Transforming Education Through Emerging Educational Technologies

T-561

https://canvas.harvard.edu/courses/18484

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Teaching (with Technology): Immersion and Learning

- 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

Innovating Pedagogy

- 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.

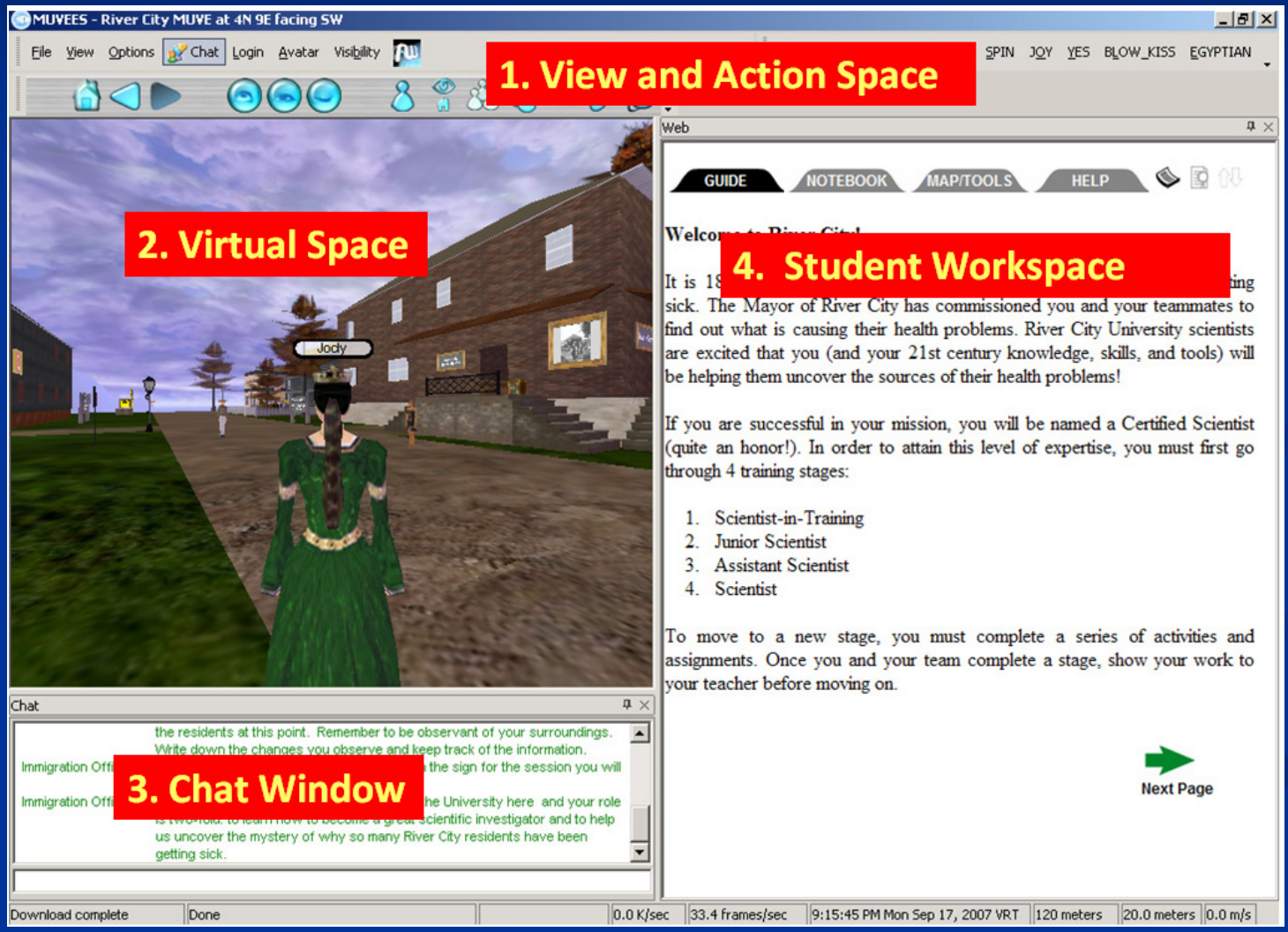
Oculus: Questions for Shared Reflection

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?

Oculus: Questions for Shared Reflection

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



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

Visit 1	Visit 2	Visit 3	Visit 4
			
Fall, 1878	Winter, 1879	Spring, 1879	Summer, 1879

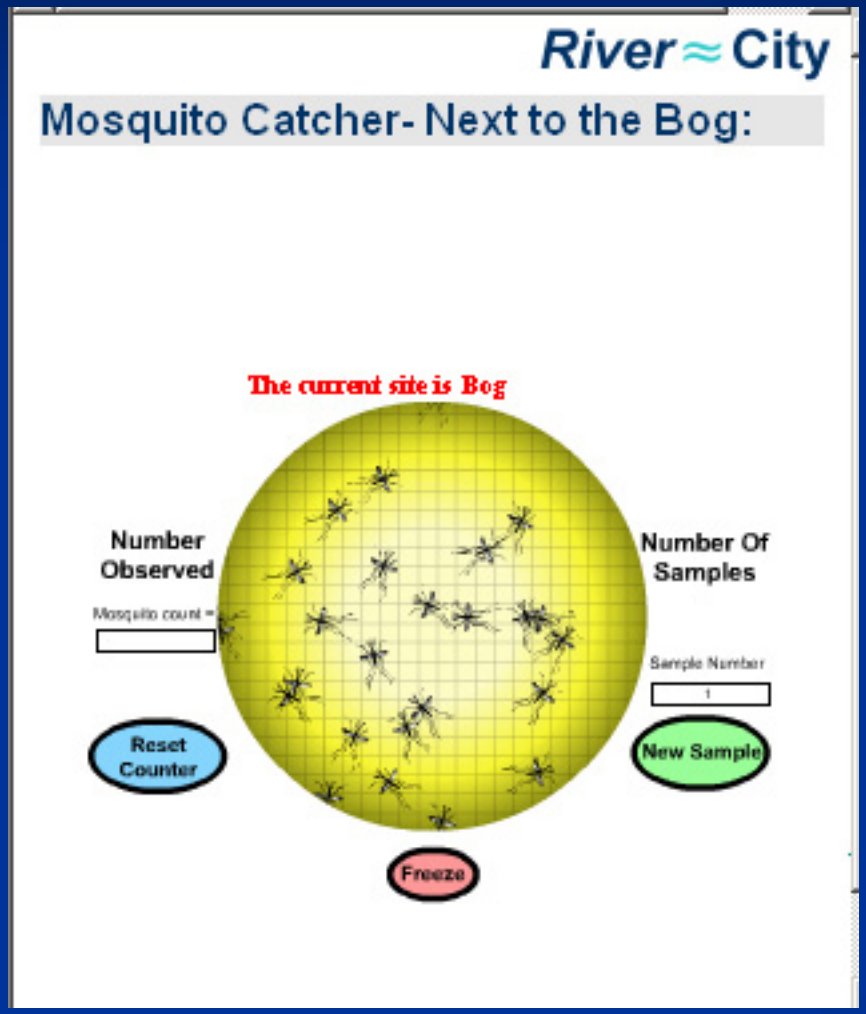
Students visit the same places and see how things change over time. They spend an entire class period in an individual season, gathering data.

Experimentation

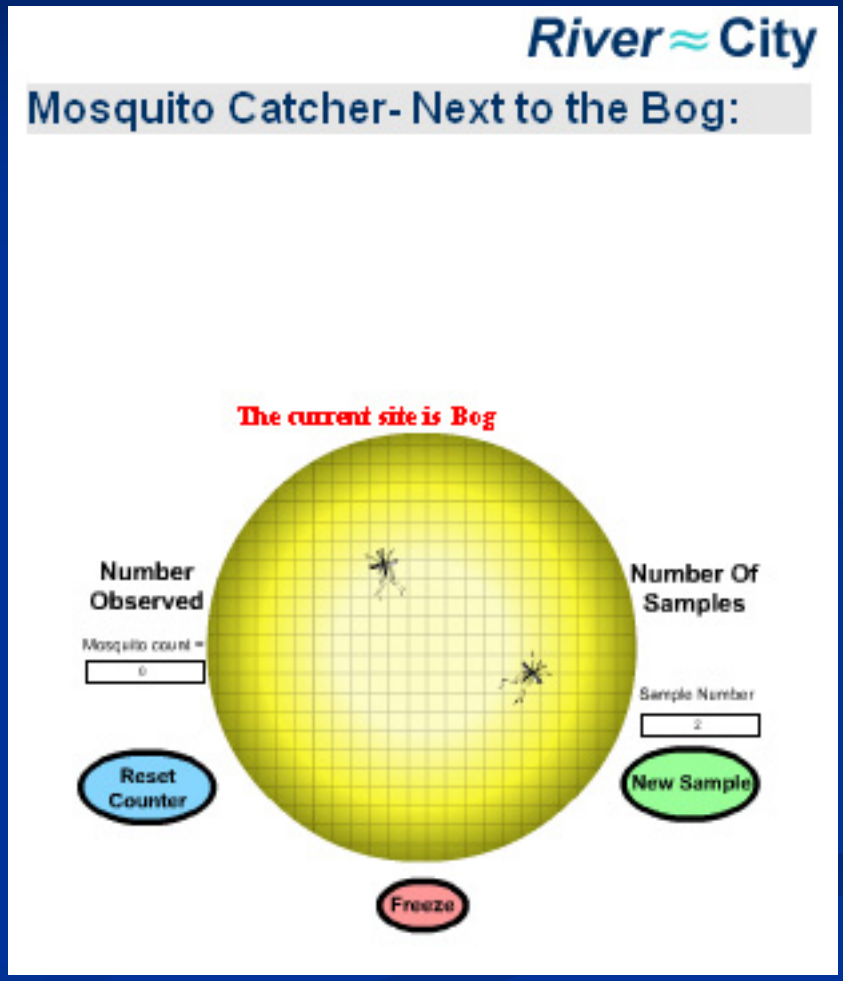
Control World: Bog

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

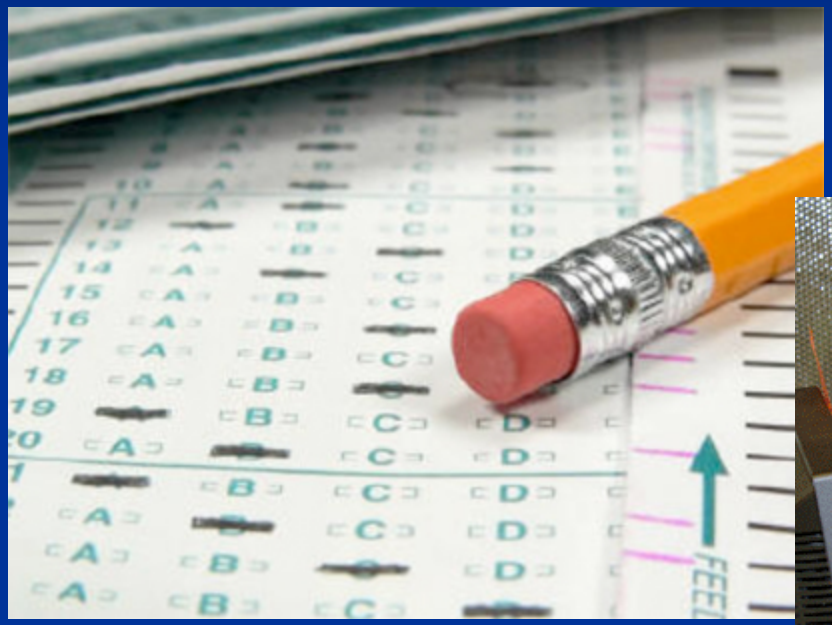
Princess – in River City

Session 1	“your not supposed to ask some1 that who is in class your supposed to ask the ppl that with the [] around their names”
Session 2	“where should I go” “james i have found a lot…u guys go to the wealthy homes 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 mosiqutos 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

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Logfiles: Events, Chats, Notebooks…

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

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	administra	testID	eventID	stage	timestamp	locationX	locationY	locationz	locationYa	assetID	detail	studentID	Description
2	3141592	497	0	0	2009-12-08	0	0	0	0	1	1	102282	assessment started
3	3141592	497	1	1	2009-12-08	364	23	-76	0	2	10	102282	stage started
4	3141592	497	2	1	2009-12-08	263	10	-6	270	2	10	102282	stage started
5	3141592	497	3	1	2009-12-08	263	8	-6	270	14	1	102282	notebook opened
6	3141592	497	4	1	2009-12-08	263	7	-6	270	14	2	102282	nitrate tab clicked in notebook
7	3141592	497	5	1	2009-12-08	257	8	-397	0	143	20	102282	Arrow selection of Surface of the bay in front of the tent
8	3141592	497	6	1	2009-12-08	0	0	0	0	2	11	102282	stage ended
9	3141592	497	7	1	2009-12-08	0	0	0	0	2	13	102282	stage ended ungracefuly
10	3141592	497	8	1	2009-12-08	0	0	0	0	1	3	102282	
11	3141592	498	0	0	2009-12-08	0	0	0	0	1	1	102282	assessment started
12	3141592	498	1	1	2009-12-08	364	23	-76	0	2	10	102282	stage started
13	3141592	498	2	1	2009-12-08	263	10	-6	270	2	10	102282	stage started
14	3141592	498	3	1	2009-12-08	263	8	-6	270	14	1	102282	notebook opened
15	3141592	498	4	1	2009-12-08	263	7	-6	270	14	2	102282	nitrate tab clicked in notebook
16	3141592	498	5	1	2009-12-08	263	7	-6	270	14	3	102282	pop density tab clicked in notebook
17	3141592	498	6	1	2009-12-08	263	7	-6	270	14	4	102282	salinity tab clicked in notebook
18	3141592	498	7	1	2009-12-08	263	7	-6	270	14	2	102282	nitrate tab clicked in notebook
19	3141592	498	8	1	2009-12-08	263	7	-6	270	14	1	102282	notebook opened
20	3141592	498	9	1	2009-12-08	0	0	0	0	2	11	102282	stage ended
21	3141592	498	10	1	2009-12-08	0	0	0	0	2	13	102282	stage ended ungracefuly
22	3141592	498	11	1	2009-12-08	0	0	0	0	1	3	102282	
23	3141592	499	0	0	2009-12-08	0	0	0	0	1	1	102282	assessment started
24	3141592	499	1	1	2009-12-08	364	23	-76	0	2	10	102282	stage started
25	3141592	499	2	1	2009-12-08	263	10	-6	270	2	10	102282	stage started
26	3141592	499	3	1	2009-12-08	263	8	-6	270	14	1	102282	notebook opened
27	3141592	499	4	1	2009-12-08	263	7	-6	270	14	2	102282	nitrate tab clicked in notebook
28	3141592	499	5	1	2009-12-08	233	4	-5	291	3	4	102282	teleport KB kelp
29	3141592	499	6	1	2009-12-08	236	6	-4	291	2	11	102282	stage ended
30	3141592	499	7	4	2009-12-08	129	10	125	0	2	10	102282	stage started
31	3141592	499	8	4	2009-12-08	124	2	117	108	212	20	102282	Arrow selection of Striped surfperch
32	3141592	499	9	4	2009-12-08	123	0	123	0	107	22	102282	Population density reading for Bull kelp
33	3141592	499	10	4	2009-12-08	129	10	118	180	209	22	102282	Population density reading for Sea otter
34	3141592	499	11	4	2009-12-08	137	0	121	37	200	22	102282	Population density reading for Corraline algae
35	3141592	499	12	4	2009-12-08	133	0	117	0	111	24	102282	Temperature reading for Bay floor
36	3141592	499	13	4	2009-12-08	133	0	117	0	111	25	102282	Turbidity sample taken of Bay floor
37	3141592	499	14	4	2009-12-08	108	0	107	37	200	23	102282	Salinity reading for Corraline algae

Match In-world Interactions to Rubrics

Question	Skill	observable variable		Evidence	score
			55	claim	
question 1 final	Claim/Reasoning	20		pollution	0
question 2 final	Evidence	21			
add item for 21	Evidence	31	1	dead bee	5
add item for 21	Evidence	31	4	green bee	5
add item for 21	Evidence	31	8	green larvae	5
add item for 21	Evidence	31	10	lab nectar	5
add item for 21	Evidence	31	13	green nectar	5
question 3 final	Experiment: Water	22	13	green nectar	5
question 3 final	Experiment: Water	22	10	lab nectar	2
			60	no DNA	
question 4 final	Experiment: DNA	23		results	5
question 4 final	Experiment: DNA	23	4	green bee	2
question 4 final	Experiment: DNA	23	1	six bee	2
question 5 final	Experiment: Blood	24	1	six bee	2
question 5 final	Experiment: Blood	24	4	green bee	5
question 6 final	All data: Evidence Tadpole	25	6	green larvae	5
question 7 final	All data: Evidence Frogs	26	4	green bee	5
question 8 final	All Data: Experiment: Wat	27	13	green nectar	5
			60	no DNA	
question 9 final	All Data: Experiment: DNA	28		results	5
question 9 final	All Data: Experiment: DNA	28	4	green bee	2
question 9 final	All Data: Experiment: DNA	28	1	six bee	2
question 10 fina	All Data: Experiment: Bloc	29	1	six bee	2
question 10 fina	All Data: Experiment: Bloc	29	4	green bee	5

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.

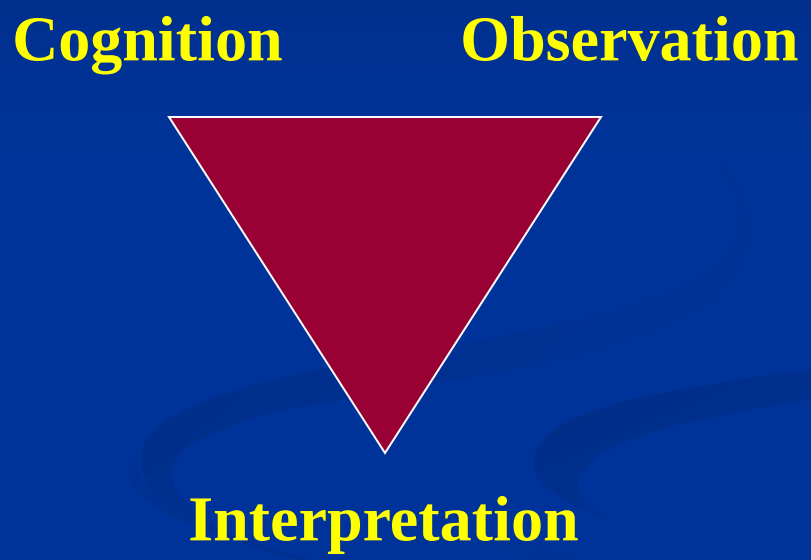
NATIONAL RESEARCH COUNCIL

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



Reasoning from Evidence

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

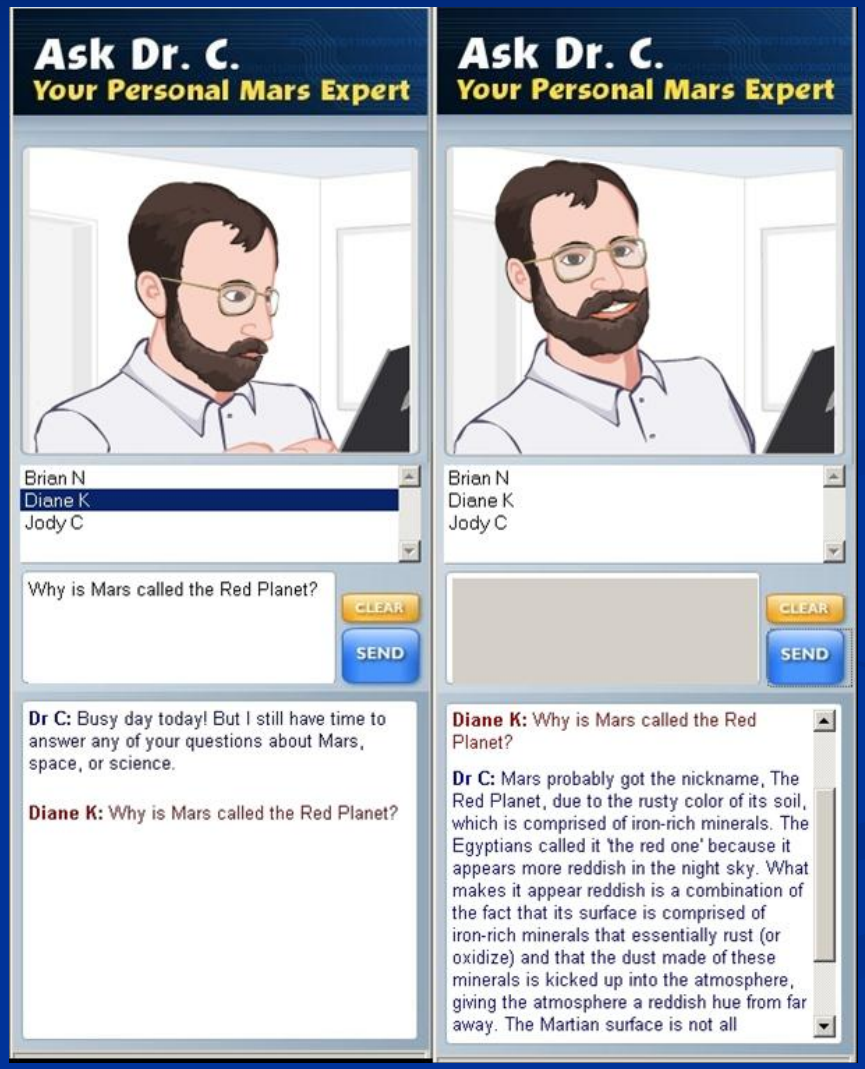
Path Analysis for Defined Tasks

Individual and Group Paths

Heat Maps

Usage of Individualized Guidance

Interacting with Animated Pedagogical Agents



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