Tar AR: Using AR to Enhance Science Enjoyment and Informal Science Learning

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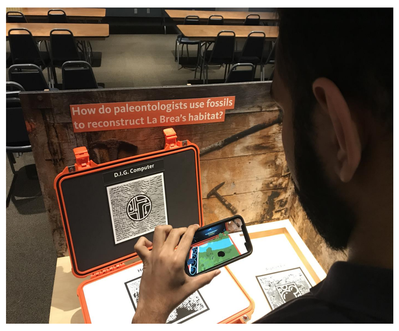
Background & Theoretical Framework

Science museums aim to engage a large, diverse public audience in science learning (Macdonald, 1997) and consequently, attempt to present information in entertaining, socially-oriented, and innovative ways. Recent work using augmented reality (AR), defined as technology that overlays virtual objects on to the real-world (Azuma, et al., 2001), engages the public using content that is both situated in the context of the exhibit and virtually generated in a way that allows hidden worlds to become visible (]Wu et al., 2013). However, little is known about how AR technology can facilitate museum visitors' science learning.

The Tar AR project, a sustained collaborative partnership funded by NSF AISL with La Brea Tar Pits/Natural History Museum of Los Angeles (NHMLA) and a local university, explores how an AR experience can (a) promote visitor enjoyment, (b) increase understanding of scientific topics, and (c) promote user's feelings of ease with AR technology.



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Research Questions Usability #1

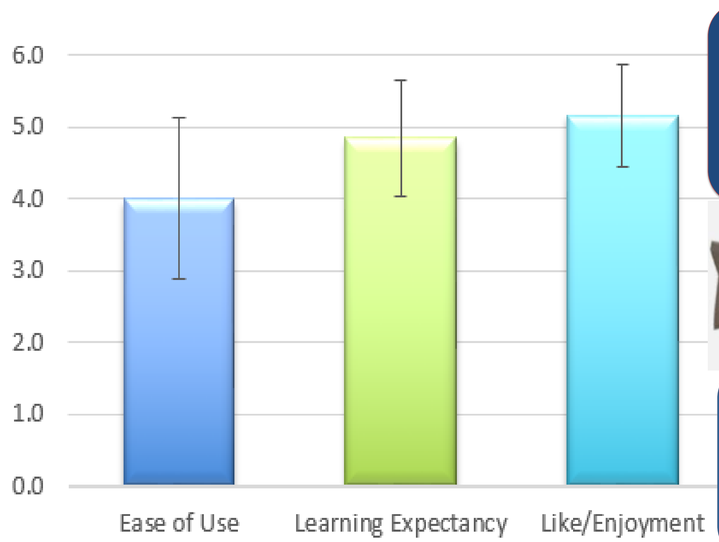
1. **Does AR technology promote visitor enjoyment of an exhibit?**
2. **Does AR technology promote visitor learning of science content?**
3. **Do visitors find AR technology easy to use?**

Methods Usability #1

Participants:
- Convenience sample n = 28 adults

Procedures:
- Participated in 10-minute AR experience which immersed participants in the Ice Age and required them to formulate hypotheses.
- Post survey where participants rate their agreement on a six-point Likert scale (1=Completely Disagree, 6=Completely Agree) with:
  - Enjoyment with statements like, *"I liked the experience"*
  - Ease of use with statements like, *"The experience was clear and easy to understand"*
  - Learning expectancy with statements like, *"The experience will help me learn better"*

Findings Usability #1



Research Questions Usability #2

1. **Does AR technology facilitate a shift in visitors knowledge about the science happening at the La Brea tar pits?**
2. **What surprised visitors after participating in the AR exhibit?**

Methods Usability #2

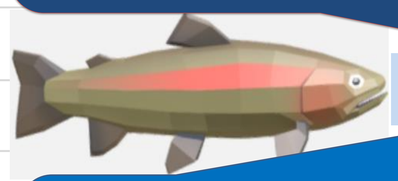
Participants:
- Convenience sample n = 40 adults

Procedures:
- Participated in 10-minute AR experience which immersed participants in the Ice Age and required them to formulate hypotheses.
- Participated in a 10-item pre and post knowledge survey
- Participated in a semi-structured interview pre and post experience and asked questions like:
  - What do you think the environment of Los Angeles looked like during the Ice Age?
  - "How might a scientific explanation change based on new evidence?

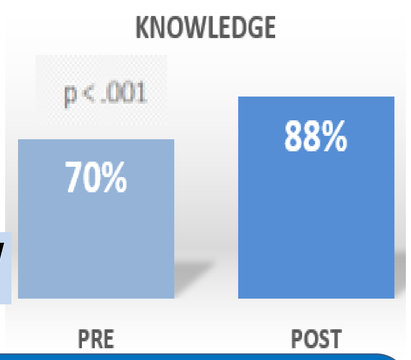
Findings Usability #2

Surprise prompted 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.



INTERVIEW THEMES



Enriched understanding of fossil evidence

I think 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.

Summary

In the first design iteration (n = 28) participants reported:
- frustrations and mildly positive ease of use (M= 4.0, SD = 1.1)
- positive perception of their ability to learn using AR (M= 4.8, SD= 0.8)
- positive emotions while using the technology (M= 5.2, SD=0.7)

In the second iteration (n=40):
- t-test pre- and post knowledge scores (ranging from 0-100) revealed significant learning gains PRE (M= 70, SD=25.9) to POST (M=88, SD=12.1, t(39)= 5.5, p < .001).

Interview data was transcribed and an initial round of open and axial coding found broader themes about participant learning: (a) surprise as an initiator for hypothesis revision, and (b) deepening understanding of fossil evidence (Saldaña, 2013). In general, current results indicate AR technology is a promising tool to help learners interact with content that dates back thousands of years and overcome their scientific misconceptions. Furthermore, incorporating AR technology into museum exhibits can update them with 21st learning tools to support visitor enjoyment in the learning experience.