Stanford Summer 2017 Workshop for Training Department Education Specialists

This document provides a detailed description of the workshop activities, the preparation participants will need to do in advance of the workshop, and how the time at the workshop will be spent. As shown in detail on the following pages, this training program will replicate—in six intensive days—the training program developed and refined in the Science Education Initiative at UBC and Carl Wieman's 10 week graduate course in science learning and teaching at Stanford. Argenta Price, postdoc working with Carl and an alum of this course, and Gloriana Trujillo, the STEM specialist for the Stanford Office of the Vice-Provost Office for Teaching and Learning, assisted with the summer workshop.

Workshop learning goals

Participants will be able to:

1. Develop questions to probe prior knowledge of student in specific area; evaluate how that prior knowledge will impact learning of relevant topics; create questions that will test accuracy of their evaluation.
2. Analyze expert organization of knowledge in a domain; create tests to distinguish expert and novice organization; create task that has learners explicitly analyze organizational structure of domain they are studying.
3. Apply multiple strategies to improve motivation to learn for a course they are taking/teaching.
4. Create set of activities that will enhance and practice transfer; create tests that determine ability to transfer, both near and far.
5. Design a deliberate practice task for a topic in target course; contrast this with a task that might be/is assigned and will take time but does not constitute deliberate practice.
6. Develop learning goals for a topic in a course they are taking/teaching; evaluate the Bloom's level of exam questions; create exam questions for specific learning goals of various types.
7. Create a number of ways to build in frequent formative assessments in target course (including way to both measure learner thinking and provide useful feedback to them).
8. Apply strategies that get students to be more self-directed and metacognitive in their learning.
9. Identify educational practices that hinder long term retention; identify and apply teaching practices to improve long term retention by learners.
10. Identify practices that increase cognitive load in presentation of material; apply practices to reduce cognitive load in presentations.
11. Articulate design principles for good clicker questions; identify principles for effective use including how to best facilitate depending on distributions of learner responses; create good clicker questions for target course.
12. Design a good group activity for use in large lecture setting for a course you are taking/teaching; do same for use in a smaller enrolment course or recitation section setting; compare and contrast the design principles for the two.

This workshop will provide participants with a basic knowledge of the relevant research in cognitive psychology and science education and the ability to apply that knowledge to enhance their ability to learn and teach. The workshop will involve readings, discussion, and application of the ideas through creation of learning activities. It will focus on the most important elements for learning science, with exploration of those ideas by in-class discussions and activities focused on applying them in an instructional context.

Workshop activities

For each of the ten units of the workshop listed below you will do the following:

1) Do the advanced reading listed below, and post your responses to the two reading questions.

I. What idea in the reading seemed the most surprising/non-intuitive to you?

II. What ideas in the reading are most and least reflected in college teaching practices?

Due to the condensed schedule, you will need to do all the reading and post answers to the questions before the workshop begins.

Please note, the reading list is extensive, although I think you will find it quite worthwhile. It would be wise for you to start on it soon and do some each week.

2) At the workshop we will discuss as a whole group the reading for each unit, going over issues of agreement and disagreement and questions about the claims and the research behind the claims. This will largely address items that come up in your question responses.

3) You will work on your own to create an instructional activity for your target course that encompasses the ideas in the readings for that section. The target course is defined below. The specific goal of the activity is defined below for each unit, respectively. These activities will typically be 1-5 pages in length, and we will share them, either by posting on website or printing out, whichever seems easiest.

4) In 3-4 person groups, you will review each of the activities created by the members of the group and suggest how they might be improved. Carl (and Gloriana and Argenta) will circulate and offer feedback to groups during this discussion.

5) There will be a brief sharing with the class as a whole of selected examples chosen by the groups. Carl may offer general comments on the activities, usually on issues of implementation in actual courses.

6) On the basis of the feedback from group, you will revise your activity as needed, and post it on the website so all participants can view it.

7) You will read over two activities done by other participants *not in your small group* and offer constructive feedback.

Target Course

You will each need to have a target course in mind when you come to the workshop. This target course will provide the context for your activity development, and presumably will be a course you will be teaching or helping to transform in the future. To facilitate the discussion with other members of your group, you should have a standard description of the target course that you put at the top of each activity that follows this template.

One brief sentence each: Course name and description. Student population. Learning goals. Classroom context. Primary problem you intend to fix.

e.g. *Physics I covers introductory mechanics and dynamics of simple systems. Required for all engineering majors (~400/year) and biology and chemistry majors (~ 40/year). 30% women, and 25% African American and Latino. Primary goal is to prepare students to apply these physics concepts in engineering courses. Course meets 3 hours/week in lecture theatre (two sections of 220), and 1 hour in lecture/tutorial (N=40) taught by TA. I want to make lecture theatre classes more interactive and interesting to students.*

Information for sharing with other participants

Participants will probably find it useful to share information and ideas with others working on similar projects. To facilitate this, please write up a couple of short paragraphs about yourself and your institutional teaching project that you are or will be involved in. You should also include your target course description and any other information you think it would be useful to share. Before the workshop, you should post this information in the discussion on the "Participant Introductions" section of the website. We will compile all these into single document and send out to all participants. I would also invite you to prepare a poster on your institutions activities for more extensive sharing and discussion among the participants, if you so choose. We will put up these posters on the walls of the room where the workshop will be held so you can stroll around and see what others are doing, during the breaks.

Limitations of the workshop

This workshop has two serious limitations. The first is that you will not be able to try out the instructional activities that you develop in actual courses during the workshop. This means you will be limited in what you learn about the complexities and challenges of implementation with students. In recognition of this, much of my feedback and comments during the workshop will involve implementation issues. The second limitation is that the workshop will not cover working with other faculty to implement new courses and new teaching methods, although many of you will be needing to do this. That limitation is partly due to a lack of time, and partly because this is usually rather dependent on your local context and so it is impractical to offer solutions that work for everyone. To partially address these limitations, we will compile a list of materials that we have developed to address aspects of these issues and will send you each copies. This will be largely based on information available at http://www.cwsei.ubc.ca/resources/STLF-develop.htm and other information on the CWSEI website (http://www.cwsei.ubc.ca/).

Assigned reading and schedule

The assigned reading for each of the 10 units is given below, and is posted on the workshop website under "Before DESTW: To read and post discussion comments". The answers to the two reading questions for each unit should be posted in the "discussion" section under each reading unit before the start of the workshop. The "Activities" will be created during the workshop.

Most of the readings are from the books: The ABCs of How We Learn, by Schwartz et al, and How Learning Works by Ambrose et al. The others are from published articles or short pieces by Wieman from the CWSEI website. Links to those articles are available for you in the "Before DESTW: to read…" section of the workshop website.

	Unit	**Reading**	**Activities – to be worked on during workshop**
#1	**Memory and retention, working memory, and cognitive load.**	• Bjork: *Memory and metamemory considerations in the training of human beings* • Karpicke & Roediger: *The Critical Importance of Retrieval for Learning* • Michelle D. Miller (2011): *What College Teachers Should Know About Memory: A Perspective* • Mayer et al.: *Increased Interestingness of Extraneous Details … Decreased Learning* • CWSEI 2 pg on Improving Learning by Reducing Unnecessary Mental Load. • E is for Elaboration chapter. Optional: G is for Generation chap. Optional: Brown, Roediger, and McDaniel: *Make it Stick: The Science of Successful Learning* (book)	a. Examine presentation in a course similar to your target course and find examples where there is unnecessary cognitive load. b. Create list of general ways to reduce cognitive load in presentations with examples. c. List practices in courses that hinder retention. d. Create list of modifications that would improve retention.
#2	**Effect of prior knowledge**	• How Learning Works chapter 1 • A is for Analogy chapter • *An improved design for in class review*. (Wieman two-stage review paper.) Optional: How People Learn chapter 1	a. Make a list of some prior knowledge (including beliefs) that can help in target course. What are some that may hurt? b. Create a diagnostic for important prior knowledge and attitudes in your target course (can use any format). Text talks about self-assessment. I am dubious.

#3	**Knowledge organization; expert novice differences**	• How Learning Works chapter 2 • C is for Contrasting Cases • K is for Knowledge Optional: V is for Visualization	a. What are the important organizational structures relevant to your target course? b. Develop a way to make important organizational structures explicit for the course. Create a task that has leaners explicitly analyze organizational structure of the domain they are studying.
#4	**Motivation.** **a. General issues.** **b. social-psychological factors**	• How Learning Works chapter 3 • R is for Reward • Y is for Yes I can • B is for Belonging • Q is for Question driven Optional: Aguilar, Walton and Wieman: *Psychological insights for improved physics teaching*	Apply strategies discussed in this chapter to develop an activity (and feedback) that will enhance learner motivation in your target course. Discuss how it addresses learners' prior experiences, meaningful context, and sense of control.
#5	**Learning and transfer**	• How Learning Works Chapter 4. • G is for Generation Chapter. • Review C is for Contrasting Cases. • Review E is for Elaboration. • SEI 2-pager *Teaching Expert Thinking* Optional: J is for Just in Time Telling.	a. Create an activity for your target course that will enhance and practice transfer. b. Create tests that determine ability to transfer, both near and far in target course and discipline.
#6	**Deliberate practice**	• How Learning Works Chapter 5 • D is for Deliberate Practice chapter • Ericsson: *The influence of experience and deliberate practice on the development of superior expert performance* Optional: *Sci. American - The Expert Mind* Optional: *Talent is Over-rated*, Colvin	Design a deliberate practice task for your target course. Contrast this with a task that might be/is assigned and will take time but does not constitute deliberate practice.
#7	**Learning goals**	• How Learning Works Appendix D: What Are Learning Objectives and How Can We Use Them? • Simon & Taylor: *What is the Value of Course-Specific Learning Goals?* • Smith & Perkins: *"At the end of my course, students should be able to..:"* • Mayer: *Rote Versus Meaningful Learning*	a. Develop learning goals for a topic in your target course, or critique & improve some current learning goals. b. From an exam (bring for your target course), evaluate the Bloom's level of some of the questions and create learning goals associated with these questions.

#8	**Formative assessment**	• F is for Feedback. • J is for Just in Time Telling chap. • SEI 2-pager Assessments That Support Student Learning Optional: Gibbs and Simpson: *Conditions Under Which Assessment Supports Students' Learning*	Create a number of ways to build in frequent formative assessments of specific aspects of your target course (e.g. learning goals) – including a plan for getting feedback to students.
#9	**Development of self- directed learners**	• How Learning Works chapter 7: How Do Students Become Self-Directed Learners? • S is for Self-Explanation chapter.	Pick a few strategies from this chapter & apply these to your target course. Think particularly for ways to encourage students to practice metacognition and reflection.
#10	**Group work including Peer Instruction. Different types, levels, benefits and tradeoffs of group activities**	• L is for Listening and Sharing chapter. • T is for Teaching chapter. • SEI 2-pagers: *Group Work in Educational Settings* and *Creating and implementing in-class activities; principles and practical tips* Watch: SEI video *Group Work in the College Classroom* • SEI clicker user's guide Watch: SEI video clips *How to Use Clickers Effectively* and *The Research: Do Clickers Help Students Learn?* • Optional: Heller & Hollabaugh: *Teaching Problem Solving Through Cooperative Grouping. Pt 2: designing problems & structuring groups*	a. Design a group activity for use in large lecture setting for your target course b. Contrast above with design that could be used in a smaller enrollment course or recitation section setting. c. Create or revise questions (either to be used with clickers or without), and discuss how to facilitate in class, depending on outcome of vote. (Bring clicker or other discussion questions from your target course)

Full 6-day workshop schedule – next 2 pages

Full schedule (were some small changes, including squeezing in some social events)

Day 1	
9-9:30	Introductions, organize groups
9:30-10:15	Discuss reading #1
10:15-12:15	Create activity #1 (work individually) Post or print out copies to share with group
12:15-1:30	Groups critique activities. Working lunch.
1:30-2:00	Present samples. Carl general feedback.
2:00-2:45	Discuss reading #2
2:45-4:30	Create activity #2 (work individually) Post or print out copies to share with group
4:30-5:30	Groups critique activity #2
Evening & morning #2	Individual work: - Review reading for units #3 and #4 - Revise activities and post - Sleep
Day 2	
	(post revised activities 1 and 2)
9:00-9:45	Discuss reading #3
9:45-12:00	Create activity #3 (work individually) Post or print out copies to share with group
12:00-1:00	Lunch break
1:00-2:00	Groups critique activity #3
2:00-2:45	Present samples. Carl general feedback.
2:45-3:30	Discuss reading #4
Evening and morning 3	Individual work: - Create activity #4, and post/print (~2hr) - Review readings for units #5 and #6 - Critique revised activities 1 and 2 (~30 min; post critiques on website) - Sleep - Revise activity #3 and post
Day 3	
	(post revised activity 3)
9:00-10:00	Groups critique activity #4
10:00-10:30	Presentations and Carl general feedback
10:30-11:15	Discuss reading #5
11:15-2:00	Lunch and create activity #5 (individual work)
2:00-3:00	Groups critique activity #5
3:00-3:30	Presentations and Carl feedback
3:30-4:15	Discuss reading #6
Evening and morning 4	Work individually: - Create activity #6, and post/print (work individually) - Critique revised activity 3 (on website)

	- Review reading units #7 and #8 - Sleep - Revise activities #4 and #5, and post
Day 4	
	(post revised activities #4 and #5)
9:00-10:00	Groups critique activity #6
10:30-11:00	Presentations and Carl feedback
11:00-11:45	Discuss reading #7
11:45-2:30	Create activity #7 and lunch (individual work)
2:30-3:30	Groups critique activity #7
3:30-4:00	Presentations and Carl feedback
4:00-4:45	Discuss reading #8
Evening and morning 5	Work individually: - Create activity #8 - Review readings #9 and #10 - Critique revised activities #4 and #5 (on website) - Sleep - Revise activities #6 and #7, and post
Day 5	
	(post revised activities #6 and #7)
10:00-11:00	Groups critique activity #8
11:00-11:30	Presentations and Carl feedback
11:30-12:15	Discuss reading #9
12:15-2:30	Lunch and create activity #9 (individual work)
2:30-3:30	Groups critique activity #9
3:30-4:00	Presentations and Carl feedback
4:00-4:45	Discuss reading #10
Evening and morning 6	Work individually: - Create activity #10 - Critique revised activities #6 and #7 (on website) - Revise activities #8 and #9, and post - Sleep - Critique revised activities 8 and 9.
Day 6	
	(critique revised activities 8 and 9)
10:00-11:00	Groups critique activity #10
11:00-11:30	Presentations and Carl feedback
11:30-12:15	Revise activity #10 and post
12:15-2:30	Lunch, and critique revised activity 10 (and 8 and 9 if necessary) (individually post critiques on website)
2:30-5:30	Concept mapping Wrap up reflections and discussion