Emerging Technologies for Effective Teaching & Learning

Continuing Education Program for Next Education India Pvt Ltd
Conducted by Educational Technology, IIT Bombay
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Next Education™
Transforming Education

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Effective integration of technology

Sahana Murthy

Recall – Padlet activity yesterday

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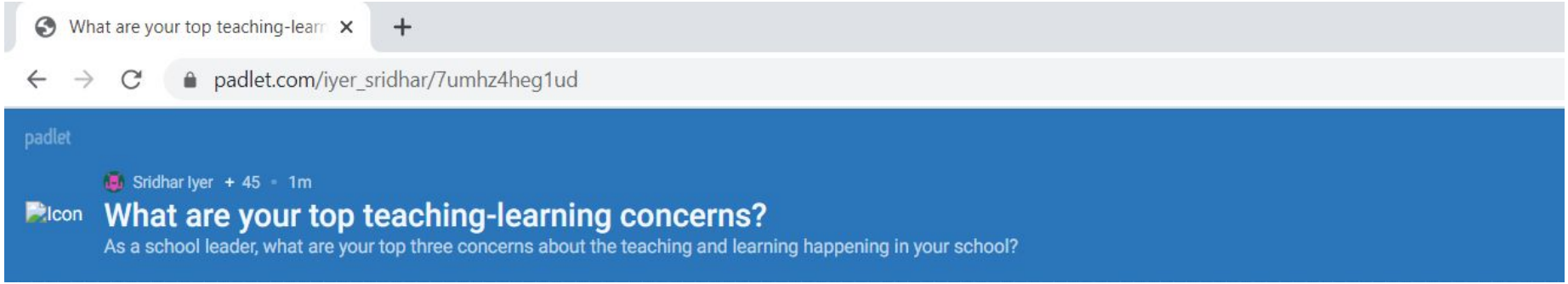

Smart learning technology

Use of technology for depth of analysis

Facilitate learning

Address needs of different children

Maintain interest in the subject

Connect Bloom's taxonomy higher levels learning objectives to ICT in class

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

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How to effectively integrate technology

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Answer already given yesterday!

How to effectively integrate technology

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Technology must be chosen so that it can support meaningful pedagogy.

Pedagogy must be designed so that it meaningfully exploits technology.

How to effectively integrate technology

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This session

Example 1: Digital visualizations

Digital visualizations commonly used

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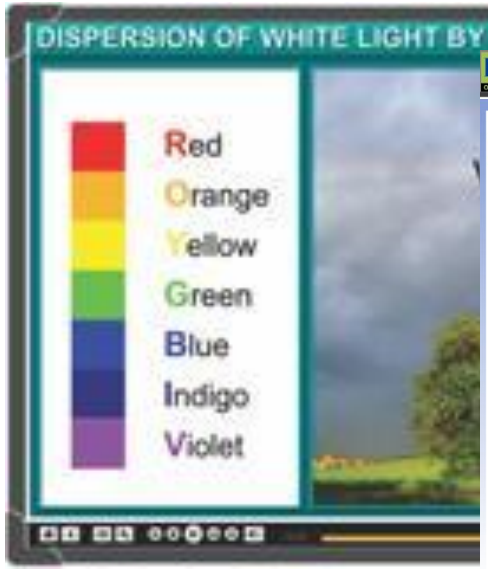
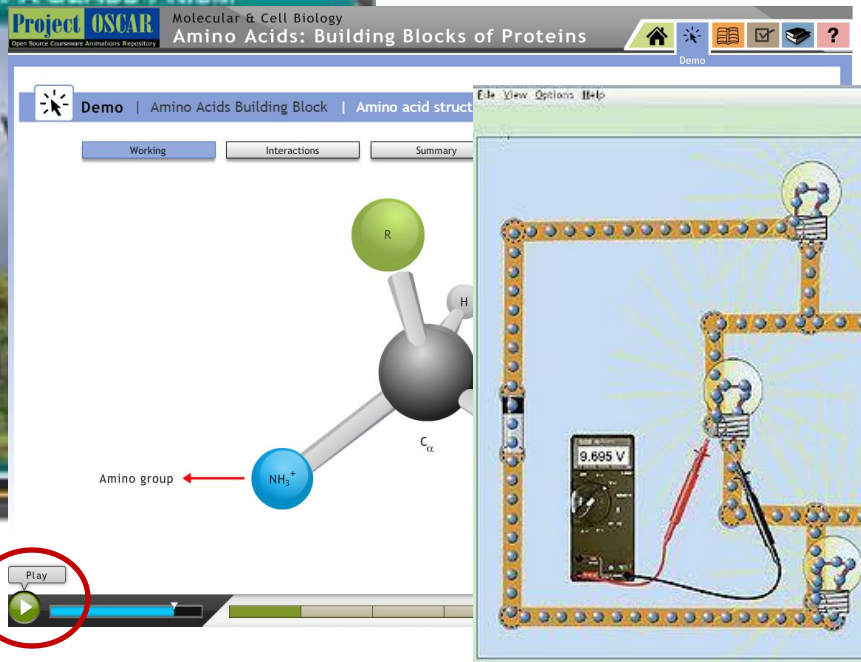
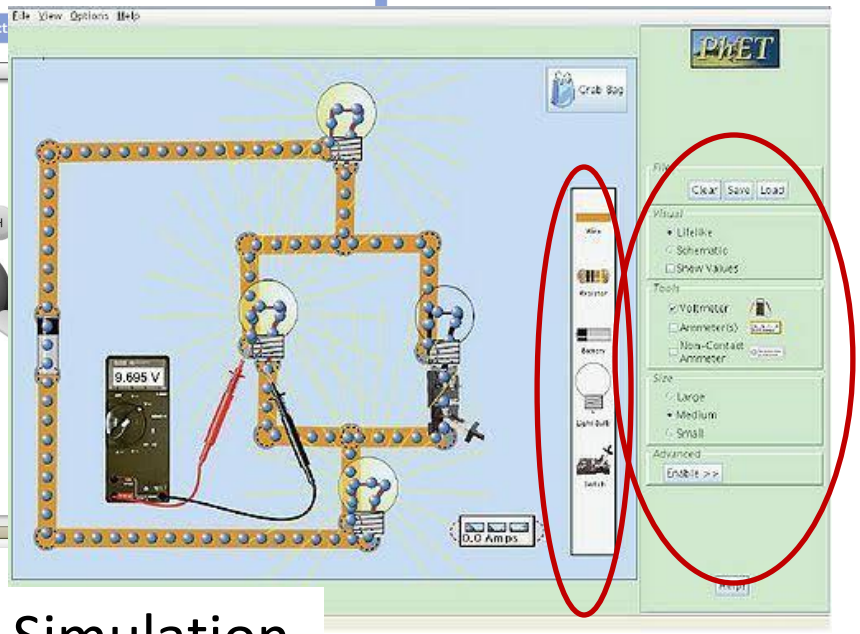


Video



Animation



Simulation

Digital visualizations commonly used

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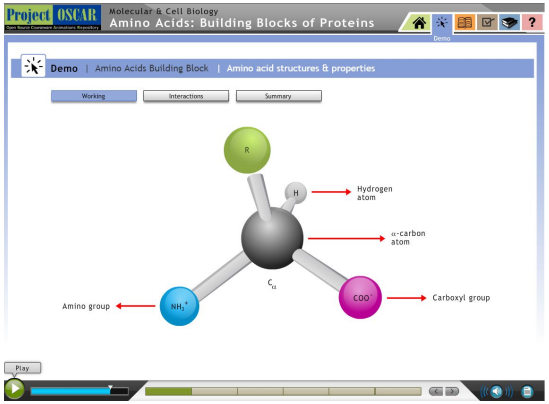

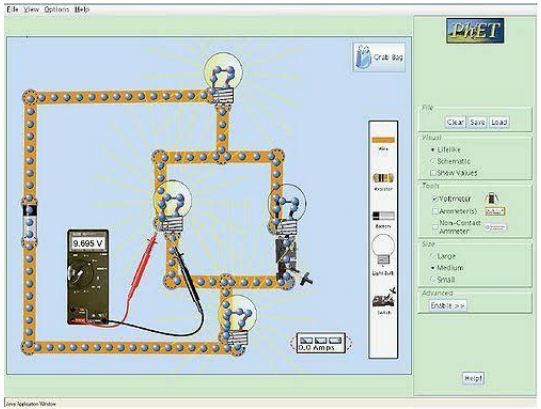

Stand-alone or part of digital classrooms, virtual classrooms

Many repositories

Shown to provide learning benefits

What is the purpose of using visualizations?

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What is the purpose of using visualizations?

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

Learning goals

- Motivation, engagement, interest

Imp goal but not always same as learning

- Easier / less boring than blackboard

Sometimes

How do most instructors use visualizations in class?

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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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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] by itself is not effective

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

Visualizations and learning: Evidence from research

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[Demo + explanation] by itself is not effective

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

Active-learning strategy with visualization led to improved outcomes

(Laasko et al 2009; Windschitl & Andre 1998, Banerjee, Murthy & Iyer 2015)

Discussion of voting question

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Does demo + explanation of visualizations improve learning?

1) Yes
2) No, not by itself

Need to incorporate active learning

How to do active learning with digital visualizations

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Observe

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.

Predict and vote

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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

Check and reflect

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Watch the video.

Did the balloon move?

1) No it stayed in place
2) Yes, it moved backward
3) Yes, it moved forward

Did you change your answer?

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

Evidence from research for active learning

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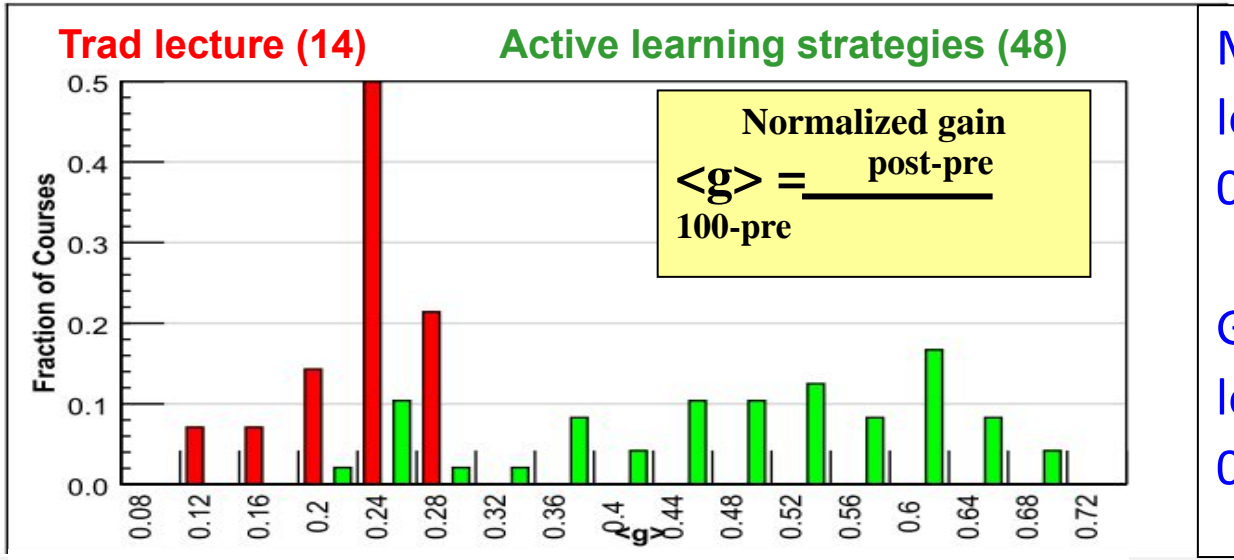
Comparative study of 62 Physics courses, 6542 students
School, high school, college
Pre-post test of conceptual reasoning – Force Concept Inventory



(Hake, 1998)

Max gain from lecture courses: 0.28

Gain from active learning courses: 0.23-0.7

Program visualization

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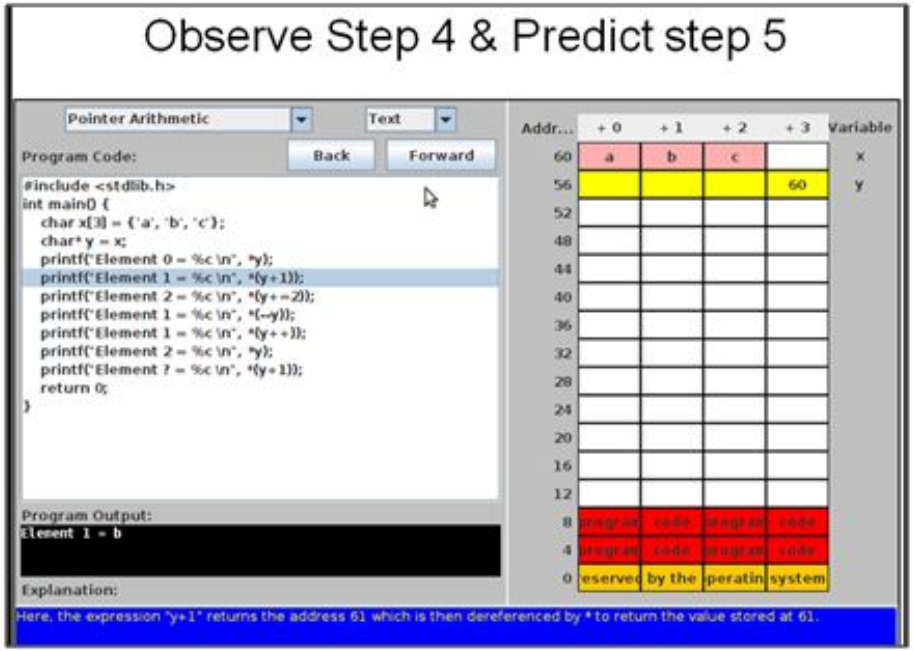
Predict output (or next step) of program



Study: Viewing vs Prediction

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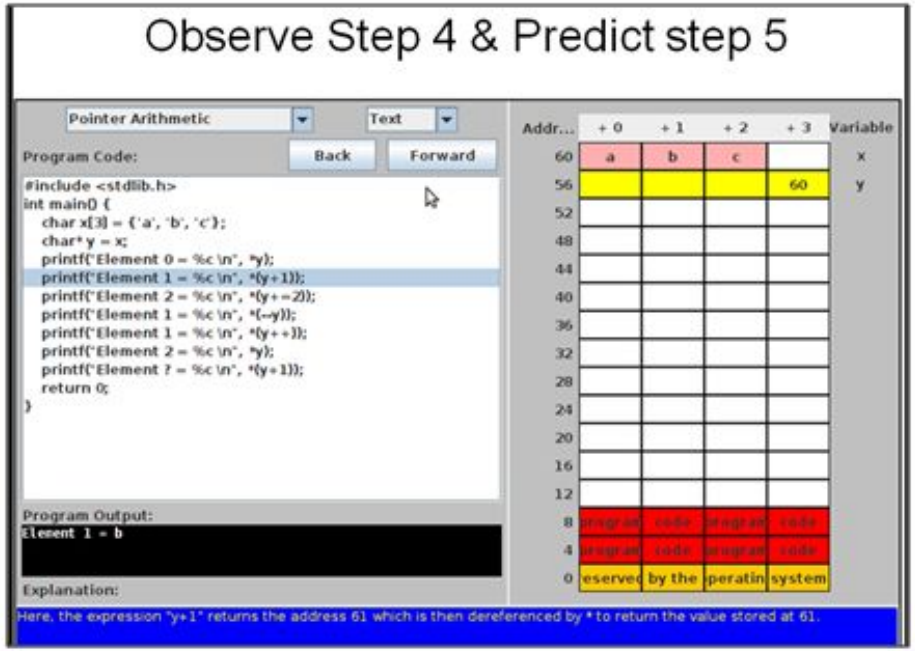
Controlled study, 2 groups:

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

Results:

For Prediction group

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



(Banerjee, Murthy & Iyer 2015)

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.

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USE STRATEGIES THAT HAVE BEEN:

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

example: peer-instruction

Example 2: 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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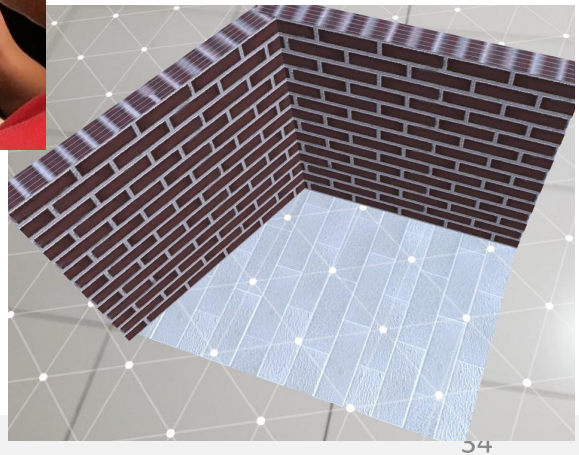

What does AR provide?

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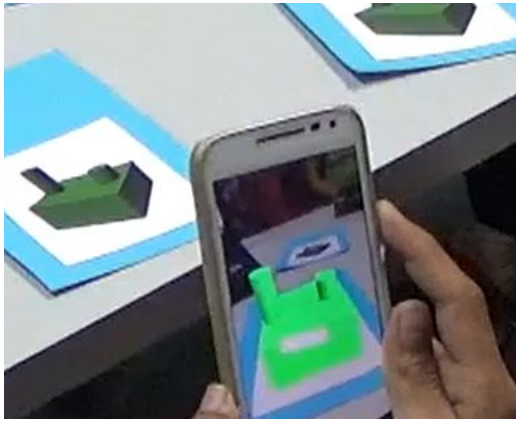
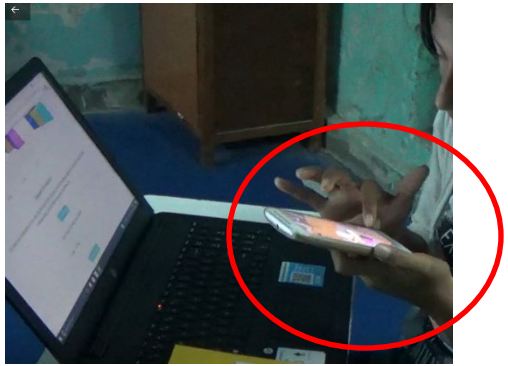
Affordances:

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

…





Active Learning with AR:

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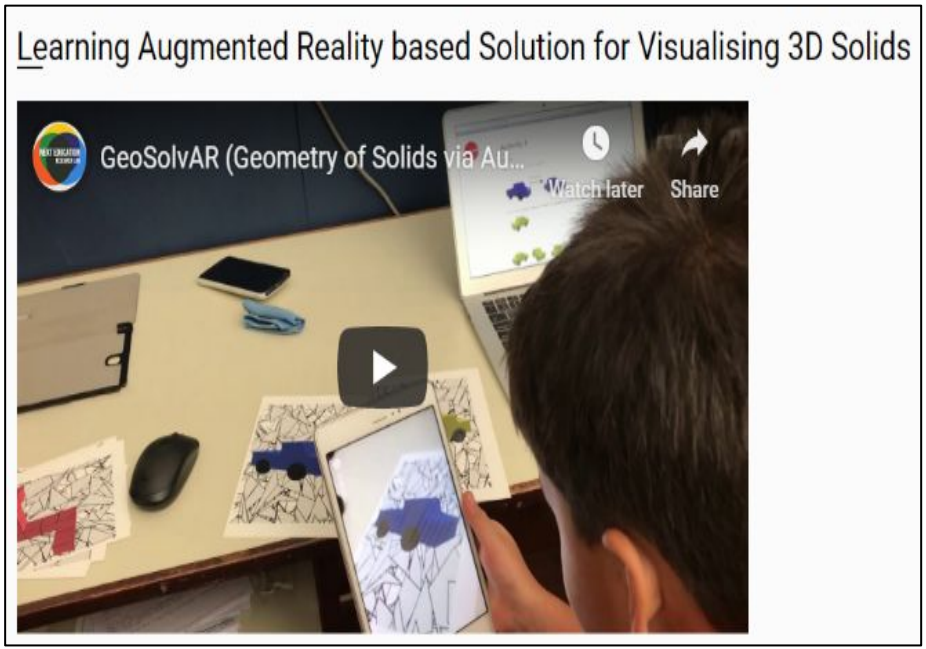
Recall from yesterday's demo : GeoSolvAR



Active Learning with AR:

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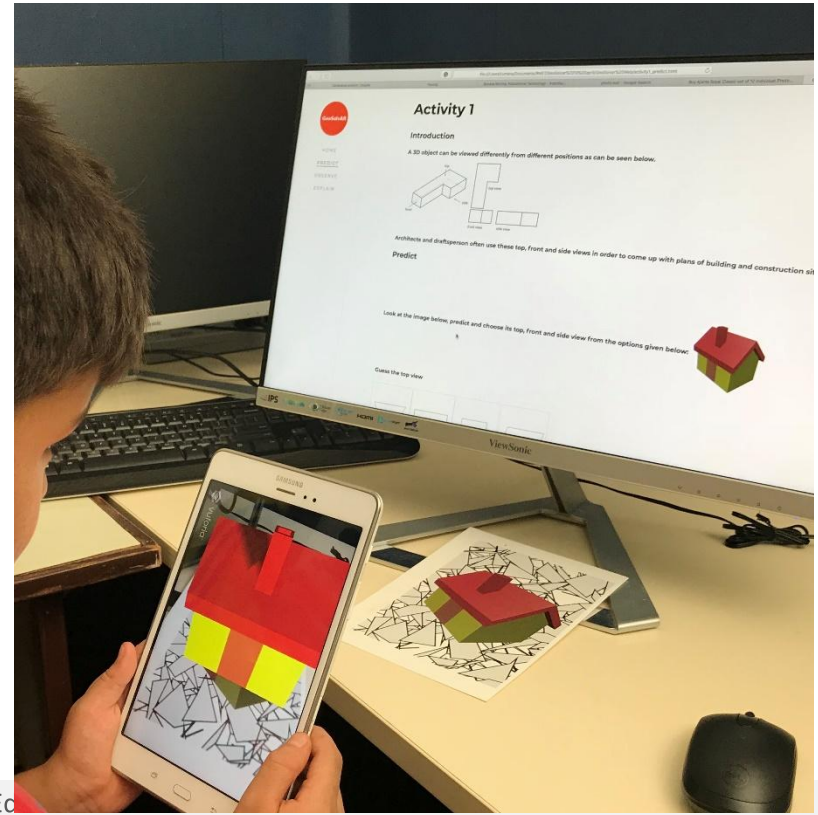
Recall from yesterday's demo

Learning activity with GeoSolvAR

Predict-Observe-Explain strategy



Active Learning with AR:

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Basic Mantra : Do active-learning + reflection

Do not leave their interaction with technology unguided

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

→

STUDENTS:
Make predictions.
Use AR to verify their predictions from observations
Example: Top, Side, Front view of object

→

TEACHER + STUDENTS:
Discussion of prediction & explanation, Reflect what went wrong

Pilot Study

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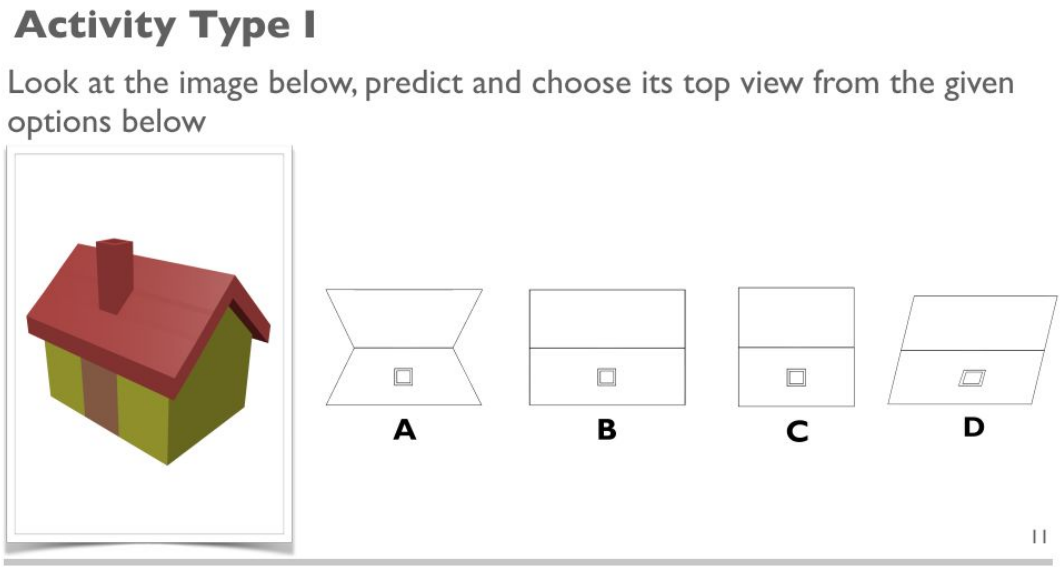
8 participants, 5 activities each

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



Principles to follow

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”,
- What is the affordance of the technology?
  - Determine what it *really* provides towards the chosen goals
- What should students do beyond watch, listen, push buttons?
  - vote, make predictions, draw concept maps, discuss with peers, reflect

Design principles

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Make sure design goal is clear:

Learning? Engagement? Efficiency? Accessibility? (not 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 and reflection during implementation

Students do activity, get feedback while exploring technology

Evaluate if initial goal is achieved

Tea Break

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Thank you

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