Transforming Education Through Emerging Educational Technologies

T-561
https://canvas.harvard.edu/courses/18484

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The learner-centered aspects of immersion include intrapersonal factors such as challenge, control, fantasy, and curiosity, as well as interpersonal factors such as competition, cooperation, and recognition.

This enables community-centered activities based on social network knowledge construction in a five-stage process: identify, lurk, contribute, create, and lead.

Both MUVEs and ARs enable developing knowledge-centered learning experiences in which students encounter richly detailed, simulated real-world situations with challenges that can be resolved through applying academic knowledge and skills.

Immersive enables assessment-centered mechanisms for eliciting performances, collecting and analyzing continuous data, and interpreting multi-modal evidence.
Engaging with authentic scientific tools and practices can build science inquiry skills, improve conceptual understanding, and increase motivation.

Students can advance their understanding of any field by arguing in evidence-based ways similar to experts in that field.

Embodied learning involves self-awareness of the body interacting with a real or simulated world to support the learning process.
Oculus: Questions for Shared Reflection

1. As best you can tell, what happened in the pilot project?

2. What seems to be its “theory of action” for academic achievement? For social justice?

3. What do you think the students may have learned? What social justice goals may have been achieved?

4. What are the challenges with the pilot’s approach to meeting its goals and becoming larger, reaching more students?
5. What parts of transformative academic learning might full immersion aid?

6. What aspects of community-led social justice might full immersion aid?

7. What would you recommend as a model for scaling up this pilot?
   a) How might its academic impact be improved?
   b) How might its social justice impact be improved?
   c) How would your model move towards ultimately achieving scale (i.e., be self-sustaining in human capacity and financial resources)?

8. If your model used interactive content on a normal computer monitor, instead of VR, what aspects of this approach would still work? Where would it be weaker?
River City Interface

1. View and Action Space
2. Virtual Space
3. Chat Window
4. Student Workspace
Purpose: River City’s Mayor

- She has commissioned student research teams for help
- Students must figure out why the residents are getting sick
- Present their findings to Mayor at end of project
Capturing Data on Change over Time

Students visit the same places and see how things change over time. They spend an entire class period in an individual season, gathering data.
Experimentation

Control World: Bog

Experimental World, Bog is drained
Experimentation

Control World

Experimental World
Student’s Role in River City

- Travel back in time to 1878-79
- Bring 21st century skills and technology to 19th century problems
- Help town understand and perhaps solve a piece of the problem of why so many inhabitants are becoming ill
  - Work as a research team
  - Keep track of clues that hint at causes of illnesses
  - Form and test hypotheses
  - Make recommendations based on experimental data
Teacher’s Role in River City

Overall: the guide to the scientific inquiry experience

- Encourage students to problem-solve rather than provide answers
  - Teachers act as 21st century experts
  - They do NOT travel back in time with students, and so profess to not know WHY residents are ill

- Respond to student questions with questions:
  - Tell me what you saw
  - What do you think that means?
River City and the "Matrix"

Students travel between the real and virtual worlds like Neo and Trinity

Teachers stay in the real world to provide support to those in the virtual world, like Tank
### Princess – in River City

<table>
<thead>
<tr>
<th>Session 1</th>
<th>“your not supposed to ask some1 that who is in class your supposed to ask the ppl that with the [] around their names”</th>
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</table>
| Session 2 | “where should I go”  
“james i have found a lot…u guys go to the wealthy homes me me me there ” |
| Session 3 | “did u guys find something out…I did”  |
| Session 4 | “There are a lot of people in the tenements really sick so I think it is the mosiquitos cause they can carry things from the dump” |
| Session 5 | “I am at the library to see if I can get any information” |
| Session 6 | i dont think that it is the water it was just a hypopthesis saying if the pipe was made of of lead. she is just teaching her class?” |
Assessment Must Advance to Support New Methods of Teaching/Learning

- New methods of instruction are unusable unless their effectiveness can be assessed
- The use of inadequate measures for learning outcomes understates the value of new pedagogies
- High stakes assessment drives both curriculum and teaching/learning
Assessing Sophisticated Performances Based on Rich Observations
Actions as Basis for Assessments

Logfiles Indicate with Timestamps

- Where students went
- With whom they communicated and what they said
- What artifacts they activated
- What databases they viewed
- What data they gathered using virtual scientific instruments
- What screenshots and notations they placed in team-based virtual notebooks
- What hints they accessed

http://vpa.gse.harvard.edu
Logfiles: Events, Chats, Notebooks...

Database of Logdata - Track students’ behaviors: where they went, what data they collected, path to solve problem

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
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<td>7</td>
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<td>2</td>
<td>14</td>
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<td>nitrates tab clicked in notebook</td>
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Data includes details such as: assessment started, stage started, stage ended, etc.
## Match In-world Interactions to Rubrics

<table>
<thead>
<tr>
<th>Question</th>
<th>Skill</th>
<th>observable variable</th>
<th>Evidence</th>
<th>score</th>
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<tbody>
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<td>add item 2</td>
<td>Evidence</td>
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<td>Evidence</td>
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<tr>
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<td>Evidence</td>
<td>31</td>
<td>green larvae</td>
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</tr>
<tr>
<td>add item 5</td>
<td>Evidence</td>
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<td>lab nectar</td>
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<tr>
<td>add item 6</td>
<td>Evidence</td>
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<tr>
<td>question 6</td>
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<td>green bee</td>
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<tr>
<td>question 7</td>
<td>Experiment: DNA</td>
<td>23</td>
<td>six bee</td>
<td>2</td>
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<tr>
<td>question 8</td>
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<tr>
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</table>
Formative/Diagnostic

- Formative diagnostic assessment provides more leverage for improvement than summative measures.
- Formative diagnostic assessment is richer and more accurate than summative measures.
- Potentially, formative diagnostic assessment could substitute for summative measures.
Knowing what Students Know: The Science and Design of Educational Assessment
The Assessment Triangle

- **Cognition**
  - model of how students represent knowledge & develop competence in the domain

- **Observations**
  - *tasks or situations* that allow one to observe students’ performance

- **Interpretation**
  - *methods* for making sense of the data
NSES Model of Inquiry

- Identify questions that can be answered through scientific investigation (not independent of knowledge)
- Design and conduct a scientific investigation
- Use appropriate tools and techniques to gather, analyze, and interpret data
- Develop prescriptions, explanations, predictions, and models using evidence
- Think critically and logically to make the relationships between evidence and explanations
- Recognize and analyze alternative explanations and predictions
- Communicate scientific procedures and explanations
- Use mathematics in all aspects of scientific inquiry
An Immersive Model

- Student takes on the identity of a scientist.
- Students complete quests.
- 90 minutes
- Four phases
  1. Orientation
  2. Problem identification
  3. experimentation
  4. Competing explanations
Focus on Design for Interweaving

- Capturing exploratory paths
- Analyzing usage of guidance systems
- Interacting with animated pedagogical agents
- Attaining “powers” through accomplishments
- Documenting progress and transfer in similar settings
Path Analysis for Defined Tasks

Individual and Group Paths

Heat Maps
Usage of Individualized Guidance

Click on one of the message tabs above to view hints about this area, object, or River City citizen.
Interacting with Animated Pedagogical Agents

Ask Dr. C.
Your Personal Mars Expert

Why is Mars called the Red Planet?

Dr C: Busy day today! But I still have time to answer any of your questions about Mars, space, or science.

Diane K: Why is Mars called the Red Planet?

Dr C: Mars probably got the nickname, The Red Planet, due to the rusty color of its soil, which is comprised of iron-rich minerals. The Egyptians called it ‘the red one’ because it appears more reddish in the night sky. What makes it appear reddish is a combination of the fact that its surface is comprised of iron-rich minerals that essentially rust (or oxidize) and that the dust made of these minerals is kicked up into the atmosphere, giving the atmosphere a reddish hue from far away. The Martian surface is not all
Documenting Progress and Transfer in Similar Settings

• Student takes on identity of a scientist

• Students complete quests

• 90 Minutes

• Four Phases:
  1. Orientation
  2. Problem Identification
  3. Experimentation
  4. Competing Explanations
Attaining “Powers”
Through Accomplishments

Mysterious Mansion

Access to Special Experiences