UHON351f/o/u: Making Math Fun for Children: Design Literacies, STEM Education, and Community Engagement

School of Education & Honors Program, Southern Illinois University-Carbondale
Fall Semester, 2024

Instructor: Lingguo Bu, Ph.D.
Pulliam 323L
Office Hours: T&W: 9-11am and by appointment
Email: lgbu@siu.edu

Instructor: Grant R. Miller, Ph.D.
Wham 210
Office Hours: T&W: 1-3pm and by appointment
Email: gmiller@siu.edu

Course Introduction:

Creativity matters. So does community engagement. In this seminar, students will learn about a basic concept in design thinking, i.e., Problem-Based Learning (PBL) and how it may be used in freeing the creativity of children and making the teaching of Science, Technology, Engineering, and Mathematics (STEM) fun for elementary school children. In this theory-practice seminar, students will study the history, development, and curricula related to Problem-Based Learning (PBL) and try out what they have learned with children. We will design toys and exercises to make these subjects fun and meaningful, in the process, discover the joys of both learning and teaching. This seminar brings together some of the best Saluki traditions, i.e., the legacy of Buckminster Fuller's contributions to design thinking and the SIUC commitment to enriching the local community.

Course Goals and Objectives:

1) Understand the playful and creative nature of mathematical thinking and its applications and relevancy in Quantitative Literacy (QL) across K-20.

2) Identify, articulate, and design solutions for K-12 STEM education problems and address existing state and national standards;

3) Relate STEM learning issues in the context of design and community-based solutions.

4) Critique, adapt, implement, assess, and redesign existing curricular practices with respect to the local needs and future development.

5) Apply the concepts of Universal Design for Learning (UDL) to appropriate STEM learning situations to meet the needs of all learners.

Canceling Class: In the event of inclement weather or other unforeseeable event, I will decide whether to hold class by 12pm of that day. We will e-mail you at that time if we are not having class.

Please Note: To better meet the needs of this course, this syllabus is subject to minor changes. If any changes are made to course readings or assignments, you will be notified as soon as possible.

Course Requirements

1) Participation (individual, 100 pts.): This assessment includes class attendance, participation in class discussion, and small tasks you will complete for each module. Assignments should be submitted during that class. Expectations for your participation include:

- Participants are expected to participate actively and professionally in all forms of face-to-face, if any, and online discussions and presentations: whole-class, small-group, or individual.
- Participants are expected to show positive attitudes and perseverance toward Problem Solving and Quantitative Literacy when supporting their own learning and others', namely during the community engagement portion of this course.
- Participants are expected to complete all course work, including quizzes, reading, and other assignments in a timely and professional manner.
- Participants are expected to respect and critique others' perspectives, viewpoints, and creativity in a constructive way and invite others to critique their own in discussion forums and written assignments.
- Participants are required to take all assessments and/or complete other course requirements at a time and a location designated by the university.

2) Design Journal (individual, check-in #1 50 pts. and check-in #2 50 pts.): Over the course of the semester, you will keep a design journal that includes several entries related to essential questions, experiential endeavors, resources/readings you will encounter in and outside of class. Each entry/topic will be posted in class and your entries will be evaluated during the middle and end of the semester. Though the depth and sources required for these entries will evolve over the course of the semester, the "core" of these entries will focus on three core prompts: a) "I notice…," b) "It reminds me of…," and c) "I wonder…" The overall purpose of these entries is to help you corroborate and synthesize the course's concepts and skills and will be evaluated on the following criteria:

50 - 40 pts.: Your entries go beyond what is expected; the work suggests considerable thought and effort and is of exceptionally high quality.
39-30 pts.: You completed the entries appropriately; this is a solid performance.
29-20 pts.: A bulk of the entries suggests a lack of effort and/or understanding; there are notable shortcomings in the work.
19 or fewer pts.: A majority of the entries fail to address the intent of the tasks assigned or are incomplete.

Check-in #1 Due Wednesday, October 16th
Check-in #2 Due Wednesday, December 4th

2) Design Activity for Elementary Students* (individual or groups of 2-3, 100 pts.): In this course, you will have several opportunities to experience problem-posing design tasks. Your goal is to develop an activity inspired by children's book series that focuses on scientific observations, architecture, and engineering. Your activity will have a design challenge with accompanying warm-up activities, objectives, learning standards, and an assessment.

Activity Outline Due Wednesday, October 30th

3) Community Engagement with Students* (teams of 3-4, 200 pts.): The core of this course is your engagement of students at various learning levels with the concepts you are learning during the first half of this course. During the second half of the semester, you will be assigned a group of students where you will have a chance to demonstrate, model, implement curriculum you have experienced and developed in this course and document your learning and your students'. An activity log signed by you supervisor will require that you have participated at this site a minimum of 2 hours a week, replacing one of the class meetings for this course during those weeks. Additional details and scoring guide for this assignment will be provided in class and on D2L.

Topics (Each Group Selects 1):

Movement	Origami & Flight
Shapes and Structures	Sound

CCSS-Aligned Articles for Topic (e.g. Flight) Due Wednesday, September 25
Draft for Curriculum Draft Due Wednesday, October 9
Final Time Log and Report Due Wednesday, December 11th

**Major assignments will be submitted in D2L.*
NOTE: *All major assignments must be submitted to avoid an Incomplete (INC) grade for this course.*

Grading Scale

500 pts. possible: A (450-500); B (400-449); C (350-399); D (300-349); F (299 or below)

Course Modules

The course consists of **eight** major instructional modules, addressing both the theory and practice related to Problem- and Place-Based Learning in the context of STEM literacies and design. Each module has one or more interactive lessons full of formative assessments, videos, images, and animations. These resources and tasks will be provided in D2L.

Sample Module (now available on D2L)

Module 1 Overview

The focus for this module includes two major concepts that are resurfacing in curriculum: *Play* and *Failure*. Both concepts are equally dismissed and misunderstood in education; however, they require rigor and support in a non-threatening learning environment, namely because both involve a lot of opportunities to persevere in order to acquire higher-order thinking skills. Resources on this topic include definitions of these concepts, their importance in education, and ways they are being included in curriculum.

Wednesday, August 20th: Now that you Failed…

1. Davidson, A. (2014, Nov. 12). Welcome to the failure age! *New York Times Magazine.* Retrieved online August 15, 2018 from: https://www.nytimes.com/2014/11/16/magazine/welcome-to-the-failure-age.html. (also available as a PDF in this folder)
2. 2. Briceno, E. (2014, Nov. 23). Why understanding these four types of mistakes can help us learn. *Mindshift*. Retrieved online August 15, 2018 from: https://www.kqed.org/mindshift/42874/why-understanding-these-four-types-of-mistakes-can-help-us-learn.
3. Discussion: Where do ideas come from? And how to start with a good failure?
4. Three simple yet intriguing (fail-for-sure) ideas: toroflux (using 3D filaments), oloid (using paper), and a 3D 2024 calendar (using paper).

In-Class Discussion

At this point, we have given you a few opportunities to fail, and there will be more throughout the semester. Reflecting on these experiences so far (e.g. design challenge), reflect upon: a) the overall requirements of the design task, b) why your design was successful or not, c) how your design compares to another students', d) how your experience (and even another student's you observed) connects to the readings provided thus far in class. For example, how does your experience relate to one of the 3 principles of learning or one of the types of mistakes?

Monday, August 26th: Making Meaning of Play in the Classroom

1. Donovan, S., & Bransford, J. (2005). Introduction in *How Students Learn: History, Mathematics, and Science in the Classroom* (pp. 1-28). Washington, DC: National Research Council.
2. AI vs children: Please read a few short essays on this page: https://www.scientificamerican.com/article/gopnik-artificial-intelligence-helps-in-learning-how-children-learn/
3. Identify, read, and bring to class a reading that emphasizes the importance of play in learning.
4. In class, you will conduct an AI (chatgpt.openai.com) or Google search for "place-based education/learning" to further define this concept.

In-Class Discussion

Donovan and Bransford present 3 Principles of Learning. Though their focus on play within these principles is limited, it is an integral part of how we learn. Using the reading you found, corroborate ways play can be incorporated (or even understood) through these 3 Principles of Learning. Here is a sample response: "Donovan and Bransford highlight the importance of monitoring self-learning. This principle is exhibited in play (as detailed in the resource I found) when…" Finally, how do the concepts of learning found in the AI article compare to Donovan and Bransford?

Wednesday, August 28th: The Literacies of Learning

1. Common Core State Standards for Mathematics (https://www.thecorestandards.org/Math/) and English-Language Arts (https://www.thecorestandards.org/ELA-Literacy/)
2. Balloon-Car Challenge Reflection Sheet

In-Class Discussion

Use the Common Core State Standards linked above to identify what math and literacy (or ELA) standards students are likely incorporating in the Balloon-Car Challenge Reflection Sheet. How could you "tweak" the activity (e.g., a prompt, a question) to incorporate an additional standard?