Augmented Learning in Human-Computer Interaction

Learning through multimodal approaches

Creating Unique Technology for Everyone

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KEIO-NUS Connective Ubiquitous Technology for Embodiments (CUTE) Center

Keio University

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Vision

- Engage millions of children and families in new forms of creative family connectivity
- Breakthroughs in multi-sensory networked communication technology
- Inventing creative ways of engaging multi-sensory communications

Keio-NUS CUTE Center

Organisation of CUTE Projects

EXPERIENCE MEDIA
Multi-sensory connection technology to engage millions of people for playful, creative and affective interactive dialogue

New Frontiers (Blue Sky)

Enrichment through Travel & Wellness

Continuing Research

Tangible Interaction
- Catapy
- Ninja Track
- Digital Taste
- Travel Teller
- Smart Mailbox

Augmented Learning
- Jackson Plan
- Cerita Singapura
- MicroAR
- EMuseum
- Smart Sail

Embodied Experience
- Midas
- LORDS
- Easy Tagging
- Crowd Trail / Scribe
- FlexIO

To Market

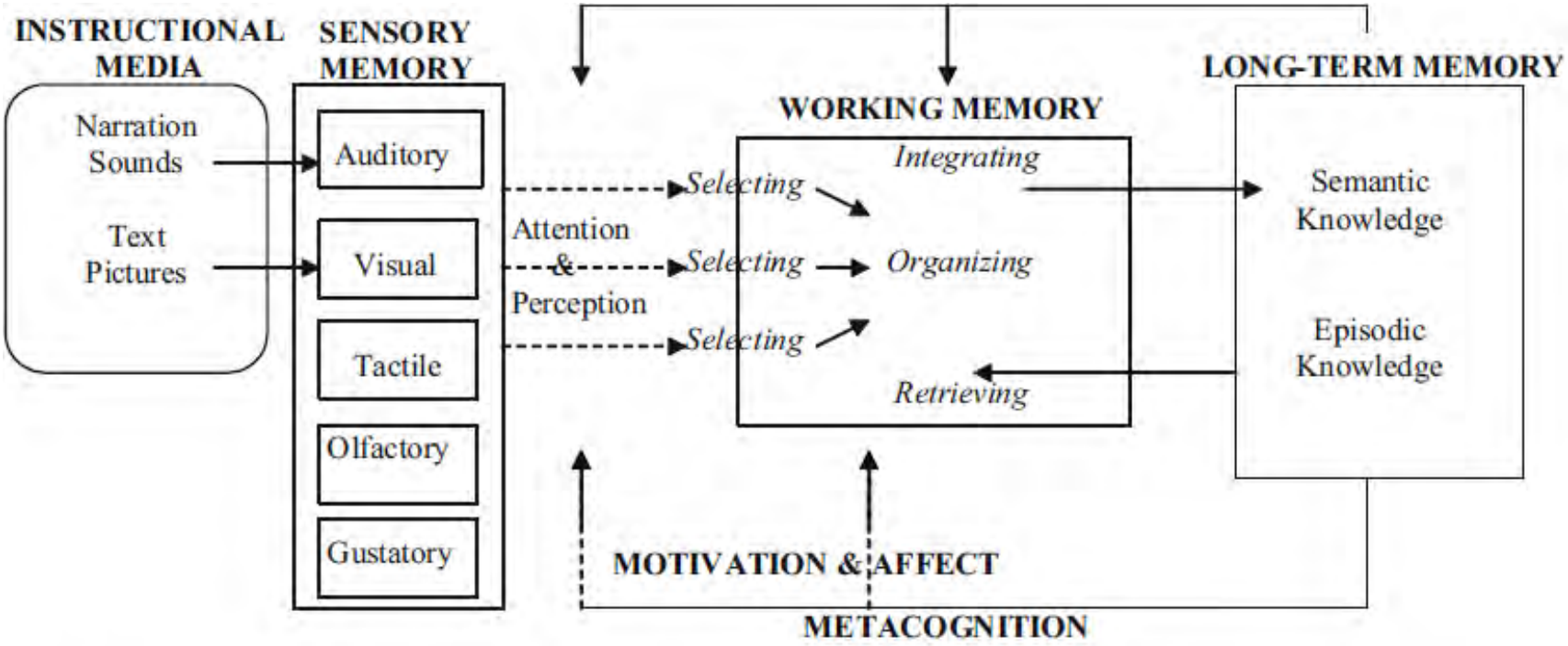
Digital Taste
T. Ware

learning

augmented learning

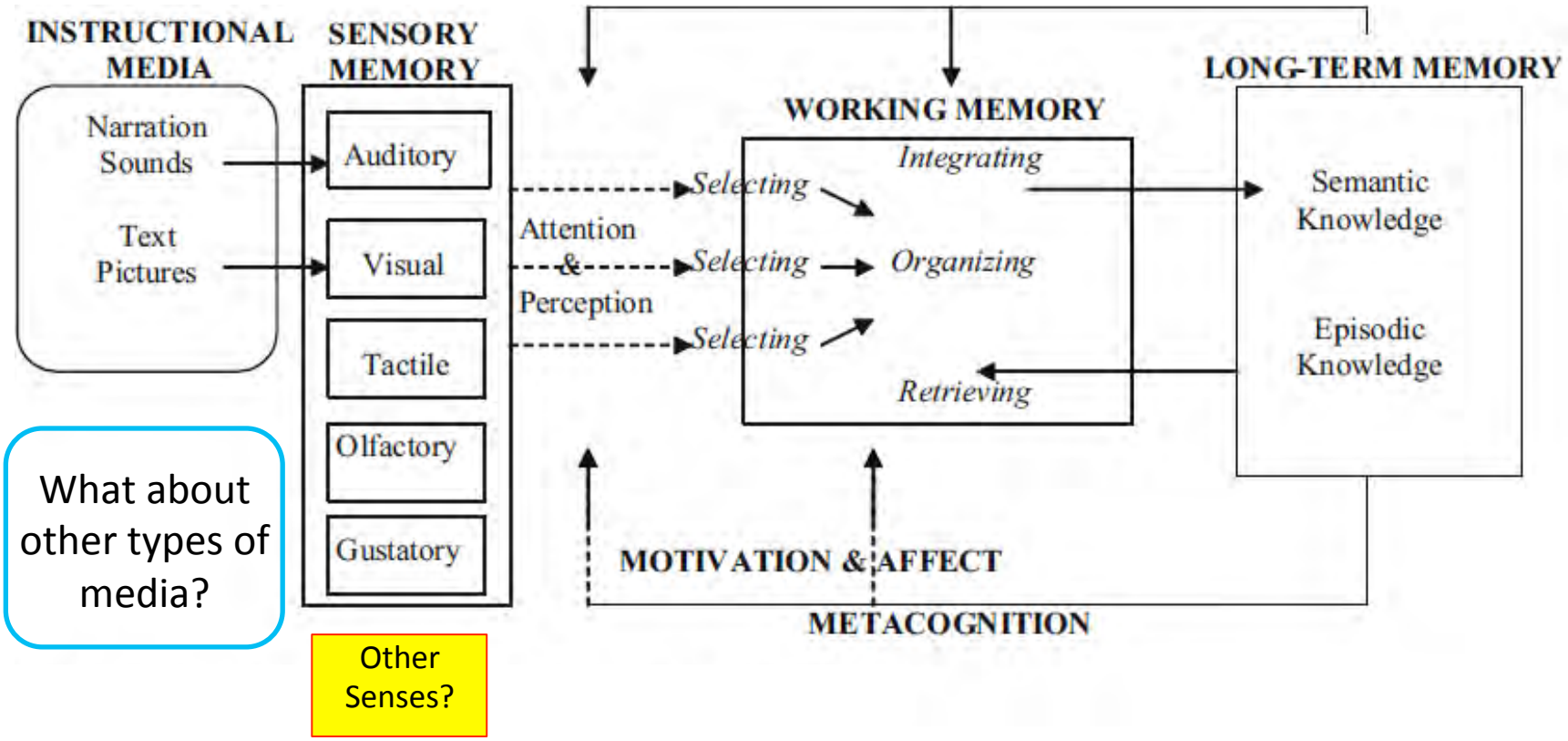
learning
education
Learning
music
five
physical
computer
sensors
exists
kinesthetic
hands
gain
work
objects
theories
Theory
awareness
method
gold
range
take
facilitate
childhood
studying
multimodal
medical
CUTE
beyond
domain
interfaces
particularly
describing
interactions
However
potential
human
preliminary
considered
encourages
manipulation
known
anatomical
examples
Augmented
still
mediated
system
reasoning
foster
HCI
gustatory
auditory
advantage
handling
topics
augmented
environments
Group
conceptual
talk
training
experience
properties
cadeveric
Kinesthetic
many
different
allowing
olfactory
human-computer
example
takes
useful
tactile
facilitated
structures
focuses
wide
processes
showcases
Similarly
Cognitive
Eurhythmics
Center's
visual
CATLM
dissection
traditional
Affective
early
place
standard
Hence
student
Media
future
vision

Cognitive – Affective Theory of Learning with Media



Moreno, R. and Mayer, R. (2007). Interactive Multimodal Learning. *Educational Psychology Review*, *19* (3), 309–326. doi: 10.1007/s10648-007-9047-2

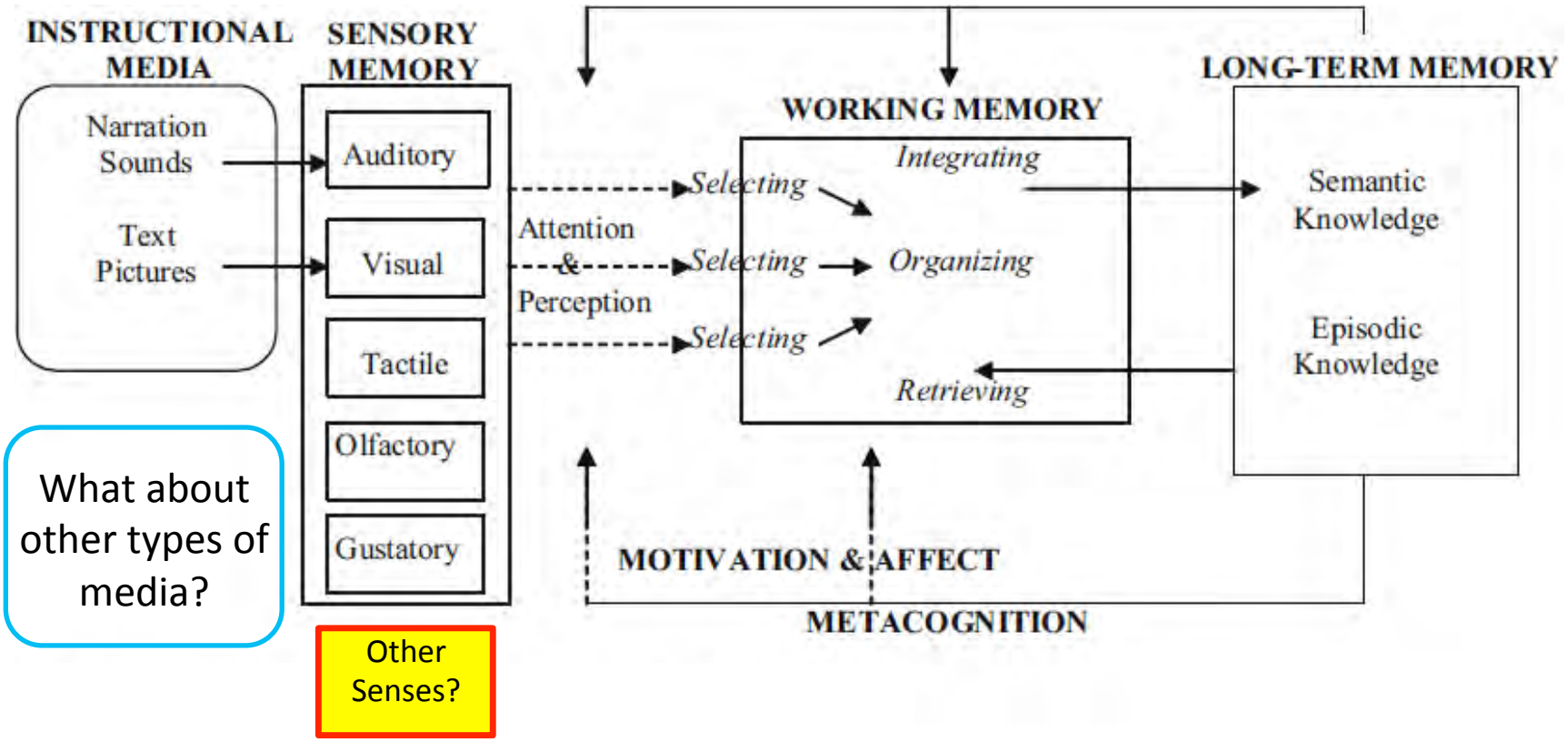
Cognitive – Affective Theory of Learning with Media



What about other types of media?

Other Senses?

Cognitive – Affective Theory of Learning with Media



We propose A-CATLM

(**Augmented Cognitive Affective Theory of Learning with Media**)

Senses

Traditional
5 senses

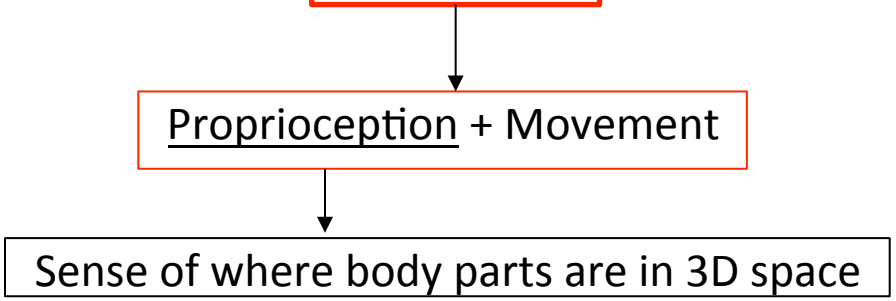
Visual | Auditory

Dual-coding principle

Tactile | Olfactory | Gustatory

Other Senses

Kinesthetic | Vestibular | Temperature | Pain | … | ?



Kinesthesia = Proprioception + Sense of Movement

Sense of Limb position, Encyclopedia of Clinical Neuro Psychology

Learning: The ability of an individual to commit information to memory [**retention**] and to use that information to solve new problems [**transfer**]

Moreno, R. and Mayer, R. (2007). Interactive Multimodal Learning. *Educational Psychology Review*, *19* (3), 309–326. doi: 10.1007/s10648-007-9047-2

Kinesthetic Learning:

The use of bodily movement to form conceptual associations and relationships for the sake of learning

Plummer, J. D. (2009). Early elementary students' development of astronomy concepts in the planetarium. *Journal of Research in Science Teaching*, *46*(2), 192–209. doi:10.1002/tea.20280

Kinesthetic Learning

Proprioception + Movement

Sense of where body parts are in 3D space

Retention

Transfer

Kinesthetic Learning
in Augmented Learning environments

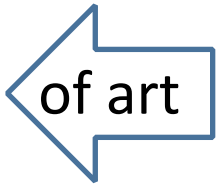
- What may interfere with kinesthetic learning?
- Does kinesthetic learning work for learning of Anatomy?
- How can kinesthetic learning enhance the learning of sensor programming?

Effects of Mobile AR-Enabled Interactions on Retention and Transfer for Learning in Art Museum Contexts

AR-muse: Augmented Reality for Art Museums

Analytical Activity:

- Precise description
- Objectification
- Generate questions



LEARNING?

How do
Learning tools:

- Physical scaffolds
- Digital Augmentations

Experiment Condition Components (Media)

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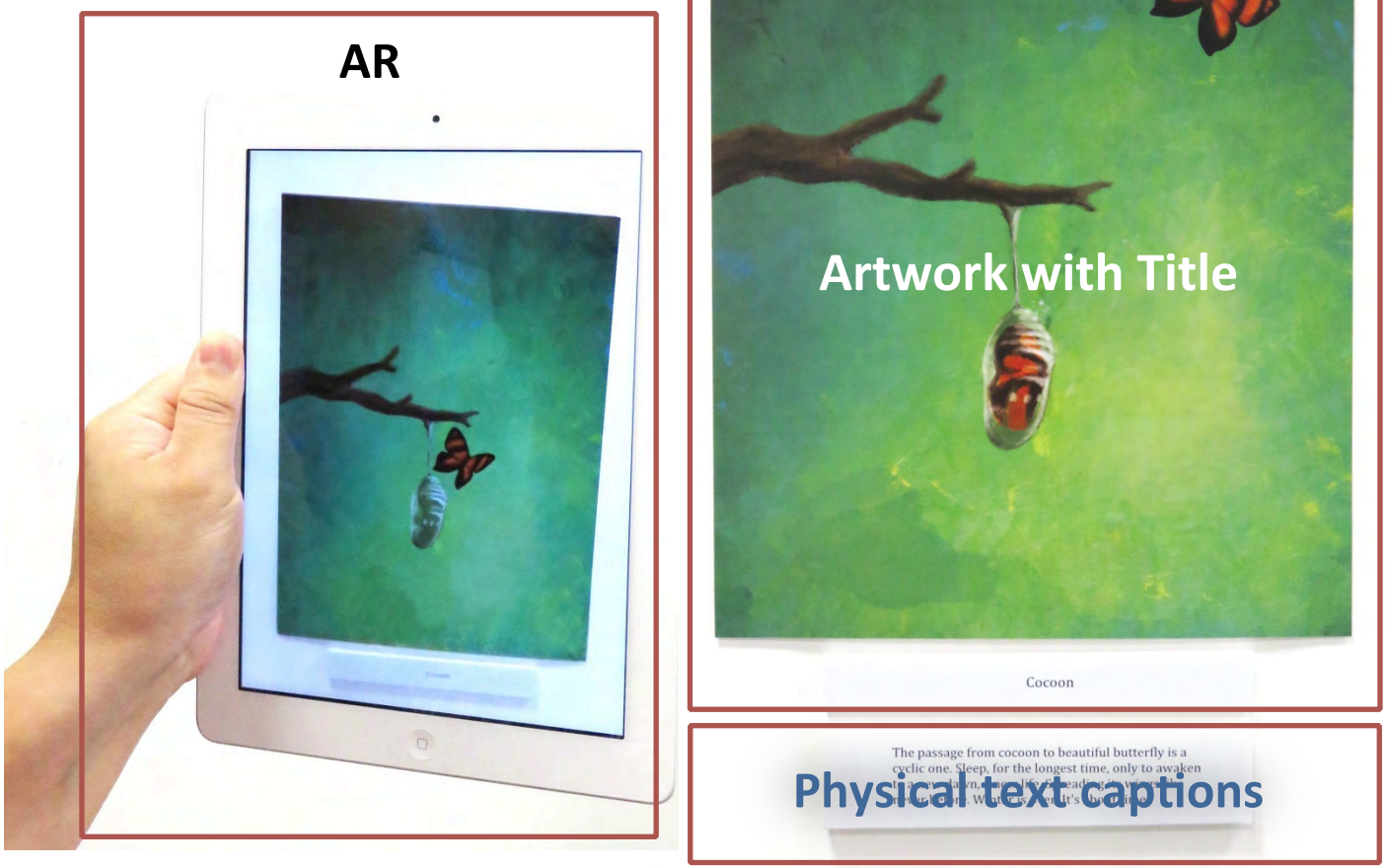

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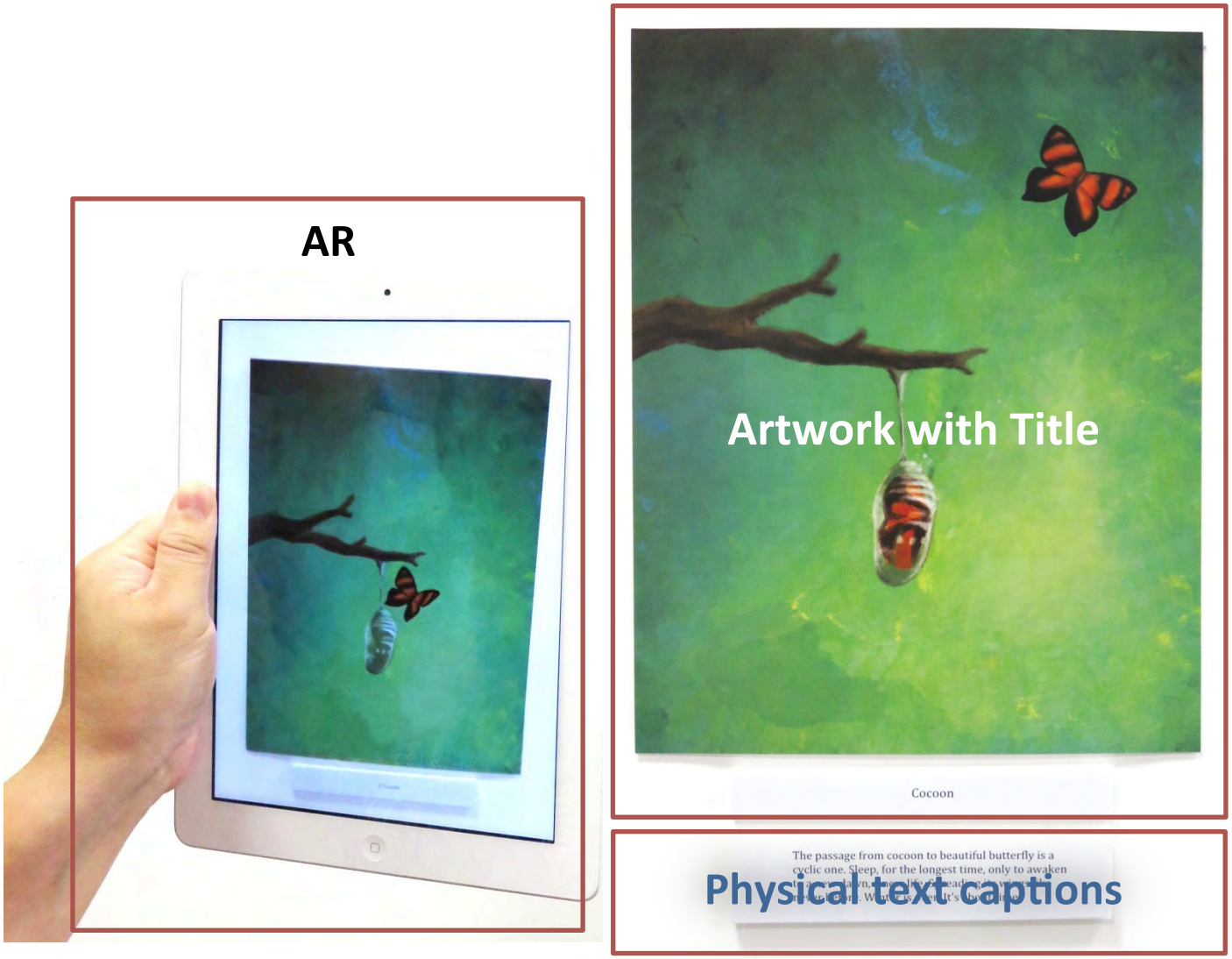
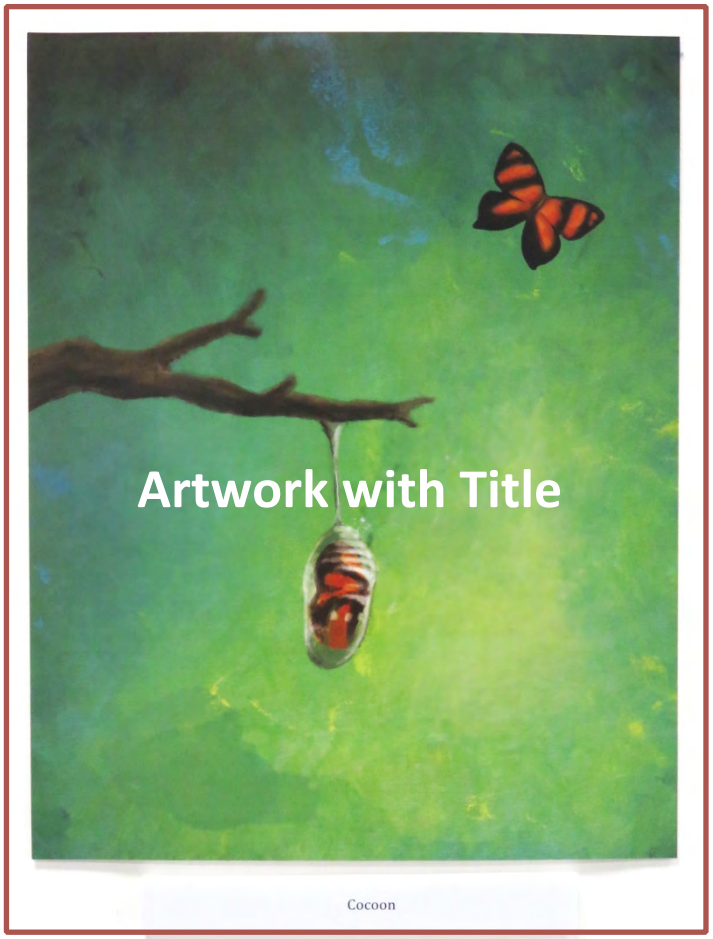
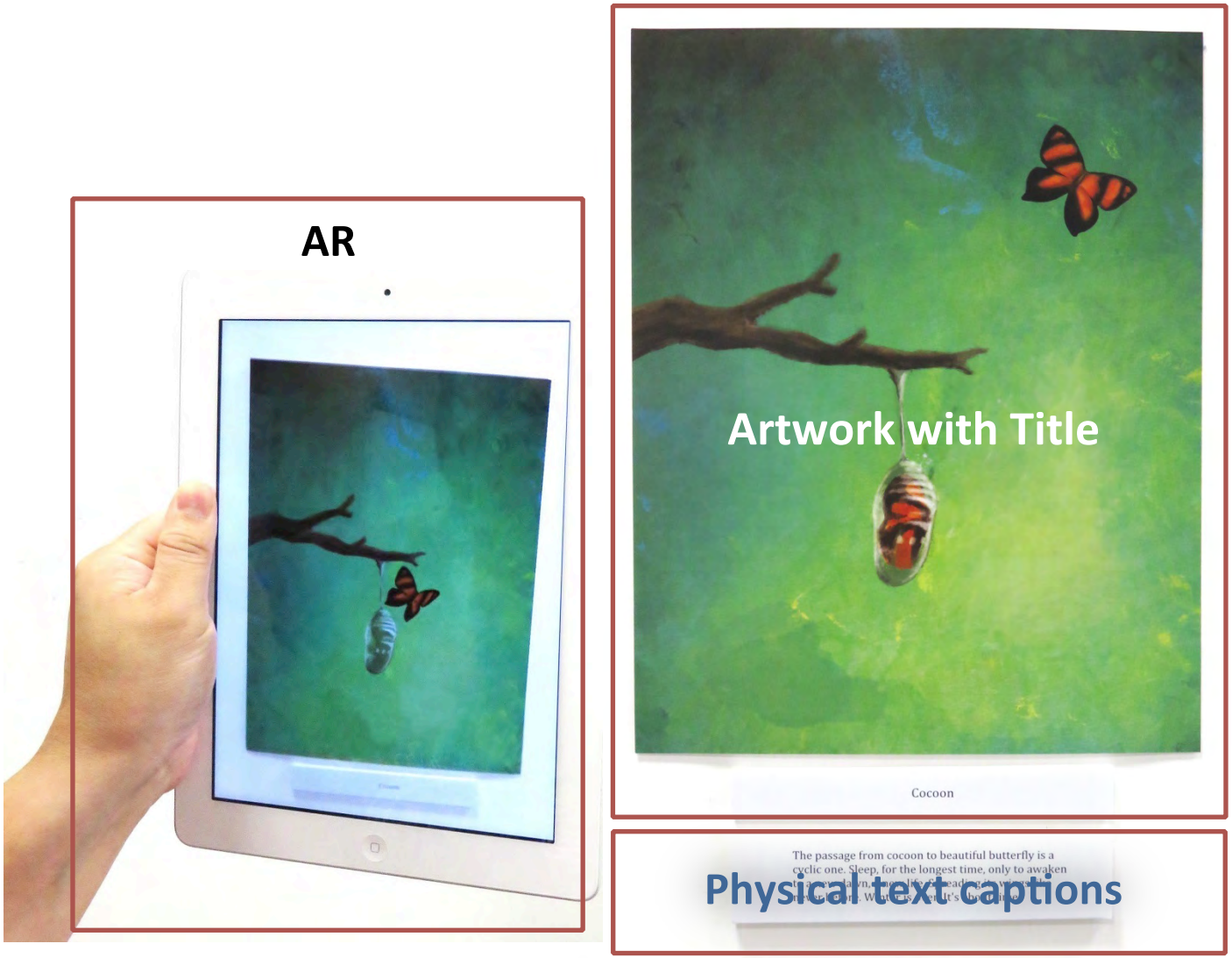


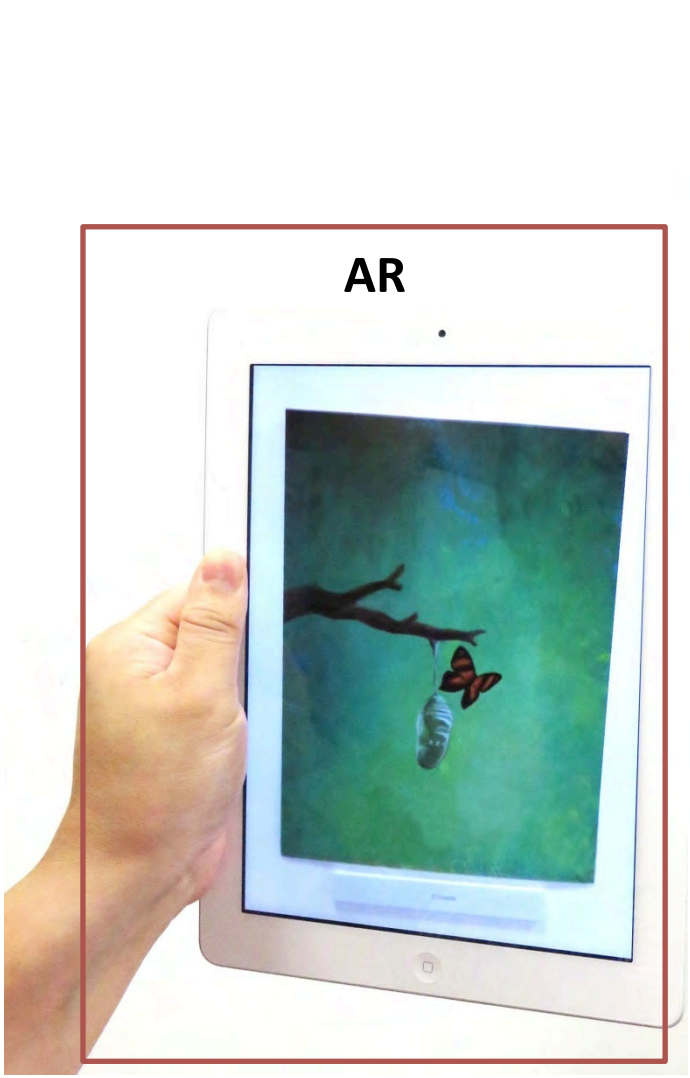
Experiment Condition 1 (Text-only)

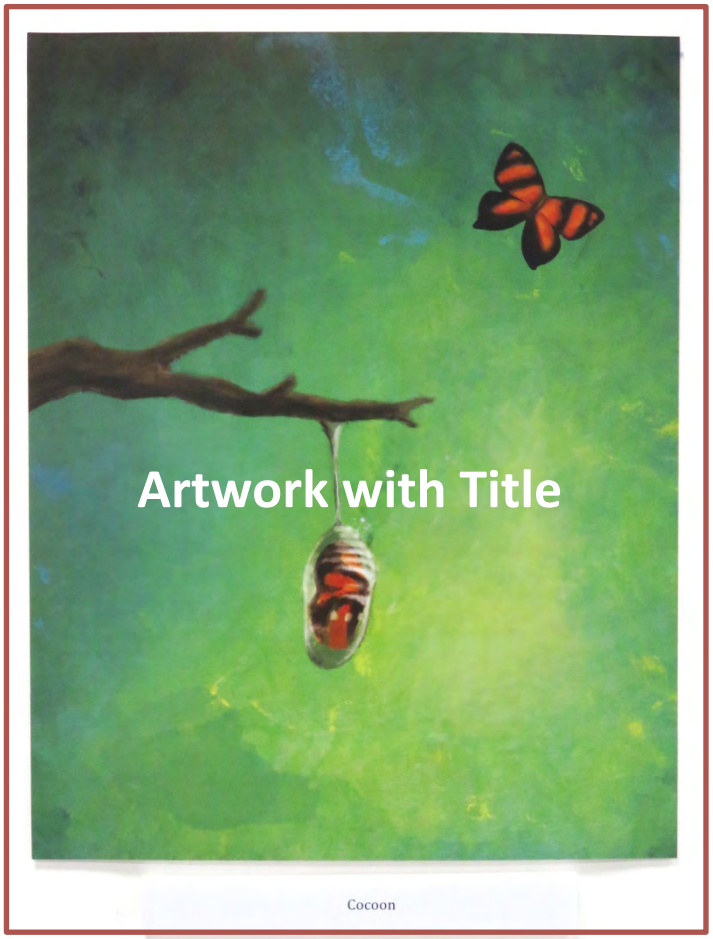


Experiment Condition 2 (Text + AR)

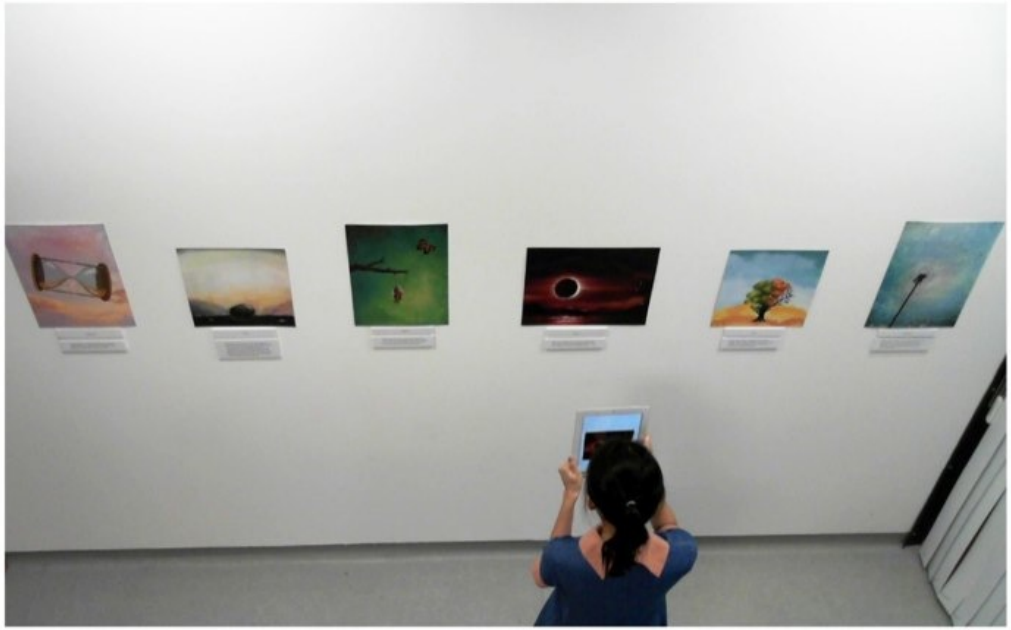


Experiment Condition 3 (AR-only)



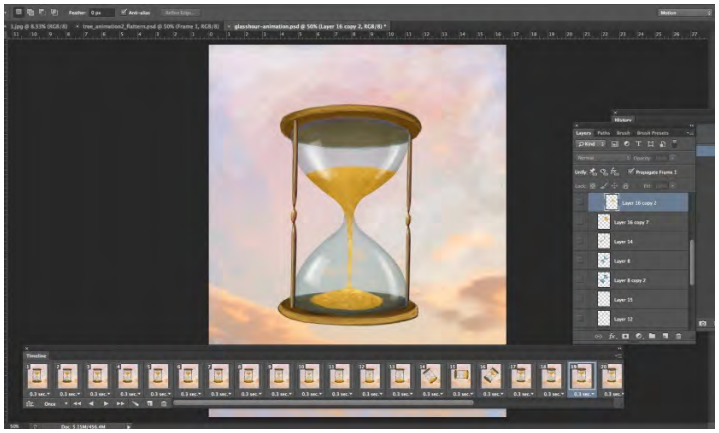


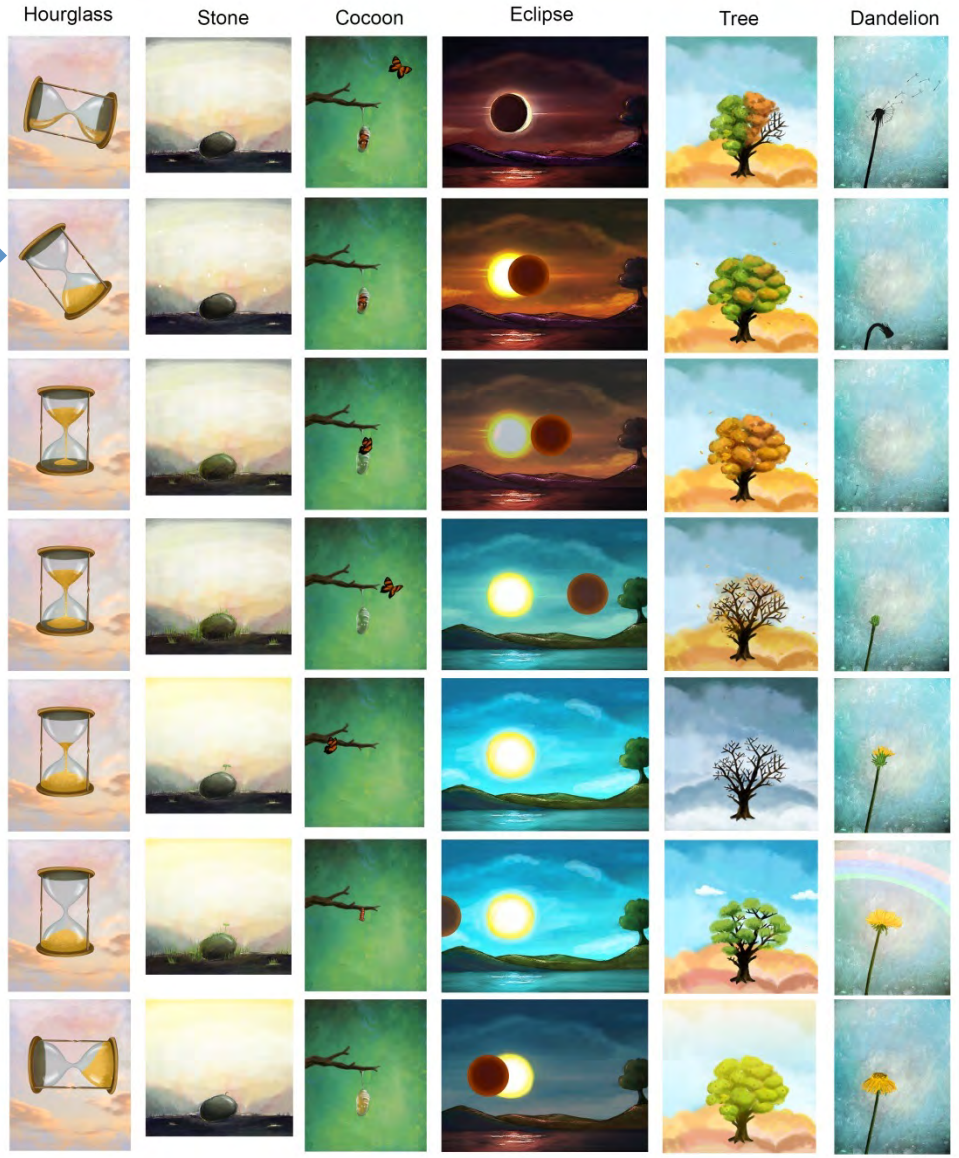
Experiment environment



Lu, W., Nguyen, L.-C., Chuah, T. L., Do, E.Y.-L. Effects of Mobile AR-Enabled Interactions on Retention and Transfer for Learning in Art Museum Contexts. Proc. ISMAR, (2014), 10-12 September, Munich, Bavaria, Germany

Experiment content creation





Qualcomm
vuforia
unity

Experiment Variables

Independent Variables (IVs)

Media Condition
[Text-only, AR+Text, AR-only]

Dependent Variables (DVs)

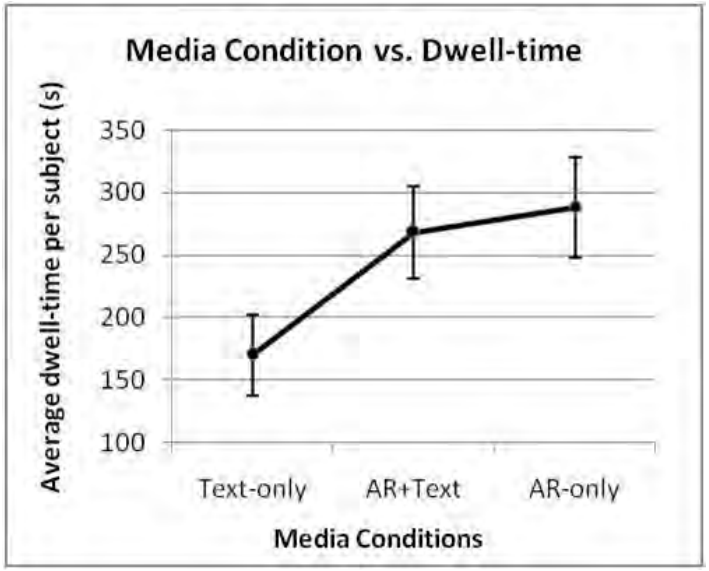
DV1: Number of paintings remembered
DV2: Appearance of each painting
DV3: Objectification
DV4: Number of questions emerged
DV5: Identification of theme
DV6: Dwell Time
DV7: iPad Use Time

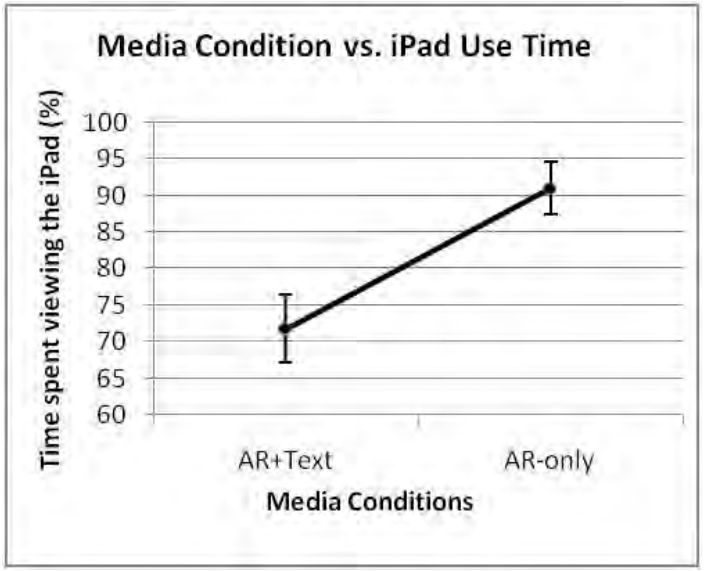
30 Participants
(Mean age 24.5, SD 3.31,
11 female)

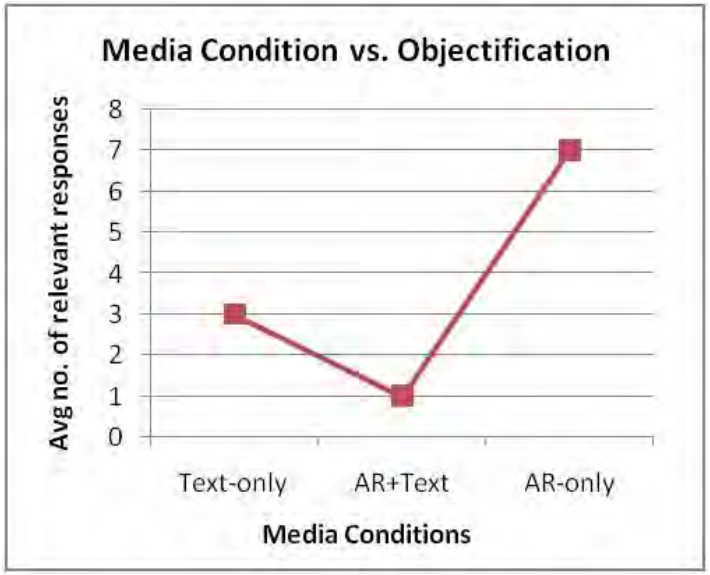
10 Participants randomly assigned to one of each condition.

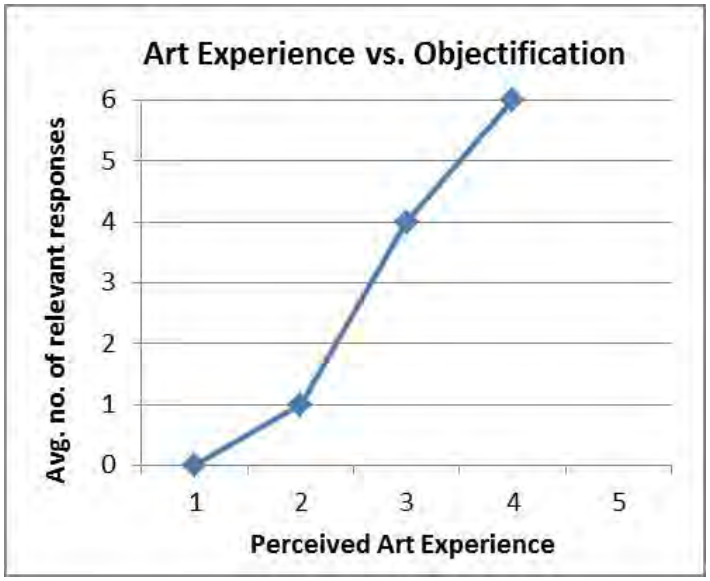
- Pre-experiment survey was conducted to gauge art experience
- Post-experiment interview was conducted to get user feedback

Results

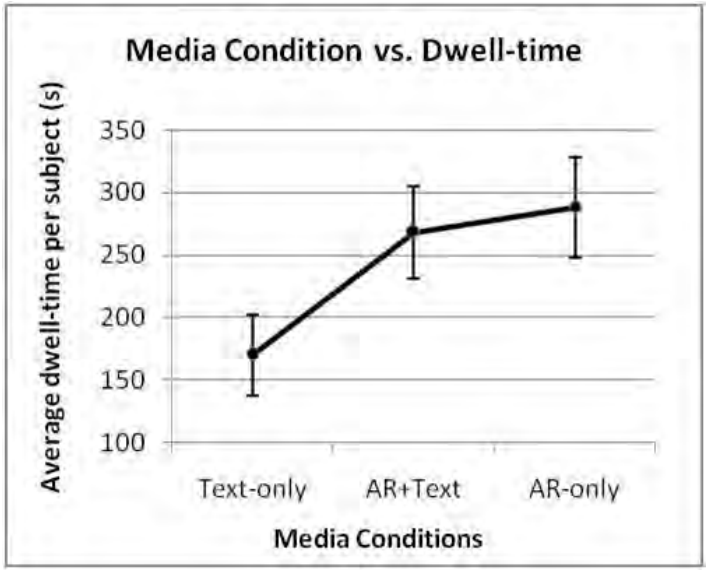

Media Condition vs. Dwell-time
Average dwell-time per subject (s)
350
300
250
200
150
100
Text-only
AR+Text
AR-only
Media Conditions


Media Condition vs. iPad Use Time
Time spent viewing the iPad (%)
100
95
90
85
80
75
70
65
60
AR+Text
AR-only
Media Conditions


Media Condition vs. Objectification
Avg no. of relevant responses
8
7
6
5
4
3
2
1
0
Text-only
AR+Text
AR-only
Media Conditions


Art Experience vs. Objectification
Avg. no. of relevant responses
6
5
4
3
2
1
0
1
2
3
4
5
Perceived Art Experience

Results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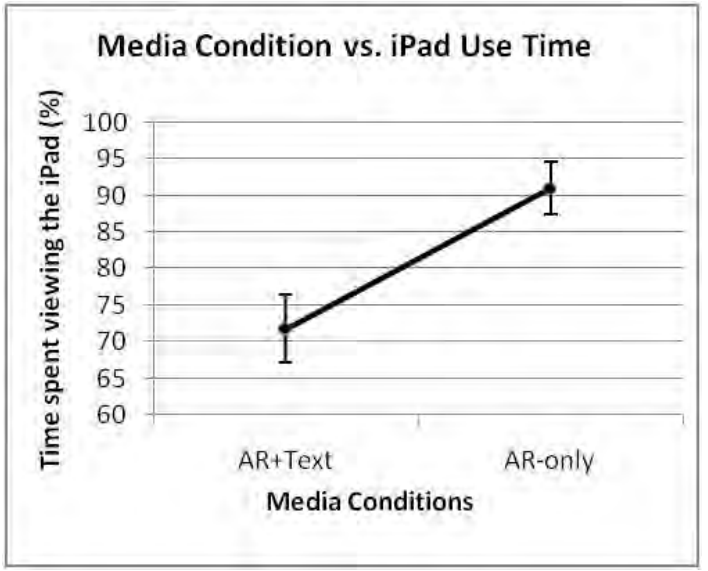
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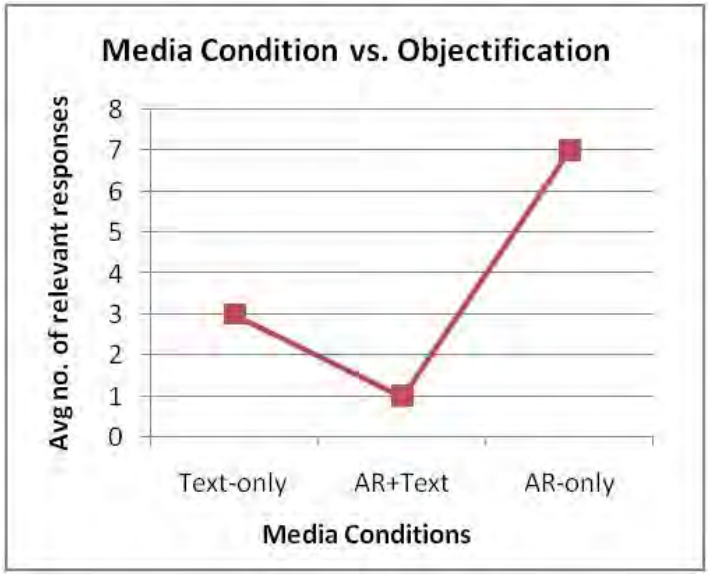
AR+Text
AR-only
Media Conditions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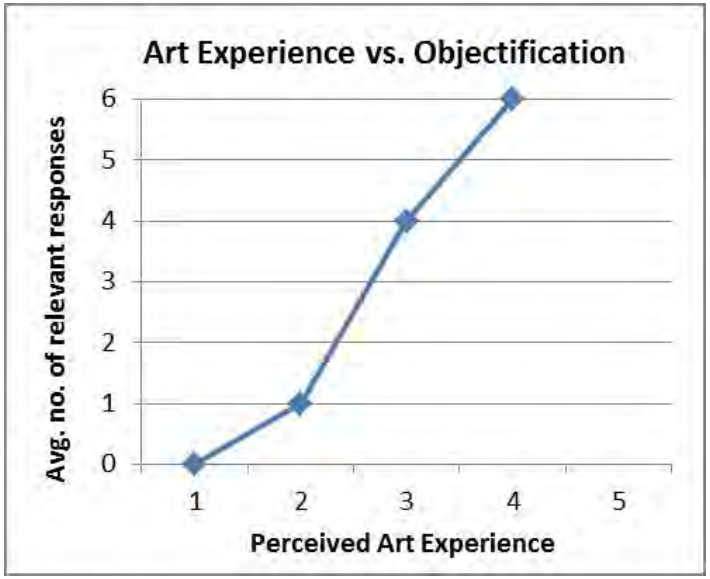
Art Experience vs. Objectification
Avg. no. of relevant responses
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5
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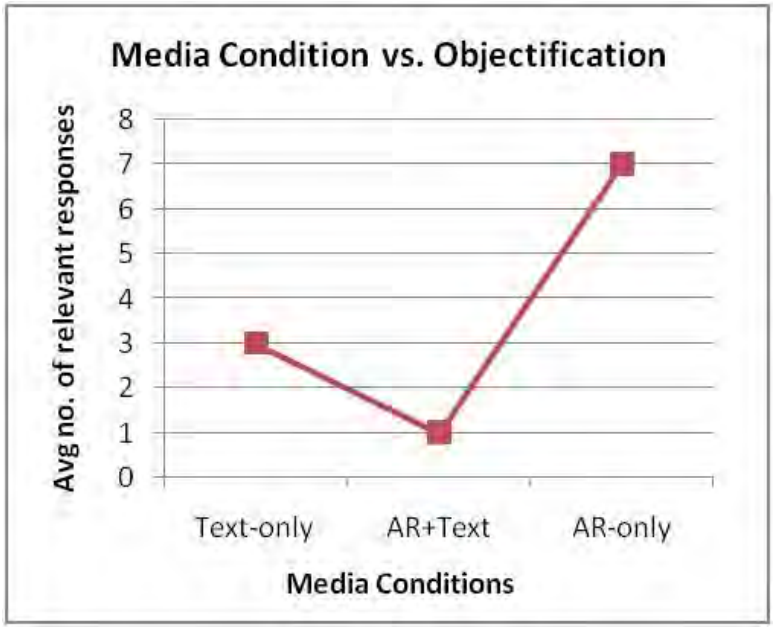
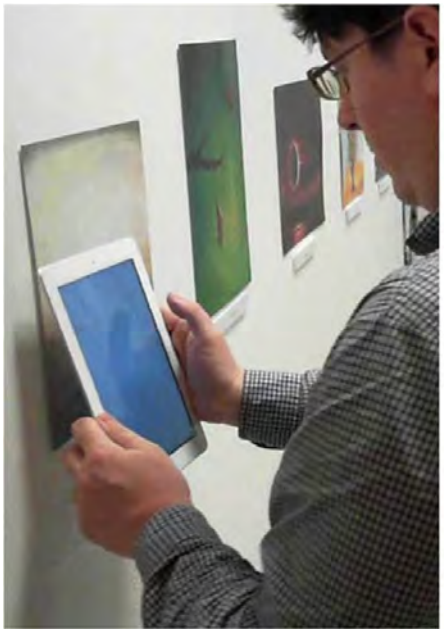
Perceived Art Experience

Findings

- Learning (in the form of objectification) was improved by AR
- There is an interaction effect between AR and Text descriptions
  - Interference caused by AR and Text
  - Possibly caused by Cognitive Dissonance
- AR-musing "distractions" may be beneficial





Limitations

- Interactions were kept simple.
- Only paintings were investigated.
- Only a small number of paintings used.

Future Work

Future Work

- Validate our findings with a larger dataset.

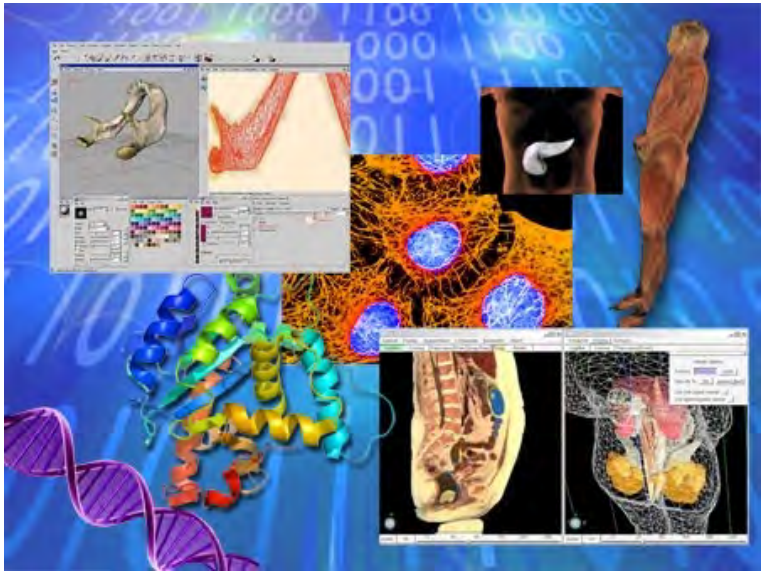
- Create a taxonomy of interactions and movements (possibly using Laban Movement classification schemes)

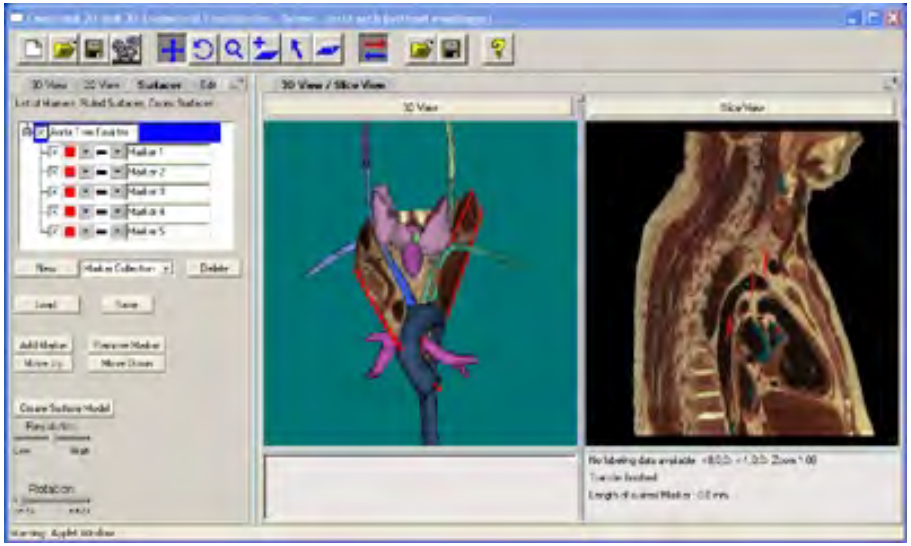
Bradley, K. K. (2009). *Rudolf Laban* (p. 67).

- Measure and classify the effect of these interactions on learning.

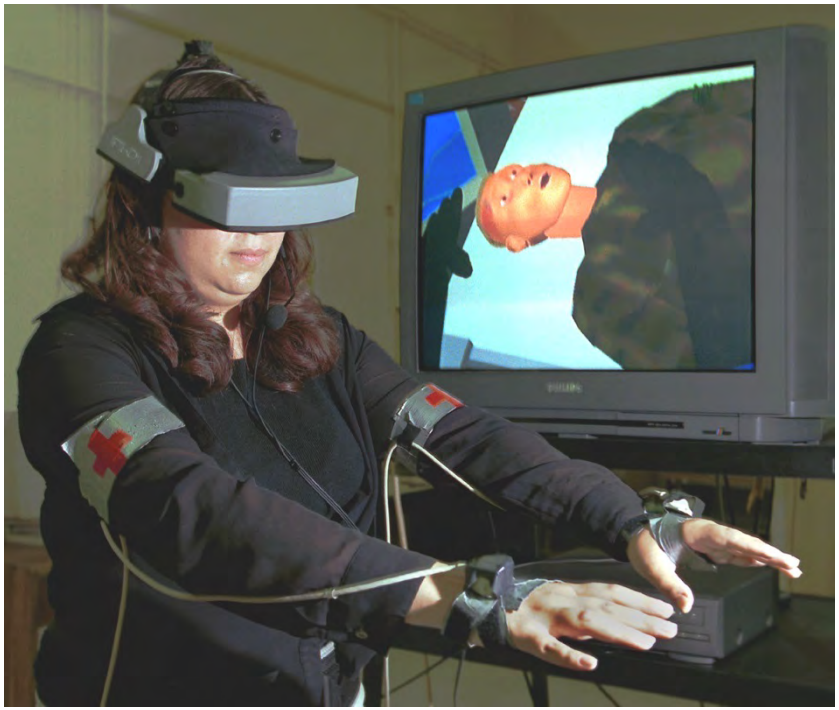
AnaLogy: Augmented Learning of Anatomy with Virtual Reality Simulation Systems

Related work in VR Anatomy focus on visualization





Medical VR for skills training, scenario simulation realism and fidelity, less on learning anatomy.



What about VR Anatomy with Multimodal, Kinesthetic Learning?

What about VR Anatomy with Multimodal, Kinesthetic Learning?

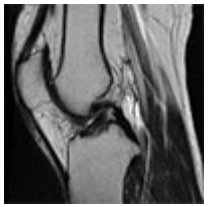
The CUTE AnaLogy project studies how kinesthetic learning can be applied to learning anatomy.

The CUTE AnaLogy project studies how kinesthetic learning can be applied to learning anatomy.

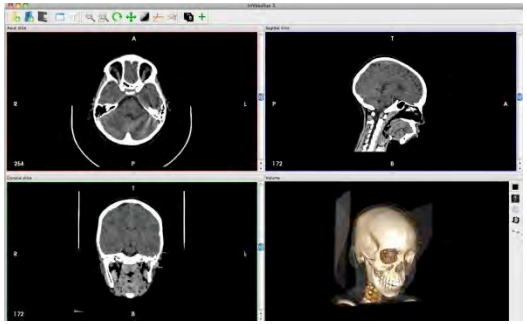
1. Create a VR environment.

2. Design and test different interaction methods

3. Measure the effect of the interaction methods on anatomy learning in medical students.



1.CT/MRI Scans from OsiriX



2. 3D reconstruction using Invesalius

AUTODESK® MESHMIXER®

3. Cleaning and optimizing model.

MAYA

4. Unwrapping, Rigging, further polygon count reduction.

MUDBOX ZBRUSH®

5. Texturing using Mudbox / Zbrush
Texture reference: Essential Anatomy 3

unity

6. 3D game engine integration

Interface devices

Input

Output

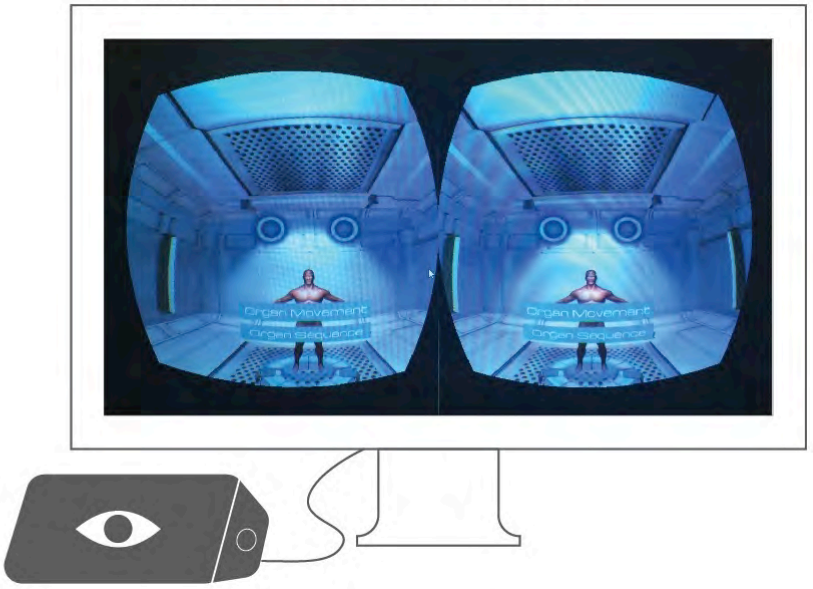
Goal:
Intuitive “Physical / Virtual (Phy-tual)” Interface

We are not there yet

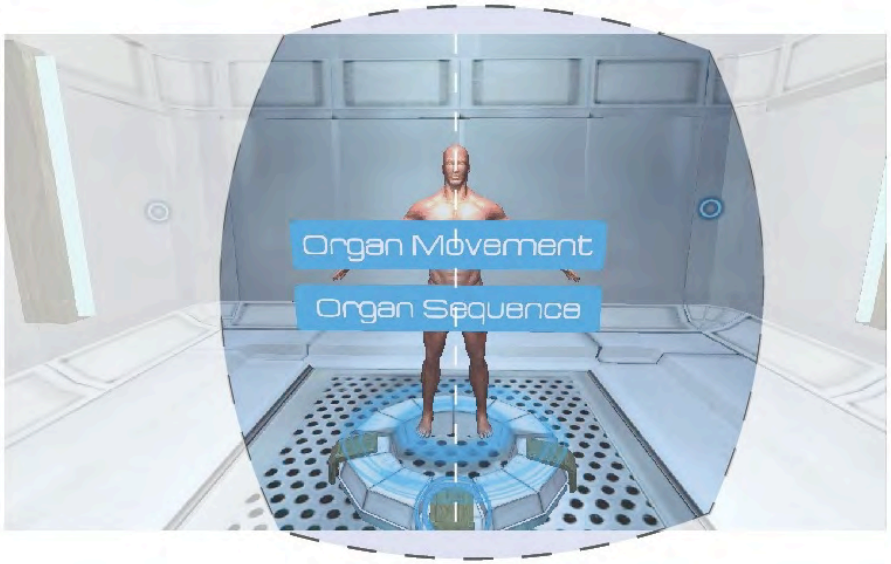
Lessons learned: Output

resolution 1280 x 720

resolution 640 x 800 each



Lessons learned: Output



Lessons Learned

1. Designing intuitive interfaces is not intuitive

2. Virtual and Physical properties and difficult to synchronize and reconcile

3. Designing Rift GUI is different from desktop display GUI

ReadPeer

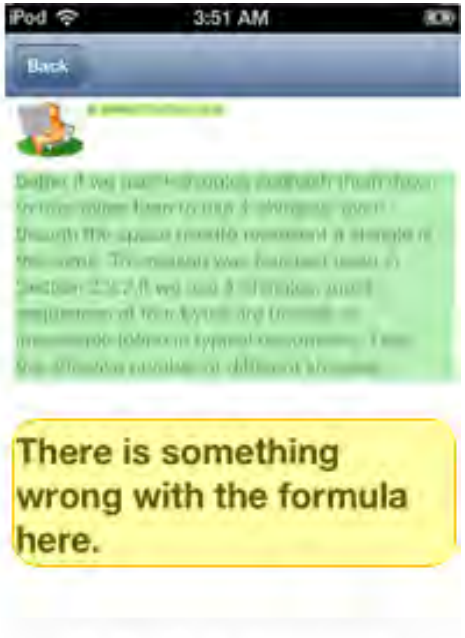
SeSaMe

-To allow users to share ideas and discussions from anywhere
-To provide an interesting feature to detect annotations on physical books through augmented reality

(a) Select a snapshot

(b) Extract text from OCR

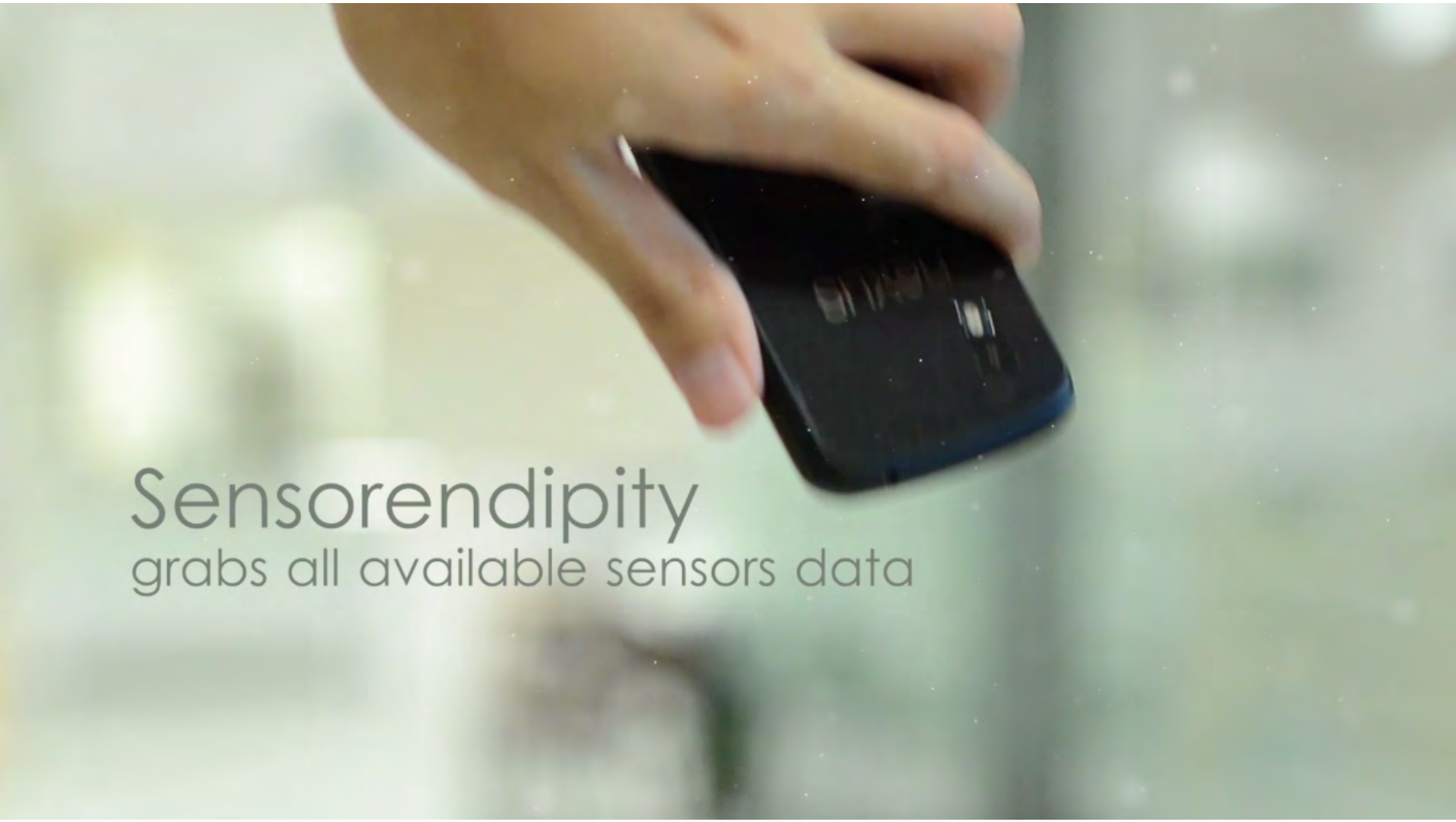
(c) Search the annotations



(d) Read an annotation

Sensorendipity

A Real-Time Web-Enabled Smartphone Sensor Platform



http://www.sensorendipity.com

Acknowledgement

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Research Assistant

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Research Assistant

Keio-NUS CUTE Center
Augmented Learning Group

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Creating Unique Technology for Everyone

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Connective Ubiquitous Technology for Embodiments

Creating
Unique
Technology for
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