Emerging Technologies for Effective Teaching & Learning

Continuing Education Program for Next Education India Pvt Ltd
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Next Education™
Transforming Education

IIT BOMBAY

Effective integration of technology

Sahana Murthy

Recall

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Strong pedagogy + meaningful technology

trumps

Sophisticated technology + mediocre pedagogy

Recall

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Strong pedagogy + meaningful technology

trumps

Sophisticated technology + mediocre pedagogy

Technology must be chosen so that it can support meaningful pedagogy.
Pedagogy must be designed so that it meaningfully exploits technology.

Frequently asked questions during demo

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How to use the technology well?

How to incorporate technology in the teaching-learning process?

What should a teacher do with the technology in the classroom for effective learning?

…

How to effectively integrate technology?

Getting to know each other better

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Each one say one

- Your name
- Your school
- Which technology do you want to “effectively integrate” – list one.

Frequently asked questions during demo

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How to use the technology well?

How to incorporate technology in the teaching-learning process?

What should a teacher do with the technology in the classroom for effective learning?

…

How to effectively integrate technology?

Visualizations (familiar, commonly available)

Visualizations in teaching-learning

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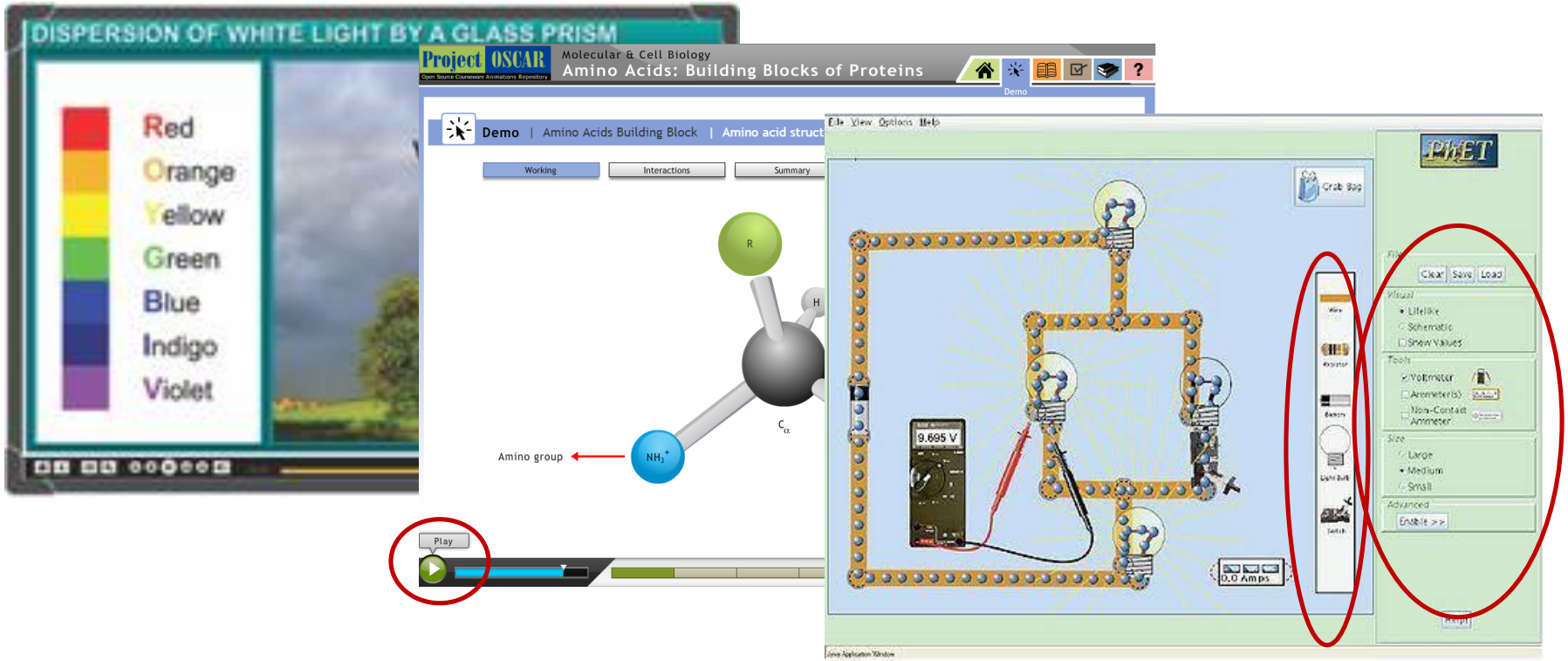

Visualizations in teaching-learning

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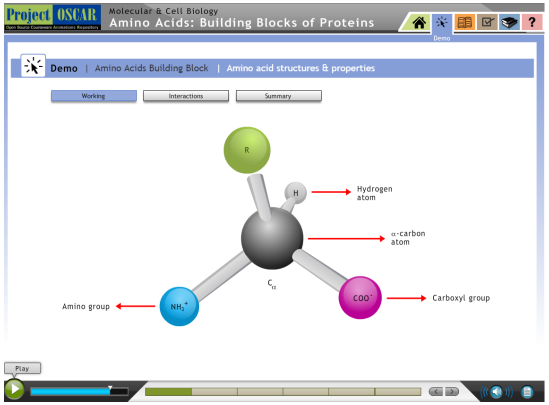

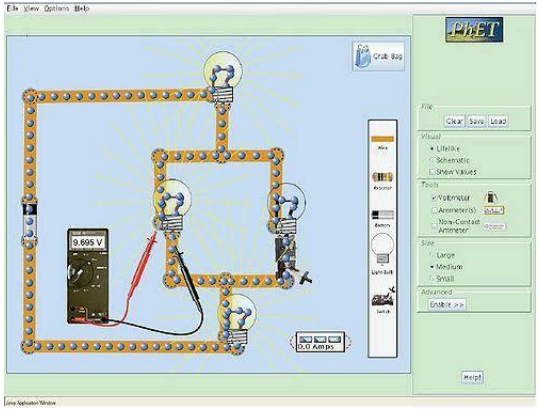

Visualizations – videos, animations, interactive simulations

Many repositories

Shown to provide learning benefits

Why do teachers use visualizations in class?

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THINK: Write one purpose for using viz, including an example from your topic. (1 min)

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IIT BOMBAY

THINK: Write one purpose for using viz, including an example from your topic. (1 min)

PAIR: Turn to your neighbour(s), examine each other's purposes. Are they similar or different?

Together – come up with at least two different purposes. (3 min)

Why do teachers use visualizations in class?

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THINK: Write one purpose for using viz, including an example from your topic. (1 min)

PAIR: Turn to your neighbour(s), examine each other's purposes. Are they similar or different?
Together – come up with at least two different purposes. (3 min)

SHARE: Share a purpose from your group with all participants.

Why do teachers use visualizations in class?

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- Make invisible visible– atoms, cells …
- Ability to visualize – 3D, internals …
- Improved conceptual understanding

Learning goals

- Higher motivation, engagement

Imp goal but not always same as learning

- Easier / less boring than blackboard

Sometimes we have this goal

How do most instructors use visualizations in class?

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- Teacher will play/ show/ demonstrate visualization, along with narrative explanation

- Students will watch and ask for clarification if needed

Vote

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Does demo + explanation of visualizations improve learning?

1) Yes
2) No

Visualizations and learning: Evidence from research

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[Demo + explanation] alone not effective

Potential benefits of visualization is lost if students merely watch & hear

Active-learning strategy with visualization led to improved outcomes

Laakso, M. J., Myller, N., & Korhonen, A. (2009). Comparing learning performance of students using algorithm visualizations collaboratively on different engagement levels. Journal of Educational Technology & Society, 12(2), 267-282.

Banerjee, G., Murthy, S., & Iyer, S. (2015). Effect of active learning using program visualization in technology-constrained college classrooms. research and practice in technology Enhanced Learning, 10(1), 15.

Example – active learning with visualization

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A helium balloon is attached to a string tied to the bottom of a cart on wheels. The sides of the cart are encased in clear plastic. A person will abruptly push the cart to the left.

VOTE - Will the balloon move?

1) No it will stay in place
2) Yes, backward
3) Yes, forward

Summary – active learning with visualization

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Observe phase

TEACHER:

- Play viz upto the point the stimulus is shown.
- PAUSE before result. Don't show rest of viz yet.

STUDENTS:

Observe first part of viz

→

Predict phase

TEACHER:

- Ask students to make prediction: "What will happen if …"

STUDENTS:

- Make prediction – write / vote
- Discuss w each other

→

Check & explain phase

TEACHER:

- Shows rest of viz, which contains result

STUDENTS:

- Check their prediction by viewing the result in viz
- Explain reason and discrepancies if any

Program Visualization

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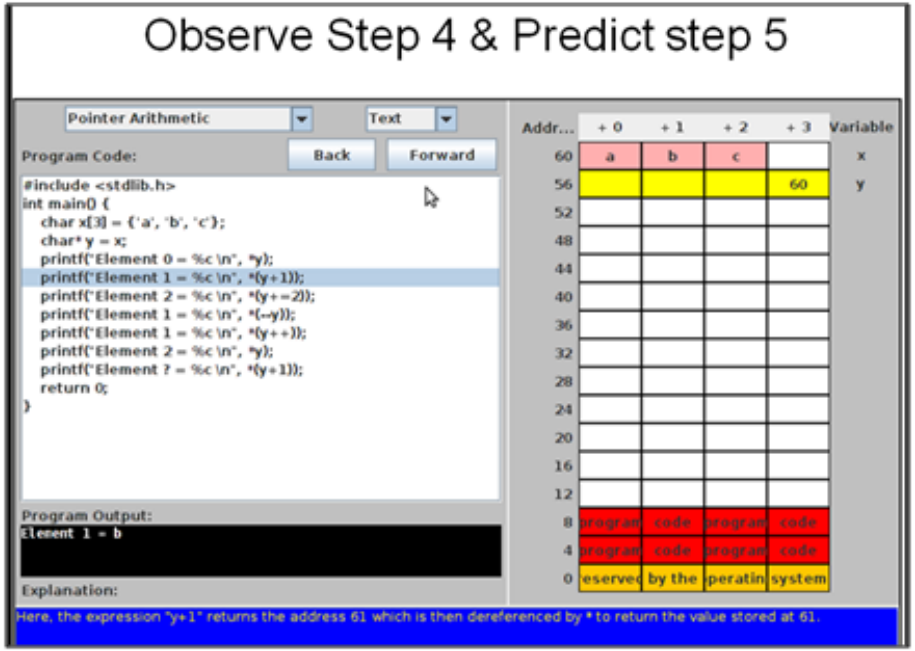
Predict output (or next step) of program



Program Visualization: Study

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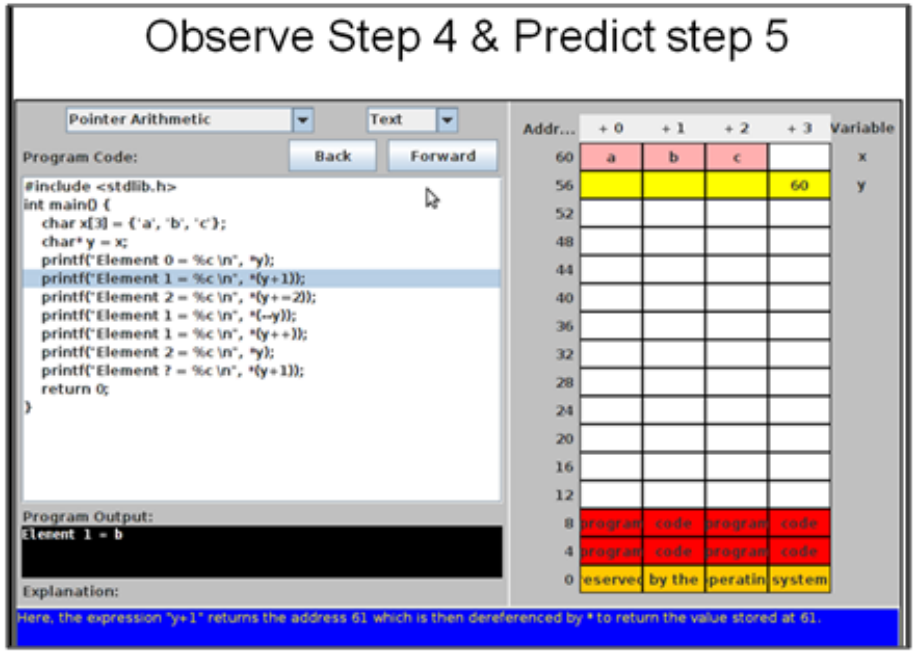
Controlled study, 2 groups:

- Viewing group (95 students)
- Prediction group (136 students)

Results:

For Prediction group

- Higher engagement in class
- Higher rate of problem-solving



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Takeaway

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Visualizations can lead to improved learning outcomes only if accompanied by active learning strategies.

Think & vote

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Is active learning the same as doing activity?

1) Yes
2) No

What is active learning?

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- Students go beyond listening, copying of notes, execution of prescribed procedures.
- Teacher designs activities that require students to express their thinking: discuss, draw, reason, solve, reflect.

USE STRATEGIES THAT HAVE BEEN:

- Explicitly based on theories of learning.
- Evaluated repeatedly through empirical research.

example: peer-instruction

Meltzer, D. E., & Thornton, R. K. (2012). Resource letter ALIP–1: active-learning instruction in physics. American Journal of Physics, 80(6), 478-496.

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Augmented Reality

What are our intended goals for using AR?

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- Visualize 3D objects
- Rotate and view
- Measure angles in along various orientations

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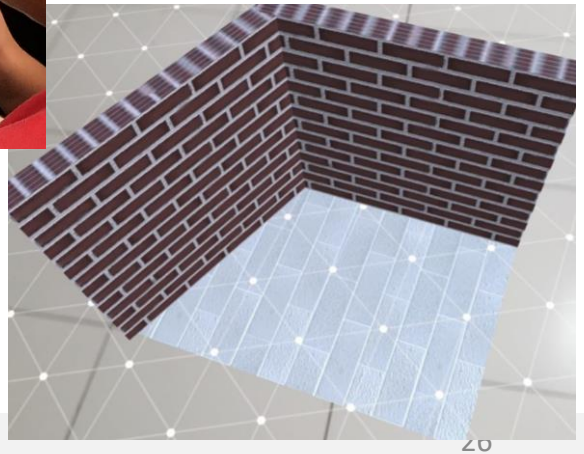

What does AR technology provide?

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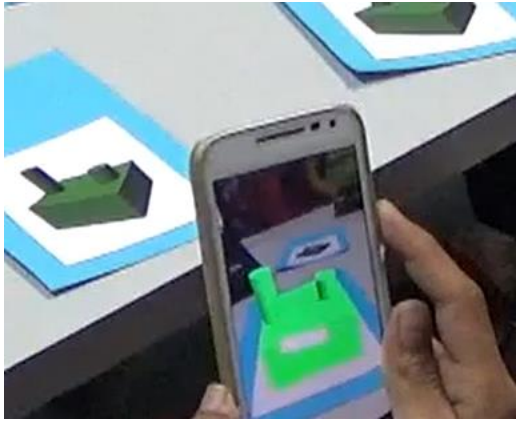
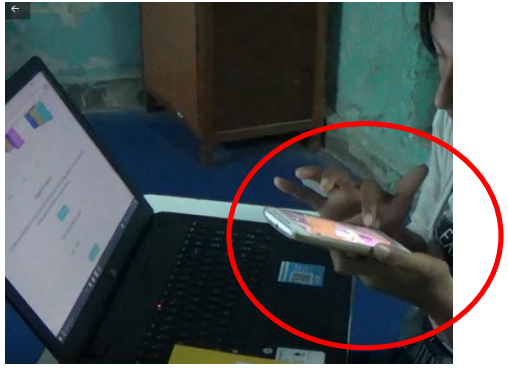
Affordances:

- Render 3D shapes
- Ability to rotate
- Ability to manipulate shapes

...





Active Learning with AR:

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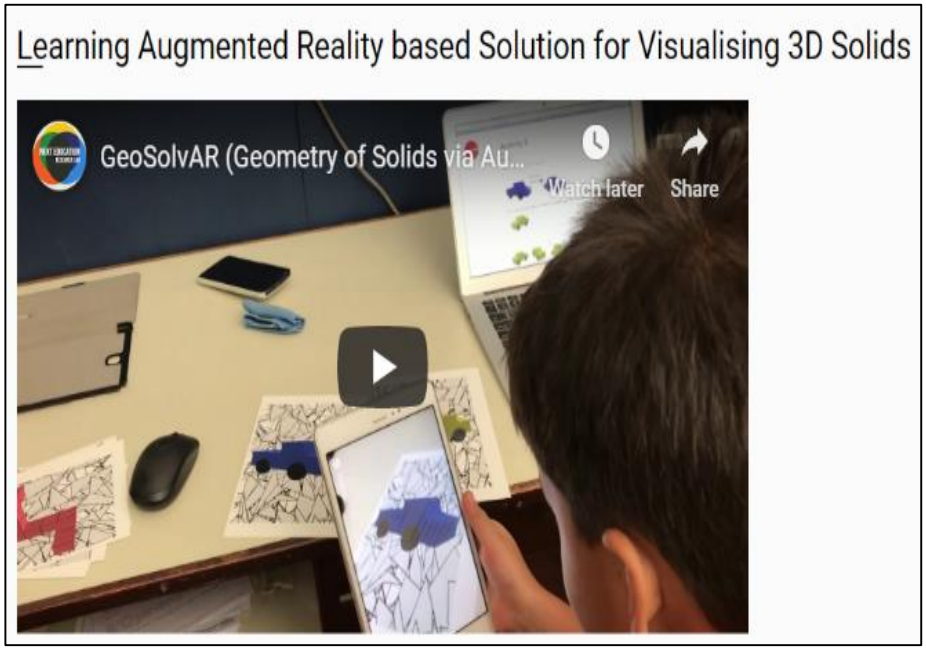
Recall from yesterday's demo : GeoSolvAR



Active Learning with AR:

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Basic Mantra : Do learner-centric activity using AR;
Do not leave their interaction with technology unguided

Active Learning with AR:

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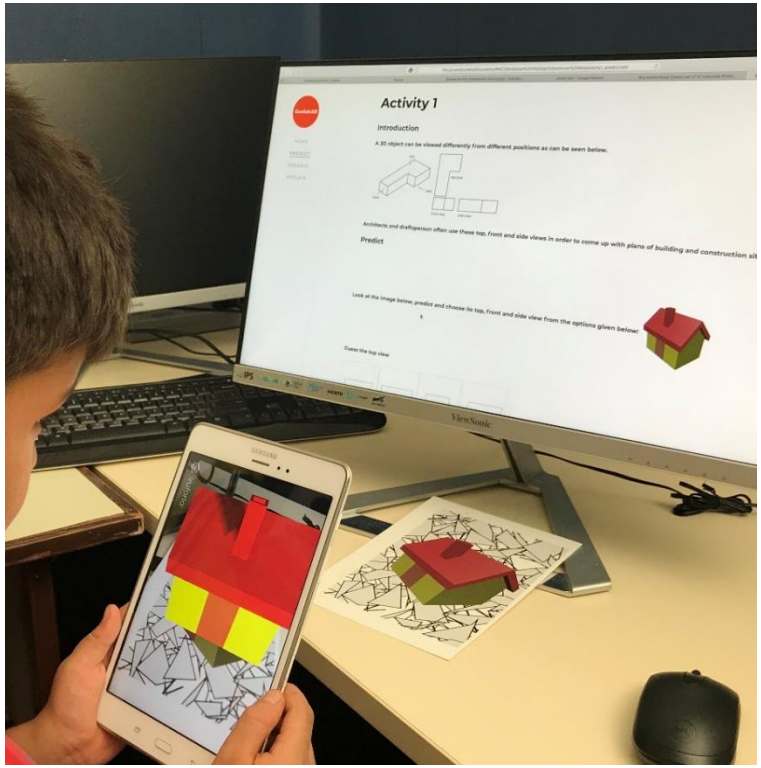
Recall from yesterday's demo:

Learning activity with GeoSolvAR

Predict-Observe-Explain strategy



Active Learning with AR:

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Basic Mantra : Do learner-centric activity using AR;
Do not leave their interaction with technology unguided

TEACHER:
Poses an activity question to predict output for given input parameters

→

STUDENT:
Makes the predictions. Uses AR to verify their predictions from observations made with AR
Example: Top, Side, Front view of given object

→

TEACHER + STUDENT:
Discusses explanation for their observations

Active Learning with AR:

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Basic Mantra : Do learner-centric activity using AR;
Do not leave their interaction with technology unguided

TEACHER:
Poses an activity question to take readings of specific parameters using AR

→

STUDENT:
Takes the readings using AR
Example:
count of V,E,F for given set of polyhedrons

→

TEACHER:
Poses follow up question on making sense of the readings from AR

→

STUDENT:
Compares the readings for emerging patterns & makes sense of them
Example:
Finds V+F = E+2 for polyhedrons (Euler's rule)

Active Learning with AR:

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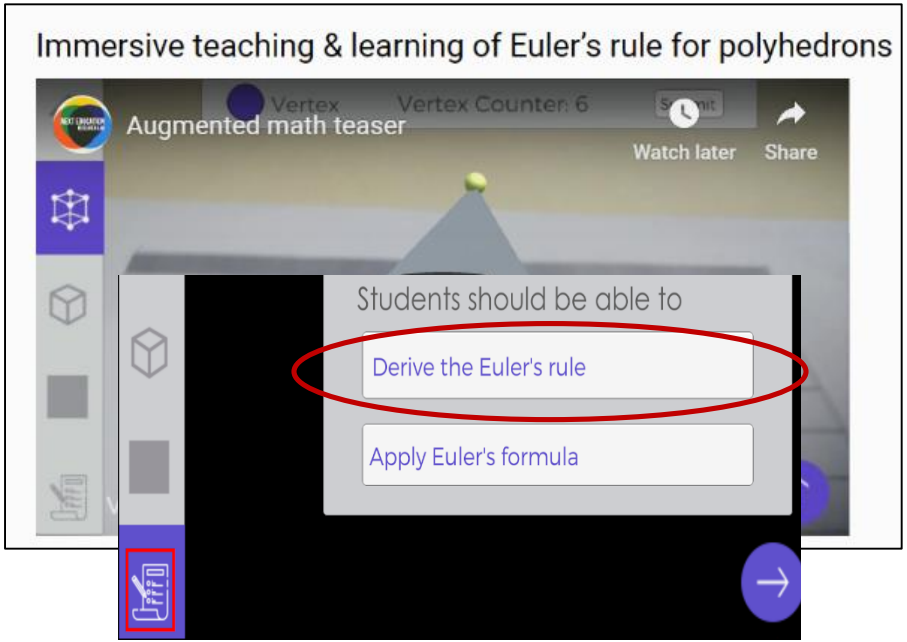
Recall from yesterday's demo :

Teaching-Learning activity with *Augmented Math*

Inquiry Learning strategy



Pilot Study

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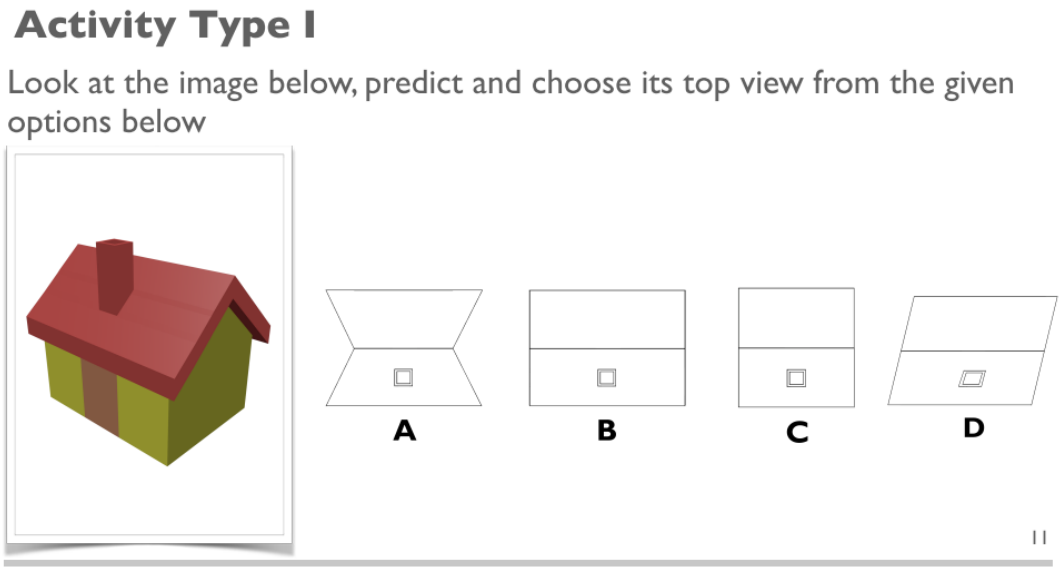
8 participants, 5 activities each

Audio and Video recordings, interviews, QUIS questionnaire, Pre-post test

Findings (usability):

- Perceived ease of use – high
- Students frequently used AR to rotate, while making prediction



Takeaway - Design principles

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Make sure design goal is clear:

Learning? Engagement? Efficiency? Accessibility? (there are all the same)

Create pedagogical activities to harness technology affordance

Create a learning activity with focus question, requiring the use of tech

Use active learning during implementation

Students do activity, get feedback while exploring technology

Evaluate if initial goal is achieved

Learning from Games

Vote – Math Blaster game

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Is this an instance of effective integration of technology?

1) Yes 2) No

Vote – Math Blaster game

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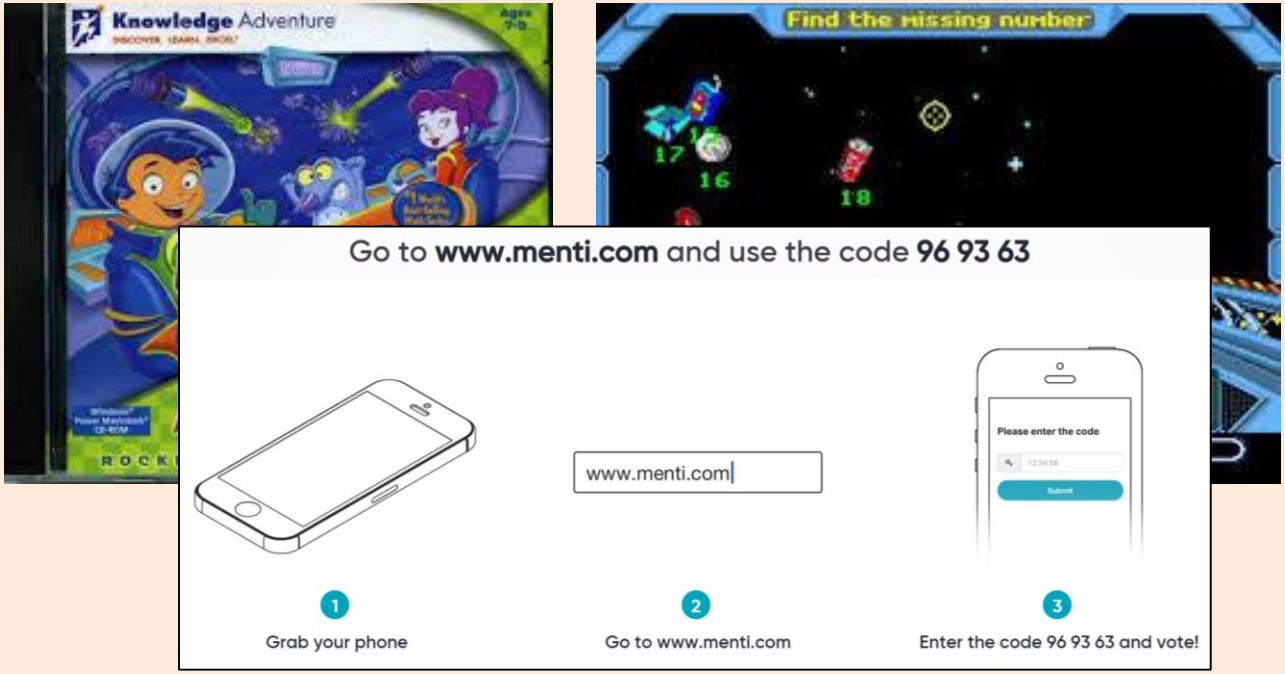

Vote – Blood Typing game

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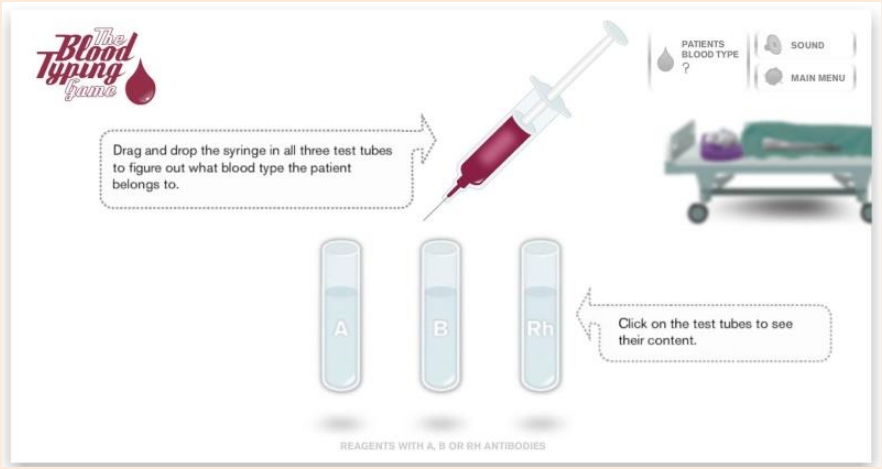

Is this an instance of effective integration of technology?

1) Yes 2) No

Analyzing computer games

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Games contain:

Activity
Context
Rules
Competition elements
levels, points

People like games because:

Responsive
Interactive
Engaging
Fun

What makes an educational game effective?

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Each one say one, based on your votes

Examine evidence: Engagement, Learning

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META-STUDIES: Review 300+ studies on games –

Engagement – HIGH; Learning - MIXED

"Some games provide effective instruction for some tasks some of the time, but these results may not be generalizable to other games"

"…need to balance motivational elements with learning processes"

Takeaway

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Align game goal to learning goal

Make learning essential to game success

Summary - How to effectively integrate tech for learning

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- What is the learning goal?
  - Avoid meaningless goals like “Teacher should use more of the new tech”
  - Avoid generic goals “Students should improve understanding”,
  - Be specific, for ex “students should determine blood type of patients”

- What is the affordance of the technology?
  - Determine what it *really* provides towards the above goal

- What should students do beyond watch, listen, push buttons?
  - vote, make predictions, draw concept maps, solve problem – using tech

Thank you

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