A CONSTRUCTIONIST APPROACH TO THE DESIGN OF LEARNING ENVIRONMENTS  
Learning Sciences 426  
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Wednesday, 1:00-4:00 PM  
Annenberg 345, South Learning Studio

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Course Description

This course is a hands-on practicum in designing and building technology-enabled curricula and/or educational software. We will use many rich software toolkits designed to enable novice programmers to get their “hands dirty” doing iterative software design. In addition to the hands-on component, the course is also designed to introduce you to the Constructionist Learning design perspective. This perspective, first named by Seymour Papert and greatly influenced by the work of Jean Piaget, is very influential in the learning sciences today. The Constructionist approach starts with the assumption that teaching cannot successfully proceed by simply transferring knowledge to students’ heads. Skillful teaching starts with the current state of knowledge of the student. In order for students to learn effectively, they need to construct the knowledge structures for themselves. In this class, we will engage in the construction of artifacts and, through such constructions, explore and evaluate the design of construction kits and tools to enable learners to construct motivating and powerful artifacts. In the spirit of constructionism, students in this course will self-construct their own understanding of the educational software and of the literature through constructing artifacts (both physical and virtual) and engaging in reflective discussion of both the artifacts and the tools used to construct them.

Students will put all of this together in a substantial final project in which they design and implement a constructionist learning environment.

After completing this course, you should be able to:

• Design and implement educational software that is at least “Alpha” ready for use
• Design technology-enabled activities that take advantage of the computational medium
• Exercise good judgement in such design within the context, domain and deployment situation.
• Avoid common educational software design errors
• Assess programming/authoring/scripting technologies as to appropriateness for educational needs
• Evaluate and utilize educational claims of software authors and promoters
• Understand the Constructionist design perspective and use it to author and assess software tools and learning environments
This class will emphasize computer programming projects using Logo-like languages. Logo is a computer programming language designed explicitly for use by children and is in use in large numbers of schools, from elementary on up. No previous programming background is assumed, but you will be expected to devote substantial time to programming. This can and will be frustrating to many of you, at least initially. I do not mean to discourage you – I am confident all of you can master the programming aspect of the course, as have many students in the past, who had had no prior programming experience. It is my belief that even if you do not intend to be a software designer yourself, it is the reality of today – and more so, of tomorrow – that should inform your choice to become at least somewhat familiar with the promise of technology in education. You are strongly encouraged to get help from your fellow students through the class email list as well as from the TAs. The TAs will hold weekly office hours designed especially for technical and programming support. We will attempt to schedule these office hours flexibly, and per special requests.

In addition to projects, there will be weekly readings. Typically, one paper or two short papers per week. There is a considerable literature that we will not have time to read this term. I have provided a more extensive bibliography at the end of the syllabus. You may find some of these readings to be useful to you in completing the final project.

**Software packages we will use**

We will use quite a number of learning software packages in this course. The 3 packages we will use the most are all based on the computer language Logo.

They are:

**Microworlds Logo** – a multi-media version of basic Logo in common use in elementary schools worldwide. It also includes music, graphics, video and web tools.

**NetLogo** – a multi-agent version of Logo, this language is tuned for constructing models of complex dynamic systems. It is useful for creating models of ecological systems, chemical systems, economic trade, social behavior, ….

**Lego Mindstorms** - a robot control language for the intelligent brick, this language enables learners to design behaviors for Lego robots. We will construct Lego robots that have sensors and motors and can interact with objects in the world.

Besides these 3 basic packages, in the software review section of the class, we will also explore a number of other packages. Software we might look at includes: TableTop, Genscope, Biologica, Zoombinis, SimCalc, HubNet, ChemSense, Fathom, MediaMoo, Moose Crossing, CSILE, Hypergami, Stagecast Creator, Vehicles, RelLab, Interactive Physics, the Sims, Impromptu, Geometer’s sketchpad, Matlab, Squeak, Boxer, Model-It, STELLA, …
Summary of Requirements

This course is designed to be somewhere between a class and a working group. I’m hoping that we’ll work together to make sense of readings, and, for most of the class projects, you will be working in small groups.

So the requirements for everyone are:

1. Keep up with the readings and participate in class, through email and on the course both in person and virtually. You will be expected to post a comment on the week’s reading each week by the day before class.
2. Complete and present several (mostly group) programming assignments using Logo, Mindstorms and NetLogo.
3. Review one educational software package and present your review in class
4. Design and implement your final project
5. Give a presentation during the last week of the course.

In addition, due to the group project nature of the class, you are also asked to send email to cd-fac (as soon as you know) if you cannot make a particular class meeting. You are also responsible for communicating with your project-mates and letting them know in advance if there is any problem with your part of the project.

About the Final Project

The final project is to design and implement a constructionist learning environment. There are 2 basic alternatives for this project:

1) **Standalone Educational Software (scaffolding in software)**

   Design and implement some constructionist educational software. This option would involve writing a design specification for the software that describes what the software is for, who it serves, why it is needed, why it is best done in software, etc. Subsequent to receiving feedback on the design specification you will need to start working on a functional specification of the software itself and then embark on implementing it. You are free to use any authoring tools you like to implement the software as long as you make a good argument for their being well matched to the task. Suggested educational software genres are: a simulation game, a microworld, a collaborative role-play or MUD (a collaborative virtual space or Multi-User Dimension).

2) **Software-embedded Curriculum (scaffolding in curricular materials)**

   Design and implement an educational activity that has a computationally embedded component. In this option, you are asked to use one of the three main software packages used in this course: Microworlds Logo, Mindstorms, or NetLogo. As above, you would begin with a design specification. Depending on the design, you may or may not require a functional specification – it could be a curriculum flow specification instead. You would then go on to construct the software and/or Lego constructions that form the kernel of the activity, flesh out the curricular materials that accompany the software and write up a paper that describes one person’s (could be yourself) path through the activity.

The final project design specification is due by February 11th.
The final project software specification (or curricular flow spec) is due by February 25th.
The final project is due by March 8th.
Final projects will be presented on March 10th. You are welcome to invite friends and/or relatives to attend.
The Final projects may be conducted individually or in groups of 2 – 3.

* For some students, the final project could take a different direction, such as designing a (computational) research model of organizational change using NetLogo. If you’re interested in this option, come and talk to me.

**Grading**
All assignments and projects will be graded as either complete or incomplete. If a project is judged incomplete, you will have an opportunity to complete it or redo it the following week. If you cannot complete the final project by March 9th you may take an incomplete for the course. No penalty will be assessed for late final projects – they can be handed in as late as the summer and your incomplete grade will be changed at that time, but you must make a coherent presentation on March 11th. You will also be assessed on your class participation both in class and virtually.

**Readings**
A course reader is available from Charla Hyde Jeffries in the LS office.
You also need to purchase a book at Norris:
WEEKLY SCHEDULE

Readings are listed on the week they are due. They will be discussed during class that week. Reactions are to be sent to the CD email list by Tuesday morning.

Week 1, January 7. Please read the entire book Mindstorms as this week’s assignment (that is, I will expect you to have read the book for Class 2, January 15; as always the reaction is due a day before the next class). Also read the 'CD getting started’ information on the course web site and follow its instructions.

Week 2, January 14
Start Microworlds Logo programming assignment
Start Group Quilt project
Discuss reading: Mindstorms

Week 3, January 21.
Microworlds Logo programming assignment due
Group Quilt project due
Start Pairs Microworlds Logo project

Week 4, January 28
Selections from Jean Piaget

Week 5, February 4
Pairs Microworlds Logo project due
Start NetLogo or Mindstorms project
Discuss reading:
Week 6, February 11
Start Final Project Design Specification
Discuss reading:

Week 7, February 18
NetLogo or Mindstorms project due
Final Project Design Specification Due
Discuss reading: To be determined

Week 8, February 25

Week 9, March 3
Discuss reading:
Final Project Software Specification due

Week 10, March 10
Discuss reading: To be determined
Final Project due on Monday March 9th
Final Project Presentations
Course packet readings:


In addition, there is a second course packet of the software manuals:

Microworlds Pro Manuals

NetLogo Manual - can be viewed at http://ccl.northwestern.edu/netlogo – click on the Users Guide

Extra Readings (for reference only, not part of course packet)

Books:


Articles:


Bruckman, A. Programming for Fun: MUDs as a context for collaborative learning. MIT Media Lab.


Horwitz, P. Contrasting styles in the design of science software. Bolt Beranek and Newman, Inc


