CS411 Digital Education Project - Spring 2025

Introduction

In this class you will be asked to complete a project in groups of three to design and empirically test a short lesson. You will work on this project over the course of the semester culminating in a presentation at the end of the semester and a project report.

In this project, you and your group will choose a topic and design a short lesson using the learning theories taught in this course. You will be asked to design two variations of the lesson following the Problem Solving followed by Instruction (PS-I) approach and the Instruction followed by Problem Solving (I-PS) approach. Additionally, you will be asked to develop a research question around learning to compare the two lessons. This research question will compare the effects of each of the different approaches on learning outcomes. You will conduct an experiment to collect data, and then perform statistical analyses on this data to answer your research question.

For the project, we have to develop the learning activities with any software development platform you like: it can be Moodle or Jupyter notebook on the Noto platform. It can also be any tool you are proficient with as the coding time is not the main assignment of this course. Keep in mind that you will need to run experiments with users. Therefore, the logistics will be easier if the development tool produces something that can be tested online. You can also use a GenAI tool but beware that fine tuning the details of generated code can be very time consuming.

Although the main deliverables will occur at the end of the semester, there will be small milestones throughout the semester that you will be asked to submit to keep your project progressing.

Goals and Objectives

The goal of this project is for you to learn how to apply different learning theories to the design of a lesson and ground your design decisions in these theories. Using the data you collected, you will have the chance to apply the statistical analysis methods taught in class to test these theories.

By the end of this project, you should be able to...

- Construct learning goals for a topic
- Decompose your learning goals into the necessary skills and knowledge needed to reach that goal
- Apply learning theories to design a cohesive lesson
- Align the lesson design with learning goals
- Create a digital educational lesson using Moodle and Noto
- Construct an experimental design to test your lesson designs
- Test the effectiveness of each lesson design using statistical methods
- Explain the strengths and weaknesses of the lessons using the results of your analysis

Tasks

Weeks 1 and 2: Choose groups and a topic

In the first two weeks you will form **a group of three**. You will need **to register this group on Moodle** by the start of the third week. Your group will also be asked to choose a topic that you would like to teach. Please choose a topic that someone in your group is comfortable with as it will then be easier to develop a lesson. You will be asked to submit this topic on Moodle for approval.

What you need to do:

- Submit your group on Moodle
- Submit your chosen topic on Moodle
- Discuss with your teammates the chois of a tool

Week 3: Define your pedagogical goals and complete a task analysis
In week 3 you will be asked to specify the learning goals of your lesson. As part of this process, you will need to identify who your target students are. This includes considering the age of your students and what prior knowledge you expect them to have coming into your lesson.

Next, you will perform a task analysis to breakdown the skills needed to reach your learning goals. As discussed in class, this analysis should match the type of goal you are trying to support. For example, you can break down a learning goal about conceptual understanding into what someone would need to know to understand that concept until you reach the prior knowledge you would expect your students to have. This can be represented as a graph. This task analysis needs to be completed for each goal that you want to address in your lesson.

What you need to do:

- Identify your target students and their traits
- Identify your learning goals
- Complete your task analysis for each learning goal

Week 4: Choose your activities and design your PS-I and I-PS scenarios
In this week you will be design the problem-solving activities you want to include in your lesson. You should be able to justify the activity choice with the learning theories that have been taught in class. You will need to outline your lesson designs, indicating the activities and their sequence.

At this point, you may realize that you cannot address all of your learning goals in a reasonable amount of time (less than 1 hour) that you have for your lesson. It is ok to scale back and to focus your lesson on only a few of your goals.

To help you design a good problem-solving activity, you will submit a 1-2 page description of this activity on Moodle. You will receive formative feedback to help you iterate on your problem-solving activity so that it is in line with theories on preparation for future learning and productive failure.

What you need to do:

- Design and outline your lesson activities and their sequence
- Justify your activity choice for the PS-I approach in learning theory
- Submit a 1-2 page description of your problem-solving activity on Moodle

Week 5: Begin implementing your lessons
During week 5, you will finalize your two lesson designs, one following a PS-I approach and one an I-PS approach. Specifically, consider how you must revise the activities and their sequencing when designing according to the I-PS approach.

You will also begin to build your lesson. As part of this process, you may need to adjust your activities to make them work in a digital environment. You can discuss these adjustments in your final report.

What you need to do:

- Design your lesson activities and their sequence
- Begin implementing your lesson

Week 7: Make an experimental design and expand the lesson to include this design
A core part of this project is comparing the effectiveness of the two lesson designs. You will do this by designing an experiment to test the two lesson designs.

The first step of designing a good experiment is to develop your research question. In this project your research question will be around comparing the two approaches for lesson design, namely PS-I and I-PS. After developing your research question, you need to identify the different parts of your experiment. For example, what is your independent variable (what you are changing), what is your dependent variable (what you are measuring), what are your control variables (what you are holding steady), and what are your intermediate variables. You will need to consider if you want to do a between subjects or within subjects design, and to decide what data you will need to collect. It is important to make sure that your experimental design allows you to answer your research question.

In this week you will also be asked to submit a short summary of the work done towards the project. You will briefly describe the steps of the project that you have worked on so far: your topic, the target students, the learning goals, your task analysis, and your lesson design for both PS-I and I-PS versions, your research question, and experimental design.

From this document, we will provide you formative feedback on the current completed steps. Using this feedback, you can make changes to your project that can be included in the final report.

What you need to do:

- Identify your research question
- Design your experiment
- Submit a 2-page summary of the work done towards the project so far

Week 8 and 9: Finalize your experiment in the chosen platform
In these weeks, you will work on your lesson and experimental design in the digital platform. This is the time to make any final changes to your experimental design or to your lesson design.

What you need to do:

- Continue your experimental/lesson design in the chosen platform
- Fill out the information sheet for your experiment

Weeks 10 and 11: Run your experiment
In the next two weeks you will run your experiments. As mentioned before, you will be expected to run your experiment with 20 students. You will need to provide your students with the information sheet in advance so they are aware of their rights.

For your report, you will need to note who the participants were in your experiment, how many, and what the learning environment was. Also the type of data that you collected from the experiment.

What you need to do:

- Distribute the information sheet for your experiment
- Run your experiment

Weeks 12 and 13: Analyze your data and prepare presentation for class (given in Week 14) Once you have conducted your experiment, you will be expected to analyze your data to help you answer your research question. This can be a very basic statistical analysis or more complicated statistical analyses to analyze the process data. However, it must be clear why you have run each type of analysis and what research question you are trying to answer with this analysis.

In the last week of class, your group will be asked to give a **10 minute presentation on your project**. You will need to prepare a 5-7 minute presentation to leave time for questions. In this presentation, you will want to present an overview of your project. First you can provide a brief overview of your topic, target audience, learning goals, and lesson design. You can then provide more detail on your experimental design, implementation, details on your experiment, your analysis, and any reflection you had on the process. If there are any steps that your team had yet to complete, you do not have to discuss this in the presentation but please mention that you are still in the process of completing those steps so we are aware.

What you need to do:

- Run the analysis for your experiment
- Prepare your presentation for week 14
- Make any changes to the previous steps that may be needed

Week 14: Write and finalize your report

In the final week, your group will be asked to begin writing the report. If you have been recording your steps as you went through the project, this step should be nearly complete. After the analysis of your data, we ask that you include a short conclusion discussing what you learned from the project, what went well (or did not) during the experiment, and how you would change your design based off of this experience if you had a chance to run it again.

For the report, an outline is provided in the deliverables section of this document. The page limits are rough guidelines and you should feel free to take the space that you need to describe your project while being succinct so your point does not get lost in detail.

What you need to do:

- Complete your final report to be turned into Moodle before June 12th.

Deliverables

At the end of the semester, you will need to deliver a written report of your project that will be about 10 pages. It is fine if it is a little longer or shorter; please take the space that you need to explain the different sections with enough detail that they are coherent and understandable for the reader without being overly verbose. Please include screenshots from your lesson in your chosen digital platform. Below is an example of an outline for your report. Also do look at the rubric at the end of this document that describes how we will be assessing your project.

Paper outline:

1. Introduction (½ page)
    a. Introduce the topic
    b. Introduce the target audience as defined in the tasks
2. Learning Goals (½ page)
3. Task Analysis (1-2 pages)
4. Lesson Design and Activities (1-2 pages)
5. Experimental Design (1 page)
6. Implementation (1-2 pages)
7. Participants, Data, and Analysis (1-2 pages)
8. Conclusions and Reflection (½-1 page)

Only one member of your team will need to turn in the documents. They will be submitted on Moodle in the class project assignment.