CSU-TIPS RESEARCH LESSON STUDY PROPOSAL

2025-6

Adapted from CANMEE Lesson Study Proposal

For the lesson on: November 14, 2025
Place: CSULB
Instructor for Research Lesson: Luis Moreno Juarez
Facilitator: Brigitte Lahme
Lesson Study Team Members: Luis Moreno Juarez, Loc Dam, JungHa An, Saana Saykali
Commentator: Ximena Cid
Course: Calculus 1

Title of Lesson: Optimization - Walking over different terrain

Brief Description of Lesson:
Students act out an optimization problem. They walk at two different velocities over pavement and grass, respectively, and find the path that minimizes time. After walking and timing different paths, they draw a diagram of the situation and find the equation for the time required to walk the paths as a function of the location where they switch from pavement to grass. They solve the problem using differentiation, predict the time needed for the optimal path and then test the solution by walking and timing the optimal path.

1. Students' competencies and challenges

Evidence / assets-based descriptors include: why each focal student was chosen; their funds of knowledge (cognitive and affective), content and agency strengths; and a content and agency goal for each focal student Add rows as needed.>

Focal Student	Competencies and Challenges
Student Name: Teacher: Brigitte	*Why chosen: Quiet student who is very engaged* *Assets: Excellent attendance and always engages with material* *Content Goal:* *Agency Goal:*
Student Name: Teacher: Brigitte	*Why chosen: Outgoing student who gives mixed signals of confidence/insecurity* *Assets: Engages with other students easily* *Content Goal:* *Agency Goal:*
Student Name Teacher: Brigitte	*Why chosen: Quiet student who is often withdrawn* *Assets: Very solid written work, excellent attendance* *Content Goal:* *Agency Goal:*
Student Name Teacher: Brigitte	*Why chosen: Often stays apart,* *Assets: Engages when prompted, works well outside of class.* *Content Goal:* *Agency Goal:*

Focal Student	Competencies and Challenges
Student Name: Teacher: Luis	*Why chosen: Quiet student who participates* *Assets: Always engages with material* *Content Goal:* *Agency Goal:*
Student Name: Teacher: Luis	*Why chosen: Outgoing student who gives mixed signals of confidence/insecurity* *Assets: Engages with other students easily* *Content Goal:* *Agency Goal:*
Student Name Teacher: Luis	*Why chosen: Outgoing student who participates* *Assets: Very solid written work, excellent attendance* *Content Goal:* *Agency Goal:*
Student Name Teacher: Luis	*Why chosen: Often stays apart, quiet at times* *Assets: Solid work* *Content Goal:* *Agency Goal:*

2. Rehumanizing STEM dimension and goal

<Resources: Standards for Mathematics Practices, Teaching for Robust Understanding, Aguirre et al 5 EQUITY PRACTICES The Impact of Identity in K-8 Mathematics Aguirre, Mayfield-Ingram, Martin; Bartell>

Rehumanizing STEM dimension: Body and Emotion

Rehumanizing STEM Goal: Each student, especially focal students will use their bodies to explore with their bodies how speed, distance, and time change in relation to one another as they walk across different terrains.

3. Content goal

Each student, especially focal students will understand how one quantity affects another before finding the optimal walking path using calculus.

Each student, especially focal students will be able to demonstrate how calculus describes motion in the real world.

4. Connecting the Rehumanizing STEM dimension and the Content goal: How can the RS dimension support learning of the content?

5. Choose the task and anticipate student responses <Do the task and anticipate how focal students will do the task>
   See Lesson Plan

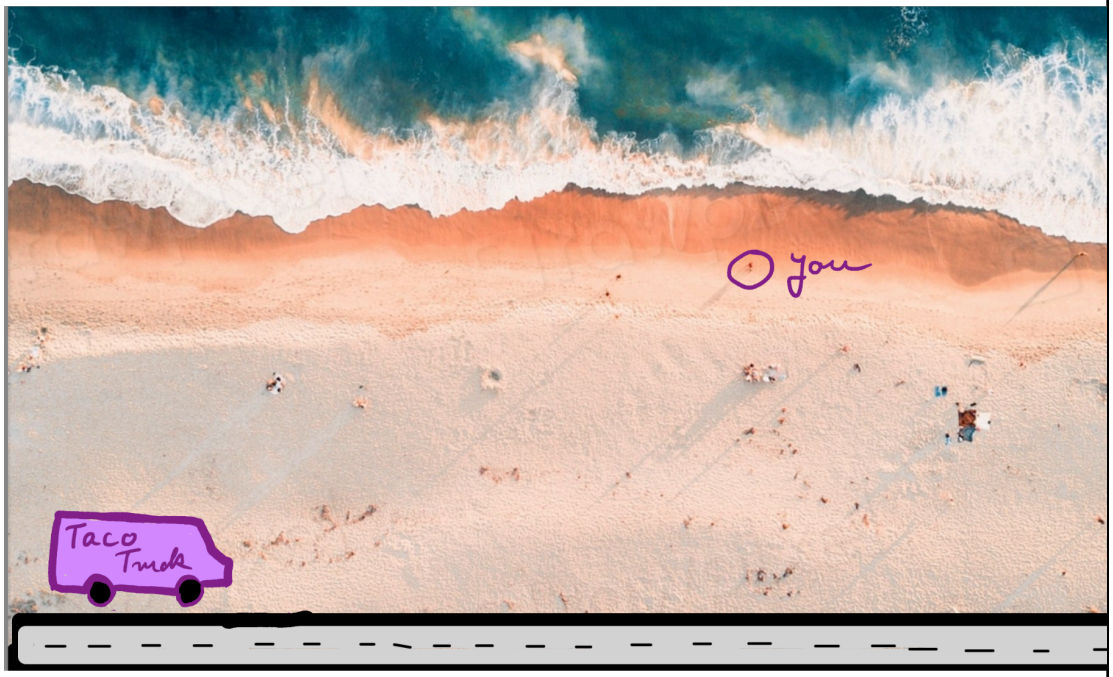
6. Unit plan < Describe lessons surrounding your research lesson, with a goal and task. Identify which lesson is the research lesson.>

Lesson	Unit Learning Goal and Tasks
1	Goal: Finding local maxima and minima using derivatives. Task: various
2	Goal: Finding optimal solution using calculus. Task: Walking across different terrain (lesson study lesson)
3	Goal: Finding absolute maxima and minima. Task: Use data from groups gathered during lesson study lesson to introduce idea of endpoints and how to identify absolute max/min on closed interval (see presentation slide 15.

7. Research Lesson Plan

Indicated time percentages are recommendations; adjust as necessary

	STORYLINE	Teaching for Robust Understanding
Norms ≅3 mins	What norms and expectations will be set for students? What norms are being built for what counts as learning mathematics?	Agency:: Expectations for how will learn
	ACT 1 :: IGNITE AND LAUNCH ≅10 minutes	
Ignite Curiosity	How will the lesson ignite curiosity and motivation to invest in this task connecting to: interests, past experience, community, prior learning? "Assumes that people are competent and have knowledge, and their life experiences have given them that knowledge" (Gonzalez & Moll 2002: 625). Imagine you are at the beach close to the water and you are hungry. There is a taco truck next to the road further up the beach (there is a paved sidewalk next to the road). If you want to get to the truck as quickly as possible, which way would you head?	Agency :: • How could we model this? (brainstorm some ideas, then students choose or instructor suggests side-stepping, alternate walking style has to be slower than normal walking on concrete) Motivation

		
Launch	Introduce activity logistics - go over handout and hand it out - explain expectations, hand out tape measure, explain flag positions **Material and Preparation:** ● Students in groups of 3 or 4 ● Each group needs: ○ Stopwatch (use phone app) ○ Measuring tape ○ Makers for start, finish, place to cut across (mini flags or so) ● For each group mark the starting and ending points.	

	Note: When walking over “Grass” we will pretend it is sand by taking sideways steps instead of full steps.	
	ACT II :: CHEW ON RIGOR ≅60 minutes	
Workshop	**Part 2: Modeling and collecting data (outside): (30-40 min)** In your group, act out the problem and record the time it takes to walk three different paths: ○ Most on pavement ○ All on grass ○ Your guess at a path that minimizes time ● Decide who will keep time, who will record and who will walk. ● Find your velocity on pavement and your velocity on grass. ● Measure the distances ● Walk the three paths and record the time **Part 3: Calculations together (inside):** **Class discussion (led by instructor): (15-20 min)** Choose one set of velocities: ● Draw diagrams, label relevant quantities ● Come up with function to minimize ● Use derivative to find optimal solution ● Calculate relevant quantities (length on pavement, length on grass, time on pavement, time on grass, total time) Groups repeat processes with their own data. (20 min)	
Anticipated Response	Anticipate focal student solution paths. What questions may be asked to assess? Orient? Advance? *Note: As you iterate the lesson, this will undergo revisions*	Cognitive Demand: Anticipate where students will engage in productive struggle Formative Assessment: How can we learn more about each student’s

		thinking?
	ACT III :: CONSOLIDATE ≅20 minutes	
Share & Connect	**Part 4: Testing your solution (outside) (10 min)** • Walk optimal path and record the time it takes	Content :: Students hear other ideas, techniques, perspectives. Ownership :: Contribute to the content seeing themselves as thinkers and learners Formative Assessment: Make thinking visible; address emerging misunderstandings
Summary	Wrap-up Discussion • How did the predicted solution compare to the actual data collected? • If the times are off, what caused the discrepancies? What types of errors contributed? • What did you find interesting? Unexpected? • Where could a similar situation come up? Brainstorm with your group. (possible answers: run and swim, drive and walk - search and rescue, get close to a place in the wild)	Content :: Students make mathematical connections
Student Reflection	• Canvas survey	Agency, Ownership, Identity: Contribute to the content seeing themselves as thinkers and learners

8. "Board" plan < How will the board be designed to reveal the history of the lesson? Make visible student thinking? Help students make connections across representations? To make sense of the content? >

9. Observation question(s) <What question (about the lesson hypothesis) does the team want answered by the commentators and observers? Does the evidence from the points of assessment in the lesson plan lead to answering this question?>

10. **Reflections** < What was learned from the research lesson? About content? About access and agency? About the lesson hypothesis? About pedagogy? About focal students?>

    - Commentaries from public lesson (commentator)
      < synthesize findings from public lesson evidence and commentaries >

    - Team reflection < Professional learning of lesson study team >

    - Students—especially focal students'—reflections < Exit slips, surveys, meet and greet :: What was learned during this research lesson? How did you learn? In what ways was the lesson challenging?>

    - Administrator(s) reflection < What teacher and student learning was noticed? How does this inform site or district initiatives? >