Using a computer game to teach scientific argumentation

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What is Project NEURON?

- Educators, scientists, and graduate students
- Curriculum development
  - Inquiry-based
  - Connect to standards
- Teacher professional development
- Research

Curriculum Unit and Game

Why dread a bump on the head?
Unit Overview

The Golden Hour game

- L1: What is traumatic brain injury?

- L2: What does the brain look like?

- L3: How does a CT scan help diagnose TBI?

- L4: How to build a neuron

- L5: What happens to neurons after TBI?

- L6: Exploring the data behind brain injury

- L7: What can we tell others about TBI?
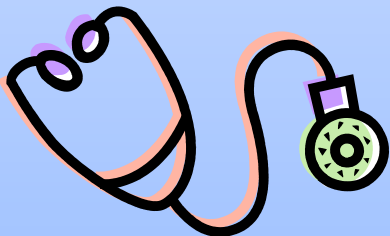
The Golden Hour Game

- A curriculum-integrated game

- Supports scientific argumentation

- Contextualizes learning

The Golden Hour Game

As the "super" medical student, the player must...

Scene 1: EMS

-Respond to 911 call
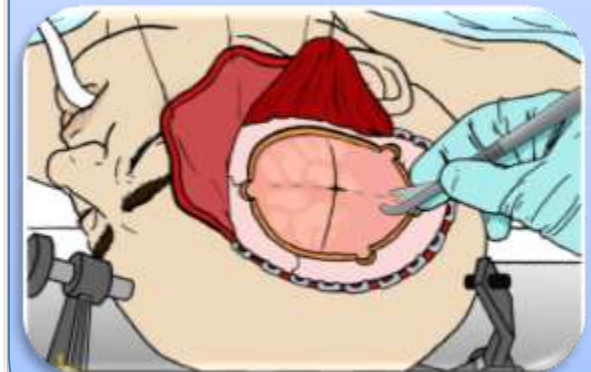
-Check vital signs

-Assess consciousness

Scene 2: CT Scan

-Review brain anatomy and function

-Interpret CT scans

-Identify TBI location and type
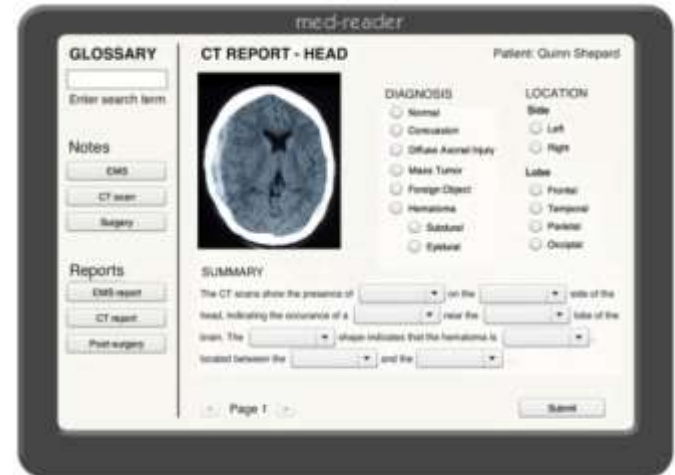
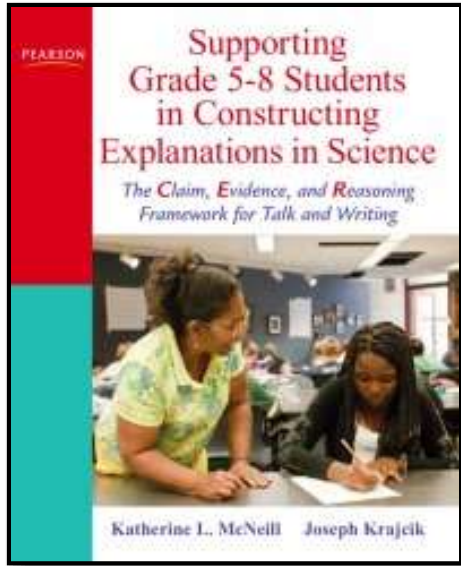**Scene 3: Surgery**

-Conduct brain surgery

Assessment Scenes

After each main scene, students complete

- Summative report of collected data

- Multiple choice dialogue (CER)

- Open response scientific argument (CER)

Claim, Evidence, and Reasoning

McNeill & Krajcik (2012)

Claim
- A statement that expresses the answer or conclusion to a question or problem

Evidence
- Scientific data that supports the claim

Reasoning
- The justification that links the evidence to the claim

Research Study

Theoretical Framework

- Scaffolding scientific argumentation
  - Teacher introduction of argumentation [do you mean more of the modeling of what an argument is and then having students take over responsibility?]
  - Features of curriculum materials and learning environments [do you mean educative curriculum materials?]

- Game-based science learning
  - Contextualized learning environments

  - Is it possible for you to put in any references here that you are pulling from?

Research Questions

- How does a high school science teacher introduce scientific argumentation using curriculum materials that feature a computer game?

- How might differences in written scaffolds influence the quality of student arguments?

Research Methods

- Design-based methodology [reference]

  – Iterative development of educational materials

- Case-study of one teacher over two years of enactment [reference]

Participants & School Context

	Description
School	• High school located in small urban community • About 48% of students identified as low-income
Teacher	• One teacher • 10+ years of teaching experience • Attended PD for the curriculum unit and game • Used the curriculum unit with *The Golden Hour* game for multiple years
Class	• Anatomy and Physiology elective course • Year 1: 5 class periods ; Average 23 students/class • Year 2: 4 class periods; Average 21 students/class
Students	• Mostly upperclassmen • Year 1: 49 participants • Year 2: 39 participants

Enactment Materials

Year 1	Year 2
• Curriculum lesson plans • *The Golden Hour game*	• Curriculum lesson plans • *The Golden Hour* game • Student sheet with CER scaffolding

Student Sheets

Iteration 1

I recommend the patient have a CT scan done. Evidence that supports this recommendation is he had a GCS score of 10, which isn't especially low. All his vitals were normal. He did have a slightly low blood pressure, so I would recommend you monitor that. His pupillary reflexes are fine, so we know there wasn't an severe brain truama ~~caused~~ Caused by the accident.

Iteration 2

Complete this page AFTER you have submitted the report above and spoken with Dr. Picotte in The Golden Hour game.

To complete your report, you must write a scientific explanation to answer **"What should be done next for the patient?"** Use the table below to organize your information. Under "Medical Recommendation", use this information to write your full scientific explanation using complete sentences. Be sure to: make a CLAIM, provide EVIDENCE and explain your REASONING.

CLAIM	EVIDENCE	REASONING
I think that the petience needs a CT scan of the brain.	My evidence is the GCS score. The GCS score was a total of 10 That means that the it's moderate	My Reasoning is that we need more conclusive information about the head trauma. It's stable enough for the patient to survive the CT scan since his GCS score is moderate

MEDICAL RECOMMENDATION

I recommend that this patient gets a brain scan. I recommend that since the patient have an head injury. We need to know more about the injury so we can know how to treat the patient and if he needs surgery or not.

Data Collection & Analysis

Data Type	Analysis
Teacher instruction • Audio recordings • Observations	• Characterized teacher instruction with framework adapted from McNeill and Krajcik (2008) • Focused on teacher introduction of CER
Student arguments	• Focused on Scene 1 for this study • Scored using a task-specific rubric based on McNeill and Krajcik (2012) • Analyzed with an independent samples t-test
Student post-tests	• Scored and scaled • Analyzed with an independent samples t-test

Results: Teacher Instruction

Aspect of introduction	Teacher enactment
Defining C, E, R	• Defined C, E, R within the context of the game • Definitions were incomplete [what was missing? And are these two bullets for both years?]
Rationale for argument	• Explained: "Convince someone that [the student's] suggested treatment would be the best treatment for the individual." (Iteration 1) • Provided no rationale to the class as a whole for why they were constructing a scientific argument. (Iteration 2)
Modeling with an example	• Provided example argument • Identified C, E, R components • No evaluation of quality of experiment • Across both years?

Results: Student Arguments
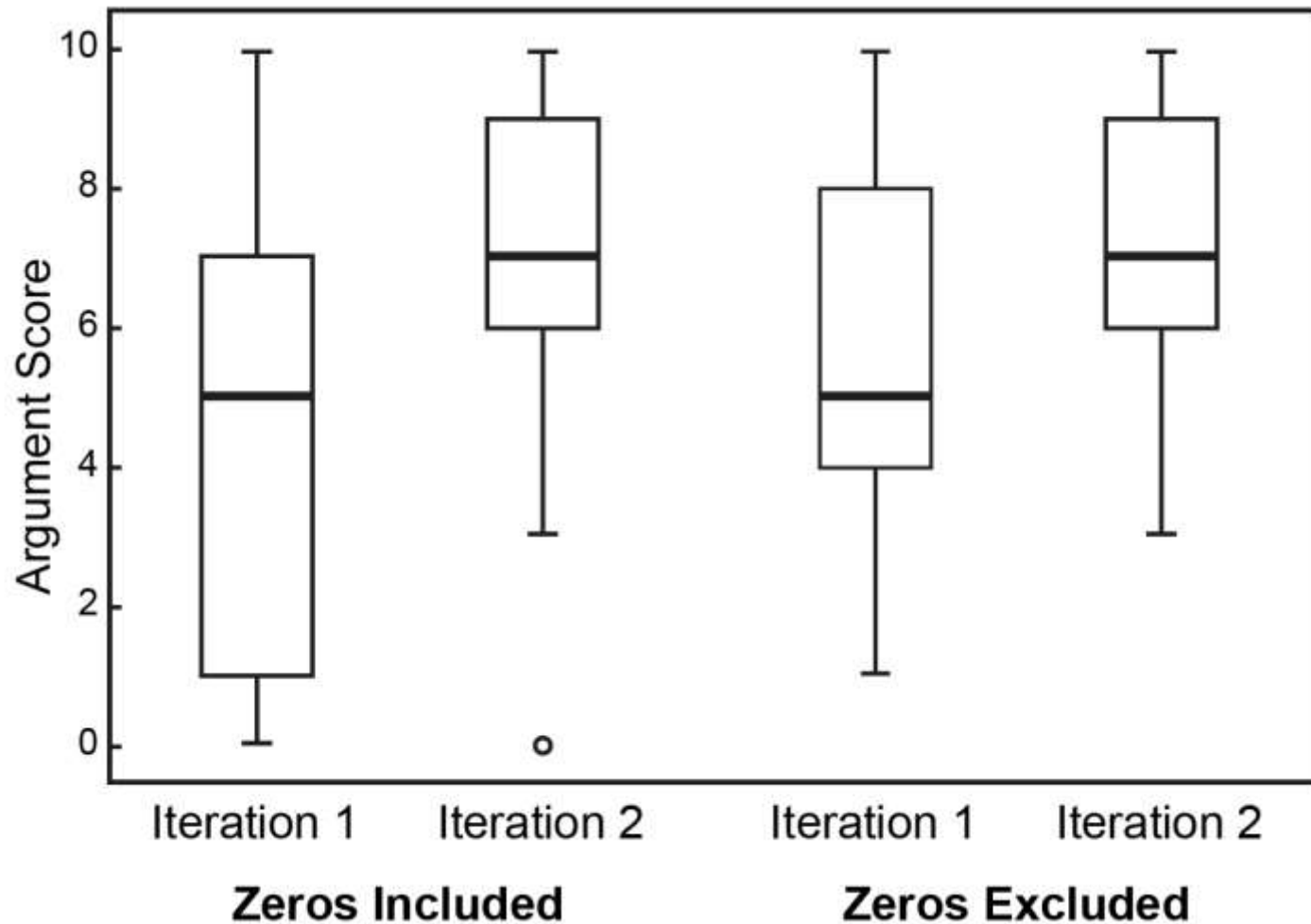
Results: Student Arguments

Table 2
Mean (M) and standard deviation (SD) statistics for each Claim, Evidence, and Reasoning component and total scores for students in Iteration 1 and Iteration 2

	n	Claim (0–2 possible)		Evidence (0–4 possible)		Reasoning (0–4 possible)		Total (0–10 possible)	
		M	SD	M	SD	M	SD	M	SD
Iteration 1	49	1.45	0.87	1.63	1.52	1.31	1.45	4.39	3.36
Iteration 2	39	1.90	0.45	2.64	1.25	2.62	1.46	7.15	2.60

Discussion

Finding:

It is likely that the scaffolds in student materials in Iteration 2, contributed to the higher mean of argument scores in Iteration 2

Changes to curriculum:

Student sheet with prompts that are scaffolded *and faded. [need to clarify– how were the prompts faded?]*

Discussion

Finding:

The teacher used the game as a context in some aspects of the introduction to scientific argumentation. However, she missed opportunities to more explicitly integrate the game to contextualize and support instruction.

Changes to curriculum:

Provide explicit support for introducing scientific arguments and integrating the game

Conjecture Map

Design Conjectures   **Theoretical Conjectures**

High Level Conjectures   *Embodiments*   *Mediating Processes*   *Outcomes*

Tools & Materials:
- *The Golden Hour computer game*
- *Student sheet with prompts that are scaffolded* & faded***
- Lesson plan & materials with explicit support for (a) introducing argumentation & (b) integrating the game**

Contextualization, *appropriate scaffolds,* & explicit instruction*** help introduce students to argumentation

Task & Participant Structures:
- Teacher enacts curriculum with game
- Students play game in pairs, engage in CER dialogue within game, write medical recommendations

Observable Interactions:
- Teacher introduction of CER framework

Participant Artifacts:
- Students produce scientific arguments with accurate and sufficient claims, evidence, and reasoning

Improved ability of students to engage in scientific argumentation

Text Key:
- Iteration 1
- *Iteration 2**
- ***Future Iteration*****

Implication

Educational game developers and curriculum developers need to consider the synergistic interaction of game, curriculum, and teacher instruction when designing classroom interventions.

Acknowledgements

- NIH, SEPA
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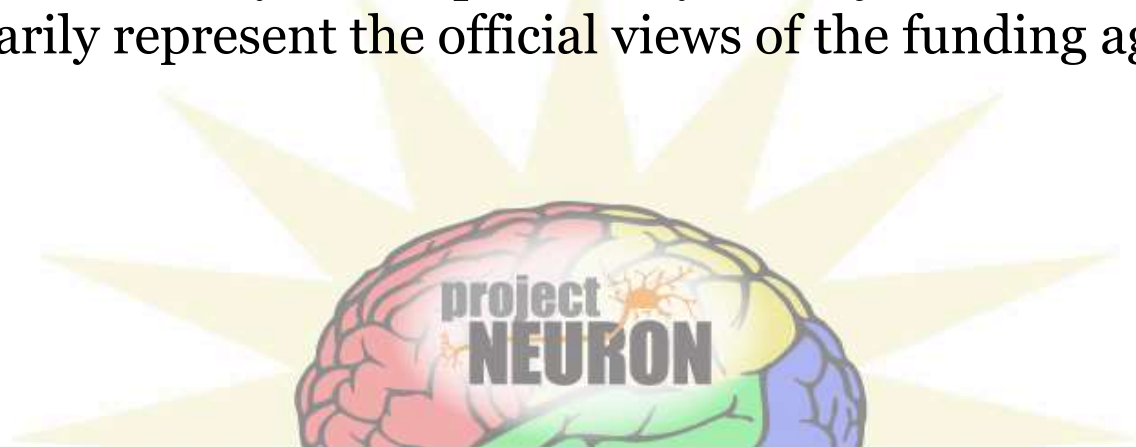
Thanks!

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