Tar AR: Bringing The Past To Life In Place-based Augmented Reality Science Learning

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Society for Text & Discourse 2020

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MOTIVATED CHANGE RESEARCH LAB

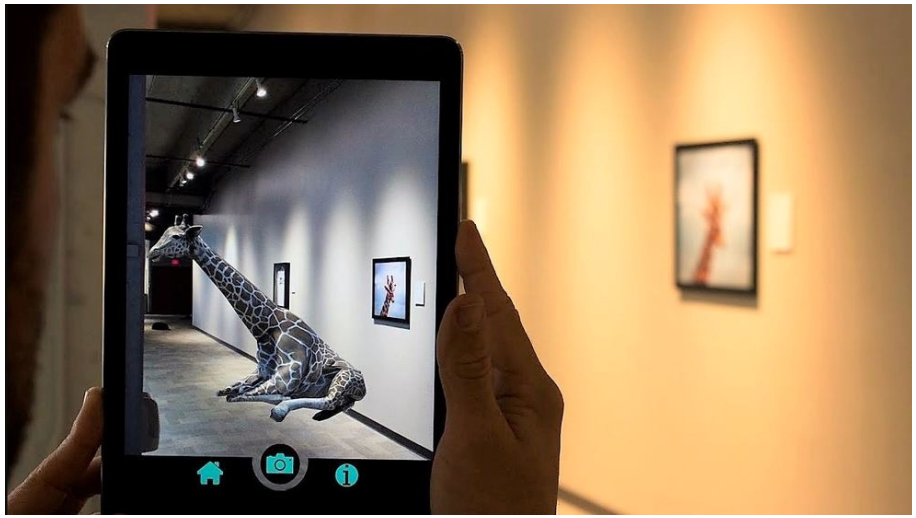
Augmented Reality (AR) in Education

AR: Immersive technology that overlays virtual objects onto the real world

- Can make hidden worlds visible
- Novel and personalized interactions with science can resolve scientific misconceptions (Dole & Sinatra, 1998; Yoon, Elinich, Wang, Steinmeier, & Tucker, 2012)
- Associated with learning gains in the classroom. (Chang, Hou, Pan, Sung, & Chang, 2015; Ferrer-Torregrosa, Torralba, Jimenez, García, & Barcia, 2015).

Augmented Reality (AR) in Education

- Informal learning institutions (e.g., museums) AR exhibits focus on the enhancement of visitor interest and engagement (e.g., Waite et al., 2005)
- AR in museum settings has been studies with students (e.g., Yoon, Anderson, Lin, & Elinich, 2017; Yoon et al., 2012)
- Less clear how adult learners experience shifts in learning and engagement within informal learning environments through AR.



Science Museum Oklahoma (SMO)

Research Questions

1. Does AR technology facilitate learning of science content?
2. Does AR technology facilitate interest/emotions in science distinguishable from interest/emotions in AR?
3. What surprised participants?
4. Did knowledge shift?

Gale testing out AR at La Brea During Data Collection

Methods

- Design Based Research
  - Design #1 pilot test
  - Design #2 usability test
- Pilot Participants:
  - Visitors to the La Brea Tar Pits and Museum
  - N = 62 adult visitors
  - 53% of participants were between the ages of 23 and 40 years
  - 77% had no prior experience with AR
  - 77% were first-time visitors to the La Brea Tar Pits
- Usability participants
  - Convenience sample of 40 Natural History museum employees

Photo of La Brea with Mammoth Models

Design #1 Pilot Methods

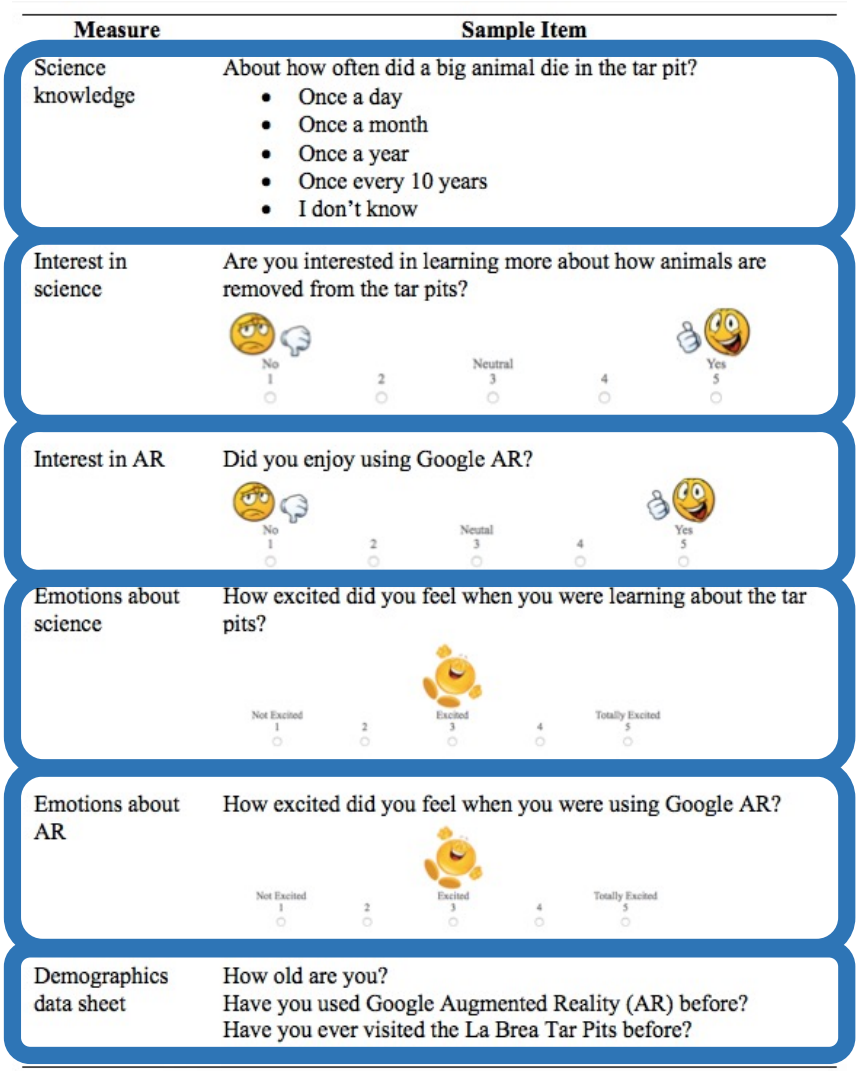
- Intervention:
  - 6-minute AR experience
  - Narrative about the entrapment process
  - 2 misconceptions addressed:
    - Only big animals entrapped in the tar pits
    - Large animals entrapped on a regular basis

AR of Mammoth Getting Stuck in Tar Pit

Methods

Measures

- Pre/post knowledge measure (6 items)
- Interest in science measure (6 items)
- Interest in AR measure (6 items)
- Emotions about science measure (7 items)
- Emotions about AR measure (7 items)
- Demographics (3 items)

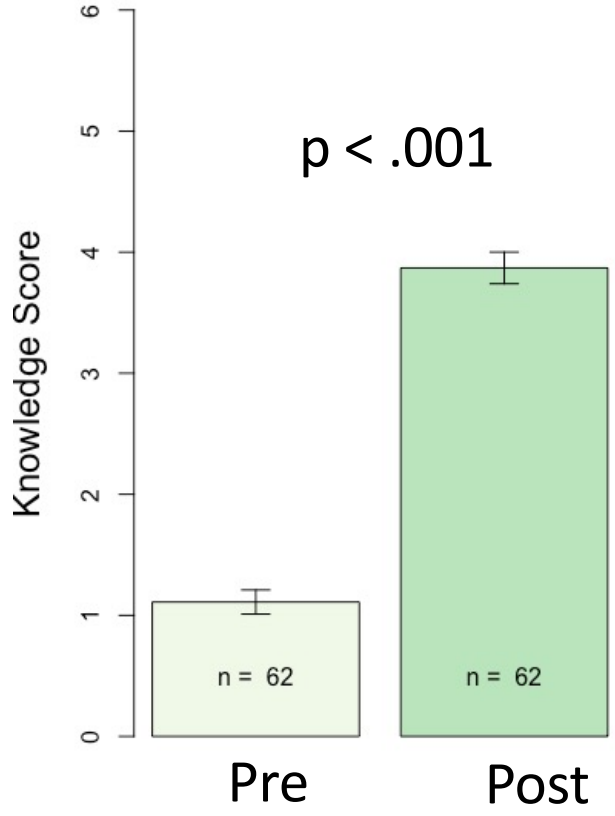


Measure	Sample Item
Science knowledge	About how often did a big animal die in the tar pit? • Once a day • Once a month • Once a year • Once every 10 years • I don't know
Interest in science	Are you interested in learning more about how animals are removed from the tar pits? No 1 2 Neutral 3 4 Yes 5
Interest in AR	Did you enjoy using Google AR? No 1 2 Neutral 3 4 Yes 5
Emotions about science	How excited did you feel when you were learning about the tar pits? Not Excited 1 2 Excited 3 4 Totally Excited 5
Emotions about AR	How excited did you feel when you were using Google AR? Not Excited 1 2 Excited 3 4 Totally Excited 5
Demographics data sheet	How old are you? Have you used Google Augmented Reality (AR) before? Have you ever visited the La Brea Tar Pits before?

Sample Interest, Emotion, and Demographic Items

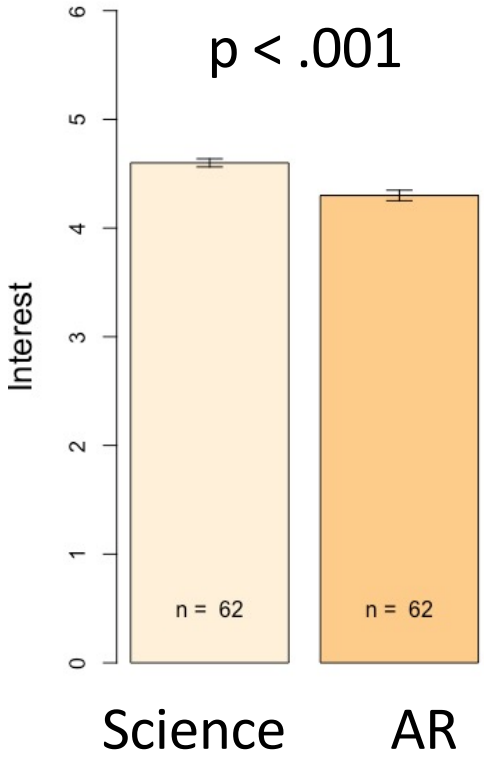
Results From Design #1

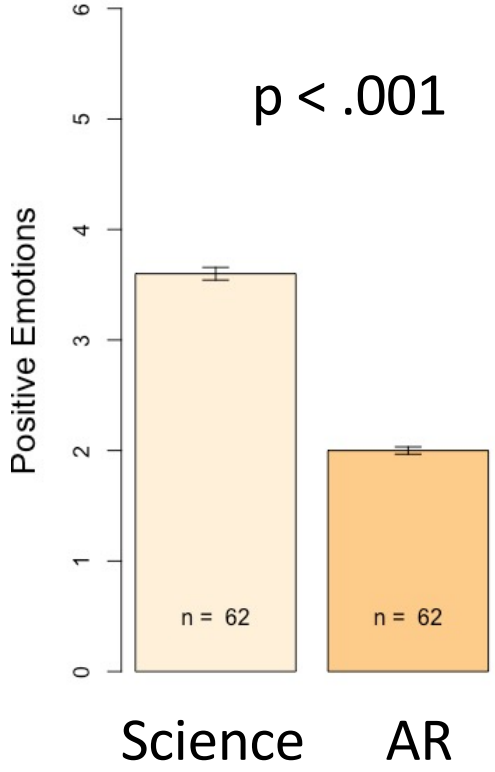
RQ1: Does AR technology facilitate learning of science content?



Results From Design #1

RQ2: Does AR technology facilitate interest/emotions in science distinguishable from that in AR?





Results From Design #1

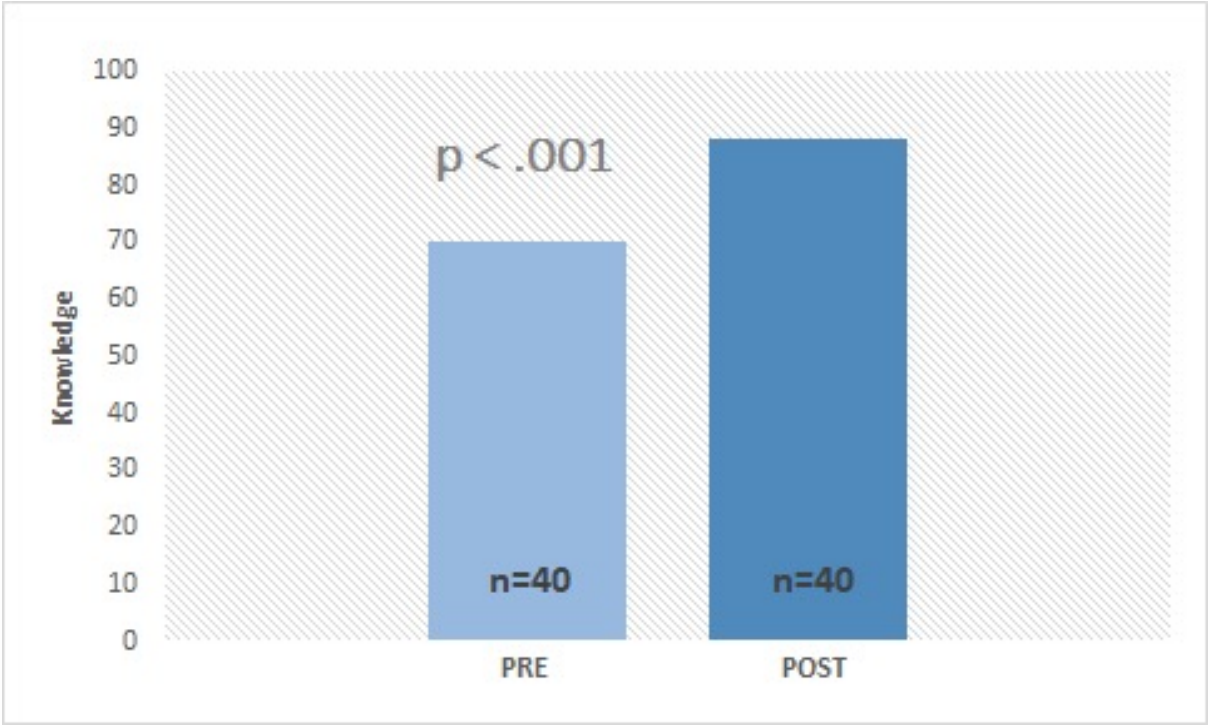
RQ3: What is the role of emotion and interest in shifting scientific misconceptions specific to the experience of AR at the La Brea Tar Pit and Museum?

	Knowledge Post-Intervention		
Positive emotions toward science	.22	.11	.11
Positive emotions toward AR	-.18	-.27	-.29
Knowledge pre-intervention	.11	.10	.10
Interest in science		**.31***	.28
Interest in AR			.07
R-Squared	.041	.104	.106

Positive emotions toward AR and science were not predictive of knowledge.
Interest in science was a positive predictor of knowledge, but not after adjusting for interest in AR.

Results From Design #2

RQ1: Does AR technology facilitate learning of science content?



Results From Design #2

Qualitative
N=35

First round of *in vivo* and open coding resulted in five initial codes.

Second round of pattern coding resulted in two broader themes:

(a) surprise facilitated hypothesis revision

> *I guess I expected it to have a look and feel more like a stereotypical ice age, but the fact that it was a lot wetter and had trees and fish was kind of a little surprising for me. I'm not a history buff. I should have known that going in.*

(b) Experience enriched understanding of fossil evidence

> *I think the idea that I started to learn more about how a fossil, discovering a fossil can influence my understanding of the environment. So I found out that, Oh, there's a fish, okay. So in the environment may not be so icy as I thought it was. There might've been some flowing water present. So I was able to reevaluate my hypothesis and choose something else that was more maybe more accurate to that time.*

DISCUSSION/IMPLICATIONS

- AR that increased scientific knowledge
- Promoted interest and positive emotions for science content compared to AR technology
- Interest in science positively associated with final knowledge scores

Students use the Perceptoscope AR viewfinder to watch Ice Age animals walk around La Brea Tar Pits. Photo credit: © La Brea Tar Pits

Next Steps: Full Scale Randomized Control Trial (RCT)

	Low interactivity	High interactivity
Handheld		
Headset		

Control/Baseline:
Standard non digital display

Pit 91 Experience

Participants see a (virtual) bubbling pit of asphalt underneath the plywood platform.

Participants “discover” fossils in the tar and send them to a lab to be identified.

Fossils help them to understand the ice environment of LA.

Questions? Contact me at gsinatra@usc.edu