WEKIT: Methodology
Wearable Experiences for Knowledge Intensive Training

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Introduction
Performance Augmentation with wearables

The stager produces narratives
The guest enacts experiences

sensor-sensory loop: super-real experience
Affordances: which cultures of use to support?

Viewpoints: from what perspective?

Abstraction: what matters? what to pay attention to?

Sensing: which senses and what sensors?

Social Scope: for individuals, teams, or more?

Editing: how to enrich or reduce?

Grand Challenges?

Capture | Re-Enact

(Fominykh, Wild, Smith, Alvarez, & Morozov, 2014)
1 | Capture experience as it emerges for hands-on, live guidance
2 | Wear and repeat
Re-enact tailored content; wear the expert experience
Workshop focus

pedagogical aspects of using AR & WT workplace learning

brainstorming exercise on building training scenarios

learn how to design training for AR & WT
Background
Experts

QUALITIES OF EXPERTS

Superior Mental Knowledge (De Groot, 1978)
Perceptual abilities (Lesgold et al., 1988)
Qualitative analysis (Klein, 1998)
Strategies (Lemaire & Siegler, 1995)
Cognitive effort (Patricia 2003)

SHORTCOMINGS OF EXPERTS

Domain limited (Fernand and Herbert, 1996)
Failure to recall surface features (Schmidt and Boshuizen, 1993)
Inaccurate prediction judgement and advice (Hinds, 1999)
Inflexibility and bias (Sternberg and Frensch, 1992)

Experts are often bad at transferring expertise!
The WEKIT Framework
Goals

Capture of Expertise
- What are relevant aspects of expertise and how to capture them?

Enable enactment of expertise
- How can we actively support the transfer of expertise to a learner?

Design of learning task
- How should learning activities be designed to support / complement expertise transfer?

Requirement generation
- How should technology be designed to foster all of the above?
Approach

Bottom-up
- start to analyse concrete tasks in industrial settings
- classify them according to common scheme identifying aspects of expertise and learning
- try to find mechanism suitable to support expertise transfer

Top-down
- identify tangible and intangible aspects relevant in all tasks
- find abstract key factors and rating scheme
- assess tasks and mechanisms according to factors and schemes
Top down Approach

(Task x Domain x Dimension) Matrix

Industrial Use case

Weight Value of Each Task Type

Weight of Complex Industrial task

identify relevant (Task x Mechanism) for the task

Requirements for design of Training plan for the use case.

(Task x Transfer Mechanism) Matrix

Theoretical Foundations

Bottom up Approach

Literature Review
Framework: Bottom-up

Task classification
- classify tasks according to common scheme
- analyse elements of expertise
- analyse learning/teaching aspects

Transfer mechanisms
- Collect tools / ideas / requirements which might help to record / re-enact expertise

Map tasks / expertise
- Which transfer mechanism helps to transfer expertise for which task?
# Task classification scheme

**Attributes**
What are the most common attributes describing this task?

**Conditions of Mastery**
What are requirements to be fulfilled for successful task execution?

**Learning Difficulties**
What complications could be faced by the learner?

**Teaching Methodologies**
What are the traditional means of teaching that an expert teacher would use to these task?

**Supporting AR & WT transfer Mechanism**
Which AR/WT means could possibly support the learning of this kind
## Transfer mechanism classification scheme

### Attributes

How can the features be described?

<table>
<thead>
<tr>
<th>Requirements for recording</th>
</tr>
</thead>
<tbody>
<tr>
<td>How is the mechanism enabled during the recording?</td>
</tr>
<tr>
<td>Which conditions need to be met to enable this feature?</td>
</tr>
<tr>
<td>Which functionalities does the feature have to offer?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Requirements for replay or enactment</th>
</tr>
</thead>
<tbody>
<tr>
<td>How is this feature enabled by/for the learner?</td>
</tr>
<tr>
<td>What does this feature do?</td>
</tr>
<tr>
<td>Which conditions need to be met to allow this feature to be present?</td>
</tr>
<tr>
<td>Which interaction means does the learner have?</td>
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</tbody>
</table>
Task classification example: High precision task
Task classification example: High precision task

Attributes
- allows only very limited deviation, higher deviation in precision may lead to high follow-up costs or risks (fine psychomotor skills)

Mastery condition
- level of precision during task execution must guarantee, that deviation stays below tolerance

Learning difficulties
- learning from an expert e.g. by observation and imitation does not reveal the high precision requirement

Teaching methodologies
- explanation: focus on those elements where precision is most critical
- simplified task models: stepwise increase precision requirement in training tasks
- Pre training instruction, and instructions on every step (for example videos)
- Reflection reinforced & interval practice

AR/WT assumptions
- zoom may help to better view high precision elements
- object enrichment may lead focus towards precision aspects
- think aloud information (spoken comments) may raise awareness of risks and pitfalls
Transfer mechanism classification example: Zoom
Transfer mechanism classification example: Zoom

Attributes
- replay of a recorded task execution with higher zoom factor

Requirements for recording
- camera with high resolution
- needs to be explicitly enabled in recording phase to trigger high resolution recording

Requirements for replay/re-enactment
- video display and video interaction (change zoom factor, replay, auto-repeat)
- when zoom feature available, interaction elements are automatically displayed
Transfer mechanism classification example: Object enrichment

Attributes
- display of recognized objects with additional information

Requirements for recording
- object recognition features enabled
- modelling of additional information for recognized objects

Requirements for replay/re-enactment
- objects recognized during novice task execution need to be enriched in the same way
- interaction elements are automatically displayed to switch object recognition on/off or to interact with specific elements
## Mapping Tasks and Mechanisms

<table>
<thead>
<tr>
<th>Transfer mechanism</th>
<th>Task Classifications</th>
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</thead>
<tbody>
<tr>
<td>Slow motion</td>
<td>High precision, High speed, Decision making</td>
<td></td>
</tr>
<tr>
<td>Zoom</td>
<td>Collaborative tasks, High memory load, Assertive task, Dual task, Performance managing, Uncertainty managing</td>
<td></td>
</tr>
<tr>
<td>Think aloud protocol</td>
<td>1, 8, 3, 13</td>
<td></td>
</tr>
<tr>
<td>Object enrichment</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Contextualisation</td>
<td>3, 9, 3</td>
<td></td>
</tr>
<tr>
<td>Self awareness of physical state</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Directed focus</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Case identification</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Spatial Simulation</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>In Situ Realtime Feedback</td>
<td>4, 17</td>
<td></td>
</tr>
<tr>
<td>Mobile control</td>
<td>5, 5</td>
<td></td>
</tr>
<tr>
<td>Virtual Post Its</td>
<td>5, 12</td>
<td></td>
</tr>
<tr>
<td>Haptic hints</td>
<td>6, 10, 11, 3</td>
<td></td>
</tr>
<tr>
<td>Virtual/Tangible Manipulation</td>
<td>7, 7</td>
<td></td>
</tr>
</tbody>
</table>

### Literature
1. Schraagen, 1993
2. Tang et al. 2003
3. Quarles et. al. (2008)
4. BMW augmented reality system (Interone Worldwide, 2010)
5. Sabine et al, 2011
6. Lahanas V et. al. (2014)
7. Chinthammit et. al. 2014
8. Lundgrén-Laine et al, 2010
9. Curtis et al. 1998
10. Seichter, H., 2004
14. larkin (1983)
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18. Martin-Gutierrez et al. (2010)
Use Cases
Aircraft maintenance – pre-flight inspection

*Procedure:* particular pre-flight checklist for each aircraft type

*Training:* company set training programme

*Training outcome:* Indicators of successful preflight:
- know the role of the aircraft preflight procedure
- know how to use the preflight procedures
- use loading charts to determine weight and balance limits
- understand the importance of proper weight and balance
- use appropriate checklists during preflight
- know what documents are required in the aircraft for legal flight
- know the roles of the Airworthiness and Registration Certificates
Aircraft maintenance – Safety at the sharp end – Communication and Shared mental modelling during Shift handover

**Procedure**: accurate, reliable communication of task-relevant information across shift changes, ensuring continuity of safe and effective working.

**Training**: Maintenance resource management

**Training outcome**

- The overall target is to improve maintenance hours and reduce errors. Another target is to improve the quality and efficiency of documentation
- Improved collaboration between maintenance personnel
- Improved requirement management
- Cost effective verification and documentation process for maintenance tasks
Space – Performance of sub-system test bench

Sub-system / payload (from now on defined as “item”) delivery to system integrator

Testing activities are executed using dedicated Mechanical Ground Support Equipment (MGSE) and Electrical Ground Support Equipment (EGSE) to verify the delivered item with respect to defined requirements – components for space are usually one-time custom developments

Activity is performed by joint team: item developers and system integrator personnel

Knowledge about the item is transferred to the integrator team based on specific “user manual” and “test procedure”

Aims:

◦ reduction of presence of developer teams at the integrator location.

◦ enhanced training experience will allow an efficacious transfer of expertise avoiding subsequent problems and failure due to bad comprehension of the manuals and procedures.
Space – Ground-space training for astronauts

Present situation: astronauts receive formal training on ground, during their mission preparation

Problems:
◦ for long duration mission, the effort to keep crew proficiency up-to-date is extremely heavy
◦ engineering models and relevant procedures may not be fully in line with the real equipment
◦ changes may be required between training and actual operations

Aims: WEKIT approach could provide a quick briefing on the procedure or allow just in time training complementing or replacing formal training or old procedure.
Workshop Assignment
Workshop Assignment

Choose one of the four use cases

Identify elements of expertise / knowledge

Identify task categories that apply

Select transfer mechanisms

Conceptualize an expertise transfer process
  ◦ What is the difference to just teaching the task?
  ◦ How do you capture / recognize expertise?
  ◦ How do you re-enact expertise?

Describe elements of a technical AR/WT solution (scenario)
  ◦ How do users interact with the solution to capture / re-enact expertise?
  ◦ Which information should be captured?
  ◦ Which information should be displayed?
  ◦ Which kind of devices do you need for capturing / re-enactment?

Framework data: https://goo.gl/eD5o6t
Q & A

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