models, novice-expert shifts, and the nature of beliefs about intelligence and how these interact with curriculum and instructional design choices. It incorporates findings from developmental research and considers how cultural and learner diversity influences instructional design. Discourse ranges from learning theory to grounded classroom examples, focusing on examples that elucidate both how theory and research inform practice and how practice informs research questions and broader theory. Class sessions will focus on specific principles from research and the analysis of examples from classrooms, curriculum, and other forms of instructional design that embody those principles. However, as a survey course, it takes a broad look at important ideas from cognitive science and it is up to the students (with the support of the instructional team) to

apply those concepts to their course projects in their particular areas of instructional interest. Class format includes activities, discussion, brief lectures, and periodically, structured activities to help you apply the class concepts to your project. Section meetings are described below.

Cognitive science covers a very broad range of topics and varies in focus from micro-processes such as working memory to macro-processes such as transfer of learning. The focus in this course is more on the macro-concepts about the nature of learning that have been shown to have substantial leverage in instructional contexts. It is not possible for one course to do a good job helping students to learn about all of the rich ideas in cognitive science that would be helpful in instruction. The course focuses on a set of powerful ideas that can shift how educators think about instructional contexts. Further, while we will occasionally incorporate some research from cognitive neuroscience, the focus of the course is on well-vetted principles from cognitive science that offer good guidance for instruction.

Students complete a term project, the choice of which is based on individual interest. Most students choose to focus on the development of a curriculum topic, However, a variety of projects are possible including the development of the curriculum bible for a children's television, educational website design, and professional development programs for adults, to name a few examples. Previous experience with lesson planning or curriculum development is helpful.

Pedagogy: The course pedagogy mirrors the principles of instructional design taught in the class. The primary pedagogies include conceptual change and project-based learning (involving developing a project for the entire semester). There is a strong focus on transfer and application. Class activities include activities to help students engage with each concept through experience, reflect upon it, learn the research findings in relation to it and then see diverse models of its application in instruction. Activities and questions are framed to encourage mindful processing and construction of knowledge with classmates as we analyze artifacts of instruction (videotape of classroom interactions, lesson plans, student work, etc.). There are brief lectures. The larger project has steps of completion, opportunities for revision, and rubrics to guide project steps. There is a strong expectation that course participants will take the initiative to pursue the additional readings and resources that the class offers which are most relevant to their project.

What Understandings/Competencies will I gain with successful completion of this course?

You will learn to:

- …formulate and articulate a set of understanding goals and the rationale behind them;
- …assess the developmental and cognitive challenges inherent in particular understanding goals;
- …use principles from research in cognitive science to design instruction to address these challenges;
- …design instructional materials for particular audiences;
- …articulate how the features of an instructional design capitalize upon what we know from principles of learning and cognition.

How will this course support Competencies in Understanding and Interacting with Diversity?

This class includes explicit attention to the diversity of learners and designing instruction to address the needs of particular audiences. One week is dedicated to issues of development, culture, and forms of diversity that interact with learning needs and strengths. Students are asked to reflect upon their own cultural identities and how it influences them as learners as a means of helping them realize how attending to diversity is important in developing instructional designs for others. The class draws upon video cases from diverse groups as instructional examples to analyze.

Course Requirements:

- Read assigned readings and occasional 1-2 page additional hand-outs.
- Complete brief assignments for class or section.
- Class and section attendance.
- Participation in and full attention to class and section activities and discussions.

- Plan, execute, and hand in an instructional design project (approx. 25-30 pages, single-spaced with lay-out that includes white space, images, etc.) that incorporates class concepts.
- Additionally, write and hand in a report (approx. 15-20 double-spaced pages) elaborating upon the instructional design choices that the project incorporates.
    - Mandatory Intermediate Project Steps include:
      -Bring project ideas to section for discussion during Week 3.
      -Work on your project throughout the semester attending to the focus given for each week.
      -Prepare for and meet with your TF in Weeks 3-5 to discuss project topic, scope, and structure.
      -Hand in draft of Topic Rationale (2 pages, part of Final Report) at the end of Week 5 (revisable).
      -Hand in draft of Understanding Goals (2 pages, part of Final Report and Project) at the end of Week 6 (revisable).
      -Hand in a draft of one portion of your design (4-5 pages, part of Final Project) to upload prior to Week 8 and bring to Week 8 Section for discussion.
      -Hand in Initial Draft of Project and Report at the end of Week 10 (formative feedback by end of Week 12).
    - Final Project and Report due Friday, May 4.
- Adherence to HGSE's rules concerning plagiarism and proper use/citation of sources. Please refer to the information sheet on citation of sources for T543 on the course website.

How to Approach the Readings:

There are required weekly readings. There is a reading guide for each week (posted on the course website) to help you get the most out of your reading and to orient you to why it was assigned and what big ideas you should focus on. Please be sure to do the readings prior to each class. It is assumed that you have this basis for participation in the group discussions, large and small. Occasionally, we will focus on the readings in class and on questions from the reading guides.

The number of readings is limited to a few key selections each week to encourage deep and thoughtful reading for understanding. Processing for deeper understanding means that you might read a piece more than once, ask yourself comprehension questions as you are reading, develop a conceptual mapping of the big ideas presented, and so forth. Additional optional readings are given for those who are interested in pursuing the ideas further. (Please ask for additional references if you are interested in diving in more deeply than the resources offered on the syllabus enable.) <u>If you are taking the course primarily for the purpose of learning the cognitive science, please be aware that the readings are selected to facilitate application of the ideas to practice, NOT for their ability to illuminate the prevailing academic debates.</u>

The required readings for the course aim towards general concepts and not towards focusing on one discipline. However, a greater number are based in math and science because of the support for research in these areas. Therefore, if you choose a strongly discipline-based topic for your project, you may wish to read some additional discipline-specific readings as well. Some of the optional readings focus on how the concepts translate for specific disciplines. Consult your TF or Tina for additional suggestions.

In addition to the required readings, optional readings are included on the syllabus for those who wish to read further about particular topics or with a particular focus on the topics. Some are included to illuminate how the concepts translate for different disciplines or to offer information about using the concepts with particular populations; others offer insights into the academic debates. The list is necessarily constrained by whether good resources exist on a particular topic. If you identify additional particularly useful resources in your own work, please share these with the class community.

While the course presents research in the field and how it bears on instructional design, the specific course readings were chosen for a variety of additional reasons including: 1) offering the best overview of the topic; 2) accessibility; 3) because it represented a seminal or critical juncture for the field; and 4) because it offered a strong bridge between cognitive science and the instructional design implications. <u>Therefore, you will note that the readings come from a range of years and intentionally represent a broader perspective than merely the last ten years.</u> While one article can summarize research evidence across many studies, one study does not constitute a

research base and scientific research progresses by challenging and vetting ideas over time; it is the cumulative evidence for powerful ideas that guide the choice of the research principles discussed in class.

We encourage you to create reading discussion groups outside of class and to regularly meet to discuss the readings. The reading guides can offer a helpful structure of these sessions and you can bring any questions that you have to class or to Friday lunch with Tina. Please let us know if we can support you in setting these up.

Section Meetings:

Section meeting is a dedicated time each week to focus on applying the course concepts to your project and to advancing the thinking and actual development of your project. The schedule for sections will be available the first week of class as soon as the enrollment is known and TF slots can be allocated. The schedule will attempt to accommodate everyone's first choice, however, priority will be given to students who enroll by the registration deadline and who turn in their section information sheets (emailed to class the day after enrollment closes) by the Tuesday of the first week of class. Sections begin during Week 2.

Note: Required readings will be provided in an online course reading packet (IPac) or are available online. URLs are provided for some readings and others, available electronically, will require using links through the HGSE library.

Course Outline:

Topic 1: Introduction to the Problem Space of Learning and Instructional Design:

The first class is a general orientation to the problem space of instructional design. We will also consider how we interact as a class and what will help to make a good learning experience for all of us in light of our diverse needs.

January 26, Week 1: Unspoken Pedagogy: Revealing and Exploring Pedagogical Assumptions—What is the Nature of Understanding, Learning, and Teaching?

What are our underlying assumptions about the nature of learning and teaching? If we don't explicitly unpack these assumptions, how might they guide our choices whether or not they represent best practices? How can we engage in the most productive discussions that lead to deeper collective understanding? What are some lessons to be culled from the discordant research results on some of the most prevalent pedagogies?

Preparation Prior to Class:
Required Readings: Hollander, J.A. (2002). Learning to discuss: Strategies for improving the quality of class discussion. Teaching Sociology, 30(3), pp. 317-327. http://www.jstor.org.ezp-prod1.hul.harvard.edu/stable/3211480 Latham, A. (1997). Asking students the right questions. Educational Leadership, 54(6), pp. 84-85. http://ezp-prod1.hul.harvard.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=f5h&AN=9703145847&site=ehost-live&scope=site Rothstein, D. & Santana, L. (2011) Teaching students to ask their own questions: One small change can yield big results. Harvard Education Letter, 27(5), 1-2, Available at: http://www.hepg.org/hel/article/507#home McCormick, D. & Kahn, M. (1982). Barn raising: Collaborative group process in seminars. Exchange: The Organizational Behavior Teaching Journal, 7(4) pp. 16-20. https://doi-org.ezp-prod1.hul.harvard.edu/10.1177/105256298200700404 Summaries on Constructivism and Behaviorism (posted on course website). Handout with diagram and a few reflection questions about the nature of knowledge.
Written Reflection to Bring to Class: Please write 3-4 paragraphs (total) answering the following questions: 1) What goals and advice do you have for yourself for developing your discussion skills this term? 2) From your own experience as a learning or educator, what are some of your current ideas about the nature of good instructional design? List 3-4 ideas and briefly explain them. Bring thoughts (does not need to be written) about the reflection questions about the nature of knowledge sheet to class.
Section (following Class 1): Complete and email your Section Form to Tina by 5 pm, Jan. 23rd. Sections start following the first class. Complete Your "Getting to Know You" Sheet and send it to your TF and Tina prior to your first section meeting. Read the "Project Overview and Getting Started" before section.

Topic 2: Understanding, Learning, and Instruction: Research-Based Frameworks

In classes 2-8, we will focus on big issues that influence how we frame instructional designs. We'll consider what understandings to focus on in terms of their importance and developmental relevance; how to cast those understandings in their most generative form; how the understandings may unfold over time and with certain kinds of experiences; and how to encourage the most active engagement with the target understandings. We'll also consider broad level issues about the nature of assessment and how to assess where your learners are along the path to understanding.

February 2, Week 2: The Nature of Understanding, Active Processing, and Generative Topics

What is the nature of understanding? How do we know when we and others understand something? What does learning research reveal about the features of deep and expert understanding? How does active processing interact with understanding? How can instructional designs be framed so that they generate active processing? What is backward design and what are arguments in support of it?

Preparation Prior to Class:
Required Readings: Wiske, M.S. (1998). What is Teaching for Understanding? In M.S. Wiske (Ed.) Teaching for Understanding: Linking Research with Practice. (pp 61-86), San Francisco, CA: Jossey-Bass. **iPac©** Grotzer, T.A. (1996). Understanding counts! Teaching for depth in math and science: Cognitive issues that affect math and science learning: Math/Science matters: Cambridge, MA: Harvard Project on Schooling and Children/ Exxon Education Foundation, pp.1-17. **iPac©** Folk, N. (2006). Understanding understanding: A review of the literature. In K.A. Leithwood, P. McAdie, N. Bascia, & A. Rodrigue (Eds.) Teaching for Deep Understanding: What Every Educator Should Know. NY: Corwin Press, pp.26-29. **iPac©**
Optional Readings: Bremer, C.D. & Morocco, C.C. (2003). Teaching for Understanding: Research to practice brief. Improving Secondary Education and Transition Services through Research, November 2003 • Vol. 2, Issue 4 (Focus on Differently-Abled Students) Ross, J.A. & McDougall, D.E. (2006). Mathematics: Teaching for deep understanding in the disciplines. In K.A. Leithwood, P. McAdie, N. Bascia, & A. Rodrigue (Eds.) Teaching for Deep Understanding (pp 33-39) NY: Corwin Press. Evans, M. & Hundey, I. (2006). Deepening understanding and competence in Social Studies teaching: Teaching for deep understanding in the disciplines. In K.A. Leithwood, P. McAdie, N. Bascia, & A. Rodrigue (Eds.) Teaching for Deep Understanding (pp 63-72) NY: Corwin Press. Gallagher, K. (2006). Imagining drama/theater and the arts: Teaching for deep understanding in the disciplines. In K.A. Leithwood, P. McAdie, N. Bascia, & A. Rodrigue (Eds.) Teaching for Deep Understanding (pp 73-82) NY: Corwin Press. Booth, D. (2006). The role of literacy and literature: Teaching for deep understanding in the disciplines. In K.A. Leithwood, P. McAdie, N. Bascia, & A. Rodrigue (Eds.) Teaching for Deep Understanding (pp 40-48) NY: Corwin Press. Scardamalia, M. (2006). Technology for understanding. In K.A. Leithwood, P. McAdie, N. Bascia, & A. Rodrigue (Eds.) Teaching for Deep Understanding (pp 103-109) NY: Corwin Press.
Preparation for Section Following Class 2:
Bring one or two initial project idea(s) and thoughts about the overall structure of the instructional design that what you might create (for example, lesson plans; workshop design; reflection guide for students or teachers; website; book proposal; television program, etc. to section to discuss. In section, you will discuss ways to make the topic more generative.

February 9, Week 3: Expert Knowledge/ Different Knowledge Types/Getting to the Bones/Part 1: Who is the Learner?: The Interaction of Culture and Instructional Design

It is common for instruction to target procedural and conceptual knowledge. What does it mean to focus on structural knowledge, too, and what is the rationale for doing so? What is the nature of expert thinking and how can instruction be designed to facilitate the development of expert patterns of thought? What attitudes do experts and effective learners bring to their thinking and reasoning? How has the role of culture been considered in cognition and development? What does research on culture and cognition suggest for instructional design?

Preparation Prior to Class:
Required Readings: Bereiter, C., & Scardamalia, M. (1993). Surpassing ourselves: An inquiry into the nature and implications of expertise. Chicago: Open Court, pp. 25-37 and 77-120. **iPac©** Grotzer, T.A. (2002). Expanding our vision for educational technology: Procedural, conceptual, and structural knowledge. Educational Technology Magazine, March-April, pp. 52-59. **iPac©** Grotzer, T.A. (2004). Putting science within reach: Addressing patterns of thinking that limit science learning. Principal Leadership, October, 2004 5(2) 217-221. http://search.proquest.com.ezp-prod1.hul.harvard.edu/docview/233323109/EADC723EF482474EPQ/1?accountid=11311 Nasir, N.S., Rosebery, A.S., Warren, B. & Lee, C.D. (2006). Learning as a cultural process: Achieving equity through diversity. In R.K. Sawyer (Ed.) The Cambridge Handbook of the Learning Sciences. New York, NY: Cambridge University Press pp. 489-504. **iPac©** Klump, J. & McNeir, G (2005). Culturally responsive practices for student success: A regional sampler, Northwest Regional Laboratory, June, 2005, pp. 1-11. http://educationnorthwest.org/webfm_send/296
Optional Readings: Bransford, J.D., Brown, A.L., & Cocking R.R. (For the Committee on Developments in the Science of Learning) (2000). How people learn: Brain, mind, experience, and school: Expanded Edition: Chapter 2: How experts differ from novices. (pp 31-50). National Academies Press: Washington D.C. Available on line at: http://www.colorado.edu/MCDB/LearningBiology/readings/How-people-learn.pdf Grotzer, T. (2012). Learning Causality in a Complex World: Understandings of Consequence, Lanham, MD: Rowman Littlefield. Nisbett, R.E. & Norenzayan, A. (2002). Culture and cognition. In D. L. Medin (Ed.).Stevens' Handbook of Experimental Psychology, Third Edition. Available: http://www-personal.umich.edu/~nisbett/cultcog2.pdf Cole, M. (2010). What's culture got to do with it?: Educational research as a necessarily interdisciplinary enterprise. Educational Researcher 39(6), 461-470.
Preparation for Section Following Class 3:
Read the "Final Project Guidelines" prior to Section. Review at least two projects from previous students from those posted on-line in the Sample Project Gallery. Then analyze the Understanding Goals from those two projects and make notes on what you notice about how they are written. Bring the UGS and the notes to section. Read the "Assignment 1: Topic Rationale and Rubric" sheet prior to section.
Reminder: Set up a meeting between Weeks 3 to 5 to meet with your TF about your project ideas. This meeting is an opportunity to discuss your generative topic, structure for your prototype, project

scope, and other specifics related to your project idea. Prepare for this meeting by reflecting upon and making notes on what you know about your project at this point and your current uncertainties or questions.

February 16, Week 4: Who is the Learner? The Interaction of Development, Culture, and Instructional Design

How has development typically impacted instructional design? How has our understanding of child development changed over time? What are some different ways that developmental research can inform instructional design? How has the role of culture been considered in cognition and development? What does research on culture and cognition suggest for instructional design?

Preparation Prior to Class:
Required Readings: Metz, K.E. (1997). On the complex relation between cognitive developmental research and children's science curricula. Review of Educational Research, 67(1), pp. 151-163. http://www.jstor.org.ezp-prod1.hul.harvard.edu/stable/1170622
Optional Readings: Bransford, J.D., Brown, A.L., & Cocking R.R. (For the Committee on Developments in the Science of Learning) (2000). How people learn: Brain, mind, experience, and school: Expanded Edition: Chapter 4: How children learn. (pp 79-113). National Academies Press: Washington D.C. Available on line at: http://www.colorado.edu/MCDB/LearningBiology/readings/How-people-learn.pdf Blumenfeld, P., Kempler, T. M., & Krajcik, J. (2006). Motivation and cognitive engagement in learning environments. In R.K. Sawyer (Ed.) The Cambridge Handbook of the Learning Sciences (pp. 475-488). New York, NY: Cambridge University Press.
Following this Class:
Read additional information on the age group that you are designing for: See the Hand-outs and Developmental Reviews by Grotzer, Donis, and Grossman on the website. Also the following books on adult development and on adolescent development on reserve in the library: Knowles, M.S., Holton, E.F. III, & Swanson, R.A. (2011.) The Adult Learner: 7th Ed., Routledge. Nakkula, M.J. & Toshalis E. (2006). Understanding Youth: Adolescent Development for Educators. Harvard Education Press.
Preparation for Section following Class 4:
Come prepared to discuss the Understanding Goals for your project. Read the "Assignment 2: Understanding Goals and Rubric" sheet prior to section.

February 23, Week 5: Schemas for Instruction I: Prior Knowledge and Designing Instruction for Conceptual Change

How does prior knowledge and assumptions interact with learning? What is conceptual change? What is the research base that supports a conceptual change approach to learning and teaching? What are the implications of using this approach to design instruction? What puzzles does it present?

Preparation Prior to Class:
Required Readings: Strike, K. A., & Posner, G. J. (1985). A conceptual change view of learning and understanding. In L. H. T. West & A. L. Pines (Eds.), Cognitive structure and conceptual change (pp. 211-231). New York: Academic Press, pp. 211-231. **iPac©** di Sessa, A. (2006). A history of conceptual change research: Threads and fault lines. In R.K. Sawyer (Ed.) The Cambridge handbook of the learning sciences, Chp. 16. New York, NY: Cambridge University Press, pp. 265-282. **iPac©**
Optional Readings: Dunbar, K., Fugelsang, J.A., Stein, C. (2007). Do naïve theories ever go away?: Using brain and behavior to understand changes in concepts. In M.C, Lovett & P. Shah (Eds.) Thinking with Data (pp 193-206), New York: Lawrence Erlbaum Associates. Lehrer, R., & Schauble, L. (2000). The development of model-based reasoning. Journal of Applied Developmental Psychology, 21(1), 39-48. Schwartz, D.L., Sears, D., & Chang, J. (2007). Reconsidering prior knowledge. In M.C, Lovett & P. Shah (Eds.) Thinking with Data (pp 319-344), New York: Lawrence Erlbaum Associates.
Project Components:
Hand in draft of Topic Rationale (becomes part of your Final Report) by Midnight, Saturday Feb. 24th on the course website. (revisable, but submission is mandatory)
Preparation for Section following Class 5:
Read the “Assignment 3: One Part of the Prototype” sheet prior to section.

March 2, Week 6: Schemas for Instruction II: Interdisciplinarity and Project-Based Learning

How do we bring learners into an instructional space in ways that invite and sustain engagement while keeping our understanding goals central? How can we get beyond instruction framed by a potpourri of activities towards the systematic building of understanding? What is the role of the disciplines in different types of instructional design? How does "epistemic cognition" interact with learning? What is project-based learning and how does it address interdisciplinarity and disciplinary knowledge?

Preparation Prior to Class:
Required Readings: Gardner, H. & Boix-Mansilla, V. (1994). Teaching for understanding within and across the disciplines. Educational Leadership, 51(5), 14-19. http://ezpprod1.hul.harvard.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=9406020886&site=ehost-live&scope=site Gardner, H. (1999). The disciplined mind: What all students should understand. New York: Penguin. (pp. 15-20, 28-40, 123-26, 143-158 only). **iPac©** Krajcik, J.S. & Blumenfeld, P.C. (2006). Project-based learning. In R.K. Sawyer (Ed.) The Cambridge handbook of the learning sciences, Chp. 19 (pp. 317-333). New York, NY: Cambridge University Press. **iPac©** Edutopia Summmary on PBL: http://www.edutopia.org/pbl-research-learning-outcomes
Optional Readings: Edelson, D.C. & Reiser, B.J. (2006). Making authentic practices accessible to learners: Design challenges and strategies, The Cambridge handbook of the learning sciences, Chp. 20 (pp. 335-354). New York, NY: Cambridge University Press.
If you would like to give feedback on how the course is going for you, please download the Mid-course Evaluation sheet on the "Logistical Information and Assignments" Page of the course website and fill it out. It can be handed in anonymously or with attribution. It can be given to Tina or to a TF, emailed to Tina, or left in an envelope on Tina's office door.
Project Components:
Hand in draft of Understanding Goals (becomes part of your Final Report) by Midnight, Saturday, March 3rd on the course website. (revisable, but submission is mandatory)
Preparation for the Section following Class 6:
TBD by TFs for each section.

March 9, Week 7: Schemas for Instruction III: Provocations and Problem-Based Learning

How can we invite learners into a problem space? What is problem-based learning (PBL) and how does it impact instructional design? What are some examples? What is the role of the disciplines in PBL?

Preparation Prior to Class:
Required Readings: Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? Educational Psychology Review, 16(3), 235–266. http://www.jstor.org.ezp-prod1.hul.harvard.edu/stable/23363859 Kirschner, P.A., Sweller, J. & Clark, R.E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. Educational Psychologist, 41(2), pp. 75-86. http://dx.doi.org.ezp-prod1.hul.harvard.edu/10.1207/s15326985ep4102_1 Hmelo-Silver, C.E., Duncan, R.G.& Chinn, C.A. (2007) Scaffolding and Achievement in Problem-Based and Inquiry Learning: A Response to Kirschner, Sweller, and Clark (2006) Educational Psychologist, 42(2), pp. 99-107. http://dx.doi.org.ezp-prod1.hul.harvard.edu/10.1080/00461520701263368
Optional Readings: Minner, D.D., Levy, A.J., & Century, J. (2010). Inquiry-based science instruction—What is it and does it matter? Results from a research synthesis years 1984 to 2002. Journal of Research in Science Teaching, 47(4), 474-496. Barron, B. J. S., Schwartz, D. L., Vye, N. J., Moore, A., Petrosino, A., Zech, L., Bransford, J.D., & The Cognition and Technology Group at Vanderbilt. (1998). Doing with understanding: Lessons from research on problem- and project-based learning. The Journal of the Learning Sciences, 7, 271-311. David, J.L. (2008). What research says about project-based learning. Educational Leadership, February. (on-line)
Project Components:
One portion of design due Midnight, Monday March 19th on the course website.
Preparation for the Section following Class 7 (the section that meets the week following vacation) :
Bring one portion of design to section to share and discuss. (You will have already uploaded it on 3/19.)

March 16 - No Class, Mid-Winter Recess

March 23, Week 8: Designing Assessments for Learning

How can we assess in ways that build and reveal understanding? When should assessment occur and why? How can we design assessments to reveal challenges students are struggling with and suggest paths to address the challenges?

Preparation Prior to Class:
Required Readings: Simmons, R. (1994). The horse before the cart: Assessing for understanding. Educational Leadership, 51(5), 22-23. http://ezp-prod1.hul.harvard.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=9406020889&site=ehost-live&scope=site Wolf, K. & Stevens, E. (2007). The role of rubrics in advancing and assessing student learning. The Journal of Effective Teaching, 7(1), 3-14. http://www.uncw.edu/jet/articles/Vol7_1/index.htm Try out the following technology-supported assessment: The Diagnoser- http://www.diagnoser.com/ Watch the brief video on Virtual Performance Assessment- http://vpa.gse.harvard.edu/video
Optional Readings: Hattie, J., & Temperley, H. (2007). The power of feedback. Review of Educational Research 77(1), 81–112. Means. B. (2006). Prospects for transforming schools with technology-supported assessment. In R.K. Sawyer (Ed.) The Cambridge handbook of the learning sciences, Chp. 30 (pp. 505-520). New York, NY: Cambridge University Press. Sadler, P. M. (1998). Psychometric models of student conceptions in science: Reconciling qualitative studies and distractor-driven assessment instruments, Journal of Research in Science Teaching, 35(3) pp. 265–296. National Research Council (2001). Knowing what students know. The science and design of educational assessment. Washington, D.C.: National Academy Press. (Jim Pellegrino, Robert Glaser, Co-Chairs.)
Preparation for Section following Class 8:
Read the Project Rubrics prior to section. Read the “Assignment 4: First Draft or Prototype and Report” sheet prior to section.

Topic 3: Fine-Grain Instructional Moves: Using Principles From Research on Cognition

With the broader framing in place, in weeks 9-12, we will focus on finer grain moves in instructional design based upon what we know from the cognitive science research. We'll consider ways to infuse these moves into lesson plans so that they enhance student understanding.

March 30, Week 9: Infusing the Teaching of Thinking and Metacognition into Instructional Design

What are some ways that the learning and instructional design community has thought about metacognition? What does the research say about how metacognition impacts learning? What are some ways that metacognitive moves can be included in instructional design?

Preparation Prior to Class:
Required Readings: Perkins, D., Simmons, R. & Tishman, S. (1990). Teaching cognitive and metacognitive strategies. *Journal of Structural Learning, 10*(4), 285-303. **iPac©** Swartz, R. J. & Parks, S. (1994). Infusing the teaching of critical and creative thinking into content instruction. Pacific Grove, CA: *Critical Thinking Press and Software*. Chapter 19, Metacognition, Chp. 19 (pp. 519-529). **iPac©** Joseph, N. (2010). Metacognition needed: Teaching middle and high school students to develop strategic learning skills. *Preventing School Failure 54*(2), 99-103. http://ezp-prod1.hul.harvard.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=44867908&site=ehost-live&scope=site Pictures of Practice Hand-Outs on course website.
Optional Readings: Grotzer, T.A. & Perkins, D.N. (2000). Teaching intelligence: A performance conception. In R.A. Sternberg (Ed.), Handbook of intelligence, New York: Cambridge University Press. White, B.Y. & Frederiksen, J.R. (1998). Inquiry, modeling, and metacognition: Making science accessible to all students. Cognition and Instruction, 16, 3-118. Zohar, A. & Peled, B. (2008). The effects of explicit teaching of metastrategic knowledge on low- and high-achieving students. Learning and Instruction, 337-353.
Preparation for the Section following Class 9:
TBD by TFs for each section.

April 6, Week 10: Considering the Role of Analogy in Instructional Design

Analogy is an essential form of learning and is commonly used in instruction. What does the research say about how learners of different ages learn through analogy? How we should structure instruction to make the best use of analogical reasoning?

Preparation Prior to Class:
Required Readings: Holyoak, K.J., Gentner, D., & Kokinov, B.N. (2001). Introduction: The Place of Analogy in Cognition, In D. Gentner, K.J. Holyok, & B.N. Kokinov (Eds.) The analogical mind: Perspectives from cognitive science. (pp. 1-19), Cambridge, MA: MIT Press. Read pages 1-10 only. **iPac©** Gillespie, J.L., Thompson, L.L., Lowenstein, J., & Gentner, D. (1999). Lessons from analogical reasoning in the teaching of negotiation. Negotiation Journal 15(4), pp. 363-371. http://search.proquest.com.ezp-prod1.hul.harvard.edu/docview/205151072/1556F27BAD9C4395PQ/8?accountid=11311 Kolodner, J. (1992). An introduction to case-based reasoning. Artificial Intelligence Review, 6, 3-34. **iPac©** Examples of Using Analogies in Teaching Hand-outs on course website.
Optional Readings: Goldstone, R.L. & Sakamoto, Y. (2003). The transfer of abstract principles governing complex adaptive systems, Cognitive Psychology 46, 414–466. Richland, L. E., Zur, O., & Holyoak, K.J. (2007). Cognitive supports for analogies in the mathematics classroom. Science, 316, 1128-1129. Dunbar, K (2001). The analogical paradox: Why analogical reasoning is so easy in naturalistic settings and so hard in the laboratory. In D. Gentner, K.J. Holyok, & B.N. Kokinov (Eds.) The analogical mind: Perspectives from cognitive science. (pp. 313-334.) Cambridge, MA: MIT Press.
Project Components:
First draft of project and report due Midnight, Saturday April 7th on the course website.
Preparation for the Section following Class 10:
Review Final Project Guidelines prior to section.

April 13, Week 11: Transfer: What Transfers and How?

Transfer of learning is what enables understandings to be applied beyond the contexts of school and to extend beyond the particular problems and contexts in which learning occurred. What are different forms of transfer? What does current research suggest about learners' ability to transfer learning and for designing instruction to encourage transfer? How does students' ability to transfer knowledge interact with whether it is taught in situated or more generic contexts? How can we design instruction to maximize students' ability to transfer what they have learned to new areas of learning—to help them apply information to new contexts, both near and far, and to be better prepared as learners?

Preparation Prior to Class:

Required Readings:

Bransford, J.D. & Schwartz, D.L. (1999). Rethinking transfer: A simple proposal with multiple implications. Review of Research in Education, 24, 61-100. http://journals.sagepub.com.ezp-prod1.hul.harvard.edu/doi/abs/10.3102/0091732X024001061

Engle, R.A., Lam, D.P. Meyer, X.S. & Nix, S.E. (2012). How does expansive framing promote transfer? Several proposed explanations and a research agenda for investigating them. Educational Psychologist 47(3), 215-231. http://www-tandfonline-com.ezp-prod1.hul.harvard.edu/doi/full/10.1080/00461520.2012.695678

Perkins, D. N., & Salomon, G. (1988). Teaching for transfer. Educational Leadership, 46(1), pp. 22-32. http://ezp-prod1.hul.harvard.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=8524829&site=ehost-live&scope=site

Optional Readings:

Bransford, J.D., Brown, A.L., & Cocking R.R. (For the Committee on Developments in the Science of Learning) (2000). How people learn: Brain, mind, experience, and school: Expanded Edition: Chapter 3: Mind and Brain. (pp 114-130). National Academies Press: Washington D.C. Available on line at: http://www.colorado.edu/MCDB/LearningBiology/readings/How-people-learn.pdf

Anderson, J.R., Reder, L. M. & Simon, H.A. (1996). Situated learning and education, Educational Researcher. 25(4), 5-11.

Greeno, J.G. (1997). Response: On claims that answer the wrong questions. Educational Researcher. 26(1), 5-17.

Anderson, J.R., Reder, L. M. & Simon, H.A. (1997). Rejoinder: Situative versus cognitive perspectives: Form versus substance. Educational Researcher, 26(1), 18-21.

Singley, M.K. & Anderson, J.R. (1989). The Transfer of Cognitive Skill: Cambridge, MA: Harvard University Press.

Perkins, D.N. & Salomon, G. (1989). Are cognitive skills context-bound? Educational Researcher, 18(1), 16-25.

Preparation for the Section following Class 11:

TBD by TFs for each section.

April 20, Week 12: Human and Technology-Based Tutoring: What do Good Tutors do?

What does research tell us about the fine-grained moves that effective tutors make? How can we design instruction, both technology-based and non technology-based to integrate them? What do we know about question-asking with different types of students?

Preparation Prior to Class:
Required Readings: Roscoe, R.D. & Chi, M.T.C. (2007). Understanding tutor learning: Knowledge-building and knowledge-telling in peer tutors' explanations and questions. Review of Educational Research,77(4), pp. 534-574. http://journals.sagepub.com.ezp-prod1.hul.harvard.edu/doi/full/10.3102/0034654307309920 Koedinger, K., & Corbett, A. (2006). Cognitive tutors: Technology bringing learning sciences to the classroom. In R.K. Sawyer (Ed.) The Cambridge handbook of the learning sciences, Chp. 5 (pp 61-78). New York, NY: Cambridge University Press. **iPac©**
Optional Readings: Ritter, G.W., Barnett, J.H., Denny, G.S. & Albin, G.R. (2009). The effectiveness of volunteer tutoring programs for elementary and middle school students: A meta-analysis. Review of Educational Research, 79(1), 3-38.
Preparation for Tutoring Activity: Think of a brief task/concept that you can teach to someone else in a tutorial. Come to class prepared to tutor a classmate on something for about 10 minutes. It can be just about anything, including knitting, throwing a Frisbee, teaching words from a new language, etc. (If there are any special things that you need to do it, bring them to class.)
Preparation for the Section following Class 12:
Section Meeting TBD by TFs for each section.

April 27, Week 13- Summing Up/ Additional Project Sessions

We may meet this week if there are interruptions to class during the semester. Otherwise, we will offer project support and review sessions during this week.

May 4, Friday at Midnight: Final Project and Report Due

T-543 Project Timeline

Week	Class Focus	Project Focus	What to Hand In*
Week 1	Jan 26- The Problem Space of Instructional Design	Do an initial brainstorm of what you might be interested in working on for your project.	Upload "Getting to Know You Sheet" to the course website prior to first section.
Week 2	Feb. 2- The Nature of Understanding and Active Processing/Understanding Goals/Generative Topics	Developing Project Ideas/Making Topics as Generative as Possible	Bring two project ideas to second section to discuss (topic and possible structure)
Week 3	Feb. 9- Expert Knowledge/Different Knowledge Types/Getting to the Bones/ Who is the Learner?: Culture	Choosing a Generative Topic/ Meet with your TF to discuss project over the next two weeks.	Analyze UGs from past projects/Bring notes to third section to discuss.
Week 4	Feb. 16- Who is the Learner?: The Interaction of Development, Culture, and Instructional Design	Refining Project Focus and beginning to develop Understanding Goals	Bring your UGs to fourth section to discuss.
Week 5	Feb. 23- Schemas for Instruction I: Instruction Designed for Conceptual Change	Refining Understanding Goals with the Learner in Mind/ Assessing Developmental, Cultural, and Cognitive Challenges	Upload "Topic Rationale" to course website by Midnight, Sat. Feb. 24th (revisable)
Week 6	March 2- Schemas for Instruction II: Interdisciplinarity and Project-Based Learning	Developing the Overarching Schemas	Upload "Understanding Goals" to course website by Midnight, Sat. March 3rd (revisable)
Week 7	March 9- Schemas for Instruction III: Provocations and Problem-Based Learning	Drafting a Lesson Plan or Portion of Instructional Design	Upload one portion of your design (one lesson, website page lay-out, etc.) to course website by Midnight Monday March 19th. Bring it to section during the section following vacation to discuss.
Mid-Winter Recess			
Week 8	March 23- Framing Assessment	Drafting an Assessment Plan	
Week 9	March 30- Infusing the Teaching of Thinking and Metacognition into Instructional Design	Writing the First Draft of Your Project and Report.	
Week 10	April 6- Analogy in Instructional Design	Writing the First Draft of Your Project and Report	First Draft of Project Design and Report due Midnight, Sat. April 7th
Week 11	April 13- Transfer: What Transfers and How?	Elaborating and Refining the Draft of Your Project and Report	
Week 12	April 20- Expert Tutoring	Elaborating and Refining the Draft of Your Project and Report	*[Formative Feedback on First Draft Returned on April 21st]*
Week 13	April 27- Summing Up/ Additional Project Support Sessions	Incorporating Feedback, Finishing, and Refining Project and Report	Final Project and Report Due at Midnight Friday, May 4th

*More information on the details listed on the Assignment Sheets on the course website and within the syllabus.