Extend your playground: Mixed-Reality Games for Learning

Prof. Dr. Roland Klemke

IMTEL Innovation Day
Immersive Tech and Serious Games
NTNU, Campus Dragvoll
Trondheim, Norway, 07.05.2019

Welten Institute, Open University of the Netherlands, http://www.ou.nl/
Cologne Game Lab, TH Köln, http://www.colognegamelandlab.de/
Humance AG, Cologne, Germany, http://www.humance.de/
Have you ever watched little children learning? Or playing? Discovered any difference?

“Fun is the original educational technology.”
– Chris Crawford
Education

• Industrialized
• Built for Scalability
• Suited for the creation of „comparable” people
Is this kind of education appropriate for the skills and competencies we need to teach today?

Creativity

Flexibility

Ability to reflect

Ability to learn
How can education be playful, individual and joyful?

- When students are grouped by age, not by abilities or interests?
- When all students receive the same learning materials?
How to unite gaming and learning again?

How to place learning and gaming in context?
LEARNING: the ultimate game where you never run out of levels
LOOKING AT THE LEARNER
Learners are individual and mobile

How can we provide learning resources with ...
- ... different media formats
- ... different devices
- ... different target audiences?

How can we personalize learning ...
- ... for the learner ...
- ... in the learning context?
LogiAssist – Mobile Assistance in Logistics

You are exceeding the allowed driving time. Please select a resting place.

OK
GIVING ACCESS IS ONE THING ...

... MAKING IT FUN ANOTHER
“Tell me, and I will forget. Show me and I may remember. Involve me, and I will understand.”

Confucius (probably)
Is it possible to create a 3D learning game with freely available technologies / contents at low modelling cost?

Use Google Streetview and the real world as a playground allowing interaction with virtual items in location-based games.

THE WORLD AS PLAYGROUND ...

... IS NOT A TOTALLY NEW IDEA

"Breakout" is a silly game

Image: Oliver Peters, Flickr, https://secure.flickr.com/photos/53127157@N06/5218440997
Scavenger Hunt is now called Geocaching
The world around you is not what it seems.

**Ingress. The game.**

It's happening all around you. They aren't coming. They're already here.

**MMMARG** (Massive multiplayer mobile augmented reality game)

Bild: [http://www.ingress.com](http://www.ingress.com)
We don’t collect stamps any more
MOBILE SERIOUS GAMES

Situation Awareness
Augmented Reality
Serious Gaming

Fig 2. Augmented reality
What is a mobile serious game?

- Embedded in Context
- Exploration and utilization of context
- Augmentation of reality
Gamification for LogiAssist – The TEGA Project

A learning game that encourages to drive economic and safe.

SALOMO
Decision training for disruption handling in logistics

Klemke, R., Kurapati, S., & Kolfschoten, G. (2013). Transferring an educational board game to a multi-user mobile learning game to increase shared situational awareness. Presentation at the 3rd Irish Symposium on Game Based Learning, Dublin, Ireland.
Mobile learning game based on team processes simulate disruption situations

From board game to multi-user mobile learning game

Klemke, R., Kurapati, S., & Kolfschoten, G. (2013). Transferring an educational board game to a multi-user mobile learning game to increase shared situational awareness. Presentation at the 3rd Irish Symposium on Game Based Learning, Dublin, Ireland.
EmUrgency: Mobile Game for Basic Life Support Training

Cardiac arrest one of the main causes of death
Only 20% of affected people survive

Chances for survival …

… are increased with the factor 3 through immediate cardiac massage

EmUrgency: Mobile Game for Basic Life Support Training

But: bystanders …
… often don’t know what to do or fear to do the wrong things

EmUrgency: Mobile Multi-user Game for Basic Life Support

Welcome to the Heart Run game. It will help you to be prepared in case of emergency. The instructions on your device will tell you how to save a life.

The game is based on messages which will appear on your device. When closing this message, you will already see the next one. You close this message by using the BACK Button. To open a message, you have to click on it. Messages which you have read are greyed out.

To do this, press the barcode icon below and hold the advice in front of the barcode. It will scan automatically.

Scan AED

Go to the next AED.

CPR

Push hard and fast in the center of the person's chest to the beat of the disco song “Stayin’ Alive.” It has more than 100 beats per minute — the correct rate to push on the chest during CPR.

Continue CPR until an AED arrives or emergency providers can take over.

If other bystanders are present, change the person giving chest compressions.

Introducing... 

**Sensorama**

The Revolutionary Motion Picture System that takes you into another world with

- 3-D
- WIDE VISION
- MOTION
- COLOR
- STEREO-SOUND
- AROMAS
- WIND
- VIBRATIONS

Sensorama, Inc., 855 Galloway St., Pacific Palisades, Calif. 90272

Tel. (213) 459-2162

Gameplay, Learning, and Player are united in an immersive environment: the real world!
Augmented Reality Glasses: Hands free interaction
3D holographic glasses for full immersive interaction

Full immersion gaming: VR glasses, VR motion system
Virtual Reality? Augmented Reality? Reality?
Out of body experiments

Two variants

- Projection of another body onto one's own position
- Projection of one's own body to another position

Outcomes

- Identification with virtual body even if it's obviously artificial
- Perceived feeling of touch or even pain after successful initiation
- Identification with the virtual location: participants return to the place of the virtual body instead of the place of observation


WEARABLE EXPERIENCE FOR KNOWLEDGE-INTENSIVE TRAINING:  
EXPLORING AUGMENTED REALITY AND WEARABLES FOR TRAINING

PROJECT EXAMPLE: WEKIT
**WEKIT - WEARABLE EXPERIENCE FOR KNOWLEDGE-INTENSIVE TRAINING**

**Learning Task**
- TM 01: Augmented path
- TM 02: Augmented mirror
- TM 12: Interactive virtual objects
- TM 16: Mobile control

**Procedural Information**
- TM 03: Directed focus
- TM 07: Highlight objects
- TM 09: Object enrichment
- TM 13: Haptic feedback
- TM 17: Formative feedback

**Supportive Information**
- TM 04: POV videos
- TM 05: Annotation
- TM 08: Cues & clues
- TM 10: Contextual information
- TM 11: 3D models & animation
- TM 14: Xray vision

**Part Task Practice**
- TM 06: Ghost track
- TM 15: Summative feedback

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**4C/ID Model**
**Based Classification**

**IDM**
Instructional Design Methods (IDM) for capturing expert performance to support training using augmented reality and sensors

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**Roland Klemke**
IMTEL Innovation Day
07.05.19
Instructional Design Methods
Example: TM03 - Directed Focus

<table>
<thead>
<tr>
<th>Description</th>
<th>Capture Method</th>
<th>Re-Enactment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual pointer for relevant objects</td>
<td>Eye tracker and video recording</td>
<td>Eye tracker for formative feedback</td>
</tr>
<tr>
<td>outside the visual area of the trainee</td>
<td>Task analysis for pointing to the next location</td>
<td>AR display for feedback</td>
</tr>
</tbody>
</table>

The markers direct the trainee to the relevant areas.
### Instructional Design Methods

**Example: TM05 – Annotations**

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<tr>
<td>Allow a physical object to be annotated by the expert during task execution (similar to sticky notes but with more modalities)</td>
<td>Methods to tag media into physical object Manual annotation or done by expert on the fly</td>
<td>AR display mechanism to read the annotations Mechanism for unobtrusive playback of information</td>
</tr>
</tbody>
</table>

A physical object is annotated by the expert with an image to allow the trainee to recognize the image.
## Instructional Design Methods

### Example: TM06 – Ghost Track

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<tr>
<td>Allows visualization of the movement of the expert or the earlier recording of the trainees themselves for imitation and reflection</td>
<td>Sensors to capture the whole-body movements Recording of results of the action performed by the expert</td>
<td>Visualization mechanisms Tracking of current state for feedback and evaluation</td>
</tr>
</tbody>
</table>

An expert’s body and hand movement is recorded and replayed as ghost track.
Instructional Design Methods
Example: TM08 – Cues & Clues

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</tr>
</thead>
<tbody>
<tr>
<td>Cues and clues are pivots that trigger solution search. They can be in the form of image or audio. They should represent the solution with a single annotation</td>
<td>Task Analysis Mechanism to allow content creation to be used for clues and cues</td>
<td>AR displays the clues anchored to the physical object Additional help when requested</td>
</tr>
</tbody>
</table>

A clue is left by the expert for the trainee in form of a text.
WEARABLE EXPERIENCE FOR KNOWLEDGE INTENSIVE TRAINING
Using VR to lower barriers and risks for beginners

Scared of heights?
Not sure what to expect?
Still want to experience and learn how to fly?

Airtime VR
Prototyp 1.0