Augmented Reality in Education: Present Accomplishments, Future Visions

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Augmented Reality in Education: Present Accomplishments, Future Visions

Today’s Discussion:
- About Augmented Reality in Education
- Case Study: EcoMobile
- Case Study: School in the Park
- Case Study: STEAMing Ahead with Mobile Learning
- A Glimpse into the Future
- Your Turn: your questions, comments, ideas
Paper includes:

• Lessons learned from 7 K-12 mobile learning projects from around the globe
New paper examines:

- 8 Essentials for Mobile Learning within higher ed context
- Includes examples from 5 higher ed projects
Join the discussion

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www.FETC.org
About Augmented Reality in Education
Situated Learning and Transfer

Guided authentic experiences in and out school

- **Engagement and Identity**
  Students are motivated to do well, see the relevance of their learning, and increase in self-efficacy

- **Evocation and Transfer**
  Immersive interfaces can evoke a wide spectrum of authentic performances with embedded support

- **Evidence for Improvement and Assessment**
  Log files, chat logs, shared notebooks, and similar artifacts provide a rich evidentiary trail
“Deeper Learning”

- Case-based learning
- Apprenticeships
- Self-directed, life-wide learning
- Learning for transfer
- Interdisciplinary studies
- Collaborative learning
- Diagnostic assessments
Dede “Deeper Learning” (2014)

Deeper learning is an instructional strategy that can help students master skills for success in the 21st century. Technology is a powerful way of implementing effective deeper learning.
Next Generation Interfaces for “Immersive Learning”

- **Virtual Reality**
  Full sensory immersion via head-mounted displays or CAVEs

- **Multi-User Virtual Environments**
  Immersion in virtual contexts with digital artifacts and avatar-based identities

- **Mixed Reality**
  Combining real and virtual settings in various ways to blend physical and digital phenomena. One flavor is “augmented reality”
Continuum of Immersive Media

REAL ENVIRONMENT
Tangible User Interfaces (TUI)
A TUI uses real physical objects in the environment and interact with computer-generated information.

MIXED REALITY (MR)
Augmented Reality (AR)
AR adds computer-generated information to the real world.

Virtual Reality (VR)
VR refers to completely computer-generated environments.

VIRTUAL ENVIRONMENT
Augmented Virtuality (AV)
AV adds real information to a computer-generated environment.

Immersive VR
An immersive VR display fills the user’s field-of-view.

Using physical objects to create a virtual model. As a user adds a physical ‘butterfly’, the new virtual model is automatically updated.


See-through AR: the butterfly is computer-generated, and everything else is real.

Semi-immersive VR using the Banco Barco rear projection (Zeltik, Roussou, Tongos, Reche & Calvo, 2004).

Projection-based Immersive VR.
The users are fully immersed in the “ Cave” (FauxSpace, 2000, Duc-Neira, Sandor & DeFanti, 1995).
Case Study: EcoMobile
Augmenting Real World Ecosystems

http://ecomobile.gse.harvard.edu
What is Augmented Reality?

QR code-based Triggers

Location-based Triggers
Virtual Binoculars
GoPro Cameras Capture EcoMOBILE Experience
IN THE FUTURE YOUR MOBILE PHONE WILL ACT AS YOUR DIGITAL "6TH SENSE"

- **LEARN**
  What You Like

- **FILTERS**
  Out the Irrelevant

- **SENSES**
  Local Content and Services

- **DISCOVER**
  Things Relevant to You

- **KNOWS**
  You and What is Around You

- **INTERACT**
  With Networks

**Interface for Your Digital Life**

IN THE FUTURE YOUR MOBILE PHONE WILL ACT AS YOUR DIGITAL "6TH SENSE"
Case Study: School in the Park
Case Study: School in the Park

3rd, 4th and 5th graders from San Diego schools attend “school” 5-8 weeks a year, learning at 10 cultural institutions at Balboa Park
Case Study: School in the Park

Students used a smartphone and augmented reality environments to augment, extend and enhance learning at the San Diego Zoo, San Diego History Center, and Museum of Art.
Case Study: School in the Park

Project goals:

1. Provide meaningful way for students to develop inquiry skills as well as content knowledge

2. Help students develop technical skills using advanced tools that may not be available to them at home or in school

3. Take advantage of the unique assets of the Balboa Park institutions and to introduce the students to these resources in their backyard

4. Engage students in learning that creates opportunities for extended self-directed learning
Case Study: School in the Park
Case Study: School in the Park

Outcomes:

○ Development of 40 unique AR experiences that amplified the resources and assets of the museums and zoo for learning purposes

○ Increased content knowledge with especially strong gains for English language learners and students needing non-traditional learning experiences

○ Provided a concrete way to embed critical thinking skill development within curriculum

○ Helped to shift teacher mindset to understand value of student-focused, student self-directed learning experiences
Case Study: School in the Park

Outcomes:

“In the past, the teachers and museum educators took pictures of the students’ portfolios, printed out the pictures and assembled them for the students to bring home. This was heavily teacher-focused. Now, students are taking pictures on their devices, putting them into a digital slideshow, posting them on blogger, and having conversations about them online in one-third of the time the previous method took. This way is more student-oriented, where students, instead of their instructors are the digital content producers.”

SITP Teacher
Case Study: School in the Park

Lessons learned:

✓ Look around you! Partnerships and assets that can be leveraged with AR are all around you.

✓ Development of effective partnerships require skill, attention, extra communications and nurturing. Be patient with your partners!

✓ Think about the devices that will be used – are they appropriate for the planned usage?

✓ Evaluate impact from multiple perspectives – be open to surprises
Case Study:
STEAMing Ahead with Mobile Learning
Case Study: STEAMing Ahead with Mobile Learning

Innovative program taking advantage of a unique environment: a charter high school that is resident within the public library in San Diego.
Case Study: STEAMing Ahead with Mobile Learning

9th graders use a 4GL tablet with an AR app to learn about STEAM elements within the Central Library Dome design, engineering and construction.
Case Study: STEAMing Ahead with Mobile Learning

Project goals:

1. Provide a contextually relevant learning experience for students that can introduce students to the role of STEAM within construction and design
2. Leverage emerging technologies to increase student engagement in learning and in their unique school environment
3. Increase student interest in STEAM career fields
4. Pilot use of AR with students to test applicability within other curricular fields and with the general public
Case Study: STEAMing Ahead with Mobile Learning
Case Study: STEAMing Ahead with Mobile Learning
Outcomes:

- Students said use of AR content increased their engagement in learning.
- Benefits included having opportunity to work collaboratively with classmates on a real world activity; enjoyment level surprised the students!
- Different learning modalities within the experience appealed to different students: videos, images, text, assessment.
- 40% of the were more interested in a STEAM career field as a result of this learning experience.
- Teachers’ excited about how to use AR in other curricular areas; library staff exploring ways to bring same content to general public.
Case Study: STEAMing Ahead with Mobile Learning

Outcomes:

“This was a great experience. This could be the new way of learning for the next generation of students like me.”

“It was a different way of learning. I liked how the Augmented Reality showed how the dome of the library around us is history and we are a part of it.”

“The things that I learned about how the dome was built was interesting to me because now I am very interested in engineering.”

Collected from 9th grade students at e3 Civic High School
Case Study: STEAMing Ahead with Mobile Learning

Lessons learned:

☑ The connection between the AR content and the curriculum is important for teachers to use effectively, and adds relevancy to the learning process.

☑ Supporting tools within the app provided a variety of learning modalities that are important for engagement of all students.

☑ Stability of the Internet connectivity is essential – using the tablet’s 4G was better than relying upon school access points.

☑ Understanding how to interact with AR content is a new workplace skill that students need to learn.
Additional resources
Augmented Reality Case Studies: additional resources

Role of Technology in Deeper Learning:
http://www.studentsatthecenter.org/topics/role-digital-technologies-deeper-learning

EcoMOBILE Case Study:
http://ecolearn.gse.harvard.edu

School in the Park Case Study:
https://www.qualcomm.com/company/wireless-reach/projects/united-states-augmented-reality

STEAMing Ahead with Mobile Learning Case Study:
To be announced at FETC 2017
A Glimpse into the Future
Continuum of *Immersive Media*

**REAL ENVIRONMENT**
- Tangible User Interfaces (TUI): A TUI uses real physical objects to both perceive and interact with computer-generated information (Shih & Ullmer, 2001).

**MIXED REALITY (MR)**
- Augmented Reality (AR): AR overlays computer-generated information directly into a user’s environment (Bircher & Kaisar, 2005).
- See-through AR (either optical or video): A user wears a head-mounted display through which they can see the real world with computer-generated information superimposed on top (Cakmakli, Ha & Kottland, 2000; Bifflinghurs, Grasser & Looser, 2003).

**VIRTUAL ENVIRONMENT**
- Augmented Virtuality (AV): AV blends real information into a computer-generated environment (Rosenbroich, et al., 2004).

**Projection Augmented Reality (PAR) models**: (PAR model) are a type of spatial AR display and are closely related to TUIs. Spatial AR: Spatial AR displays project computer-generated information directly into a user’s environment.

**Semi-immersive VR**: A semi-immersive VR display fills a limited area of a user’s field-of-view.

**Immersive VR**: Immersive VR, which uses either a head-mounted display or a projection-based system, completely fills the user’s field-of-view.

Using physical objects to create a virtual model (chitsa, batl, & Kallman, 2004). As a user adds a physical “habitat” to the construction, the equivalent virtual model is automatically updated.

The ‘Bubba’ room – ‘Emerging Technology’ at SIGGRAPHOS. The paths of the smoke-filled bubbles are tracked and an image is projected into them as they rise.

See-through AR: The butterfly is computer-generated, and everything else is real if necessary. (Barz & Stabler, 2006; Kilscher, Barz, Höllener, & Tsch, 2004).

Semi-immersive VR using the Barco Barco workbench (Zettlka, Kousou, Tompao, Roche & Calo, 2004).

Projection-based immersive VR: The users are fully immersed in the “DAVE” (FakerSpace, 2003; Ducneira, Sander & Delafont, 1993).
Modern Manufacturing Helps Us Shape our World

http://formlabs.com/
Augmented Reality Lite

Uses both GPS and Compass

Layar Inc.
Google Glass
True Augmented Reality

Kaufmann 2006

Information Revealed

Satisfies the mind’s desire for “Closure”
Immersive Theater

http://speakeasydollhouse.com/
Museum Exhibits

Hughes 2004
Manipulating Imaginary Objects
Your Turn:
your questions, comments, ideas
Thank you for joining us today.

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