A design toolkit for emerging learning situations supported by ubiquitous computing

June 2, 2010
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I. Introduction

The best way to predict the future is to invent it.

-Alan Kay
Research Aim

What new design approaches can be developed for supporting emerging learning landscapes with ubiquitous computing?
the scope

- Technology-enhanced Learning
- Interaction Design and HCI
- Science of Design
- Proactive computing
- What I mean by a design toolkit
2. Why?

Kaput (1992): “major limitations of computer use in the coming decades are likely to be less a result of technological limitations than a result of limited human imagination and the constraints of old habits and social structures”

Active Learning

The very nature of learning is changing from transfer, remember and recall to create, discover, understand, organize, interconnect, retrieve, and to apply knowledge in a culture and context.


The role of designer is to explore the science of making and the philosophy of realizing social artifacts.

The tools and theories of design can be both be supported by design-based research utilize the tensions from debate between theories and practice in HCI.

But, a new set of tools and methods need to be considered for these emerging learning situations.
Overview of Research

*a science for design is by necessity both a science of making and a philosophy of realizing artifacts with and for others.*

-Klaus Krippendorf
Different Cases

• mlearn2go
  • Mobile Location Based Games and Activities Platform

• GeM - AMULETS
  • Geo Math: AMULETS: Advanced Mobile and Ubiquitous Learning Environments for Teachers and Students

• Lets Go
  • LETS GO: Learning Ecology with Technologies from Science for Global Outcomes

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mlearn2go

• Settings
  - Informal & Formal
  - Co-Design and Blended Design
  - Prototype to commercial spin-off

• Research aims
  - Which design methods are appropriate for developing novel learning activities using mobile games?
  - How does the involvement of the teachers and the learners impact the design process and how has this given us new perspectives regarding strategies for learning activities?

• Outcomes
  - Bottom up approach with informal games & physical activities
  - Value of different using design methods
  - (re)Identified some initial design factors
GeM & Lets Go

- **Settings**
  - Middle School & Highschool
  - Co-Design
  - Field work, Lab work, classroom

- **Research aims**
  - What design lessons can we get from novel prototypes of learning activities that bring together mobile and 3D technologies?
  - How to initiate the co-design process together with teachers, researchers, scientists, designers, and developers in order to develop mobile science collaboratories to support open inquiry-based learning.

- **Outcomes**
  - Cycles of sketching » How to find good ideas
  - Participatory = higher risk of failure
  - GeM Scaling back to find the right idea (research question)
  - Theory vs Practice in the team
  - Functional requirements and the design process
  - Sketches cycles support of the design process
  - Role of the DESIGNER
Lets Go

Enter your group name.
Select your group.
Group 1

Water Quality activity (1)
Take GPS coordinates.
Make sure you have a view of the sky.

Capture Location

Temperature
Dissolved Oxygen
pH
Conductivity
Technology Thoughts

• Settings
  - technology infrastructure
  - connecting the user needs

• Research aims
  - What features and capabilities should collaborative mobile tools and systems provide to support different learning activities?
  - How mobile web and sensory technologies could be integrated to support science learning activities in the classroom and in outdoor settings?

• Outcomes
  - trying to develop technology to support the natural flow of learning and teaching
  - recognizing the reality of school IT infrastructure
  - trying to utilize open standards in a mostly closed standard world
open standard approach
open standard approach
open standard approach
Research Approach

*It is a capital mistake to theorise before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts.*

-Sir Arthur Conan Doyle
Different Theories

Learning
- Instructionism
- Contructionism
- Social-Cultural
- Collaborative

Design
- aim to change to preferred
- initiating change in man made things
- reflective conversation
- thoughtful interaction / prospective

Design
- HCI
  - usability
  - factors
  - actors
  - CREATORS

Design
- mobile learning
  - conversational framework
  - task model / socio-cultural engineering
  - mobile complex
  - Augmented contexts for development

Design
- Ubi - comp
  - calm computer
  - context
  - proactive
  - COPING

Different Theories
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Fallman's (2003), Design-oriented Research (left) vs. Research-oriented Design (right)
Co-design can be defined as a highly facilitated team-based process in which teachers, researchers, and developers work together in defined roles to design an educational innovation (Penuel et al., 2007).

the cycle of design-based research

(http://www.lkl.ac.uk/projects/designresearch/)
# DBR & Interaction Design

<table>
<thead>
<tr>
<th>DBR Theory Testing</th>
<th>Interaction Design Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The development of a theory.</td>
<td>1. Identifying the needs and establishing requirements for user experience.</td>
</tr>
<tr>
<td>2. The derivation of principles of for designs from the theory.</td>
<td>2. Development alternative designs that meet these requirements.</td>
</tr>
<tr>
<td>3. The translation of the principles into concrete designs.</td>
<td>3. Building interactive versions of the designs so that they can be communicated and assessed.</td>
</tr>
<tr>
<td>4. The assessment of the designs to test whether they works as anticipated.</td>
<td>4. Evaluating what is being built throughout the process and the user experience it offers.</td>
</tr>
</tbody>
</table>
5. Discussion

You can’t depend on your eyes when your imagination is out of focus.

-Mark Twain
Revisit: Research Question

What new design approaches can be developed for supporting emerging learning landscapes with ubiquitous computing?

- What is the role of the creative designer in research?
- What types of tools are required for these designers to conduct this type of research?
- What type of design toolkit for researchers can be developed to support mobile and ubiquitous computing for learning?
Initial Factors

<table>
<thead>
<tr>
<th>Creation</th>
<th>Action</th>
<th>Sharing</th>
<th>Reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>learners actively create</td>
<td>learners explore</td>
<td>learners share artifacts and converse about data</td>
<td>learners collaboratively expand knowledge through reflection and conversation</td>
</tr>
<tr>
<td>artifacts and learning</td>
<td>physical and tangible data in the real world</td>
<td></td>
<td></td>
</tr>
<tr>
<td>materials</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- How do we design for creation or action, emerging behavior?
- How do we design for coping in the landscape?
- Human factors » actors »CREATORS
- Design as synthesis / prospective
Coping in the learning landscape

Aspects of our being in the world

- Thrown
- Absorbed in coping
- Projecting

Implications for learning landscapes

- No time time to **reflect** on the world (Suchman, 1987)
- Needs to **physically** available (Norman, 1988)
- Needs to **cognitively** available (Waller & Johnston, 2009)
- Physical and Cognitive availability involves orientation to the future
  a) manipulating the space of possible actions
  b) indicating the possibilities for action (Waller & Johnston, 2009)
  c) enabling creation (this presentation)
  d) providing new spaces for sharing and reflection (this presentation)

# Expanded Factors

<table>
<thead>
<tr>
<th></th>
<th>Action</th>
<th>Creation</th>
<th>Sharing</th>
<th>Reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thrown</strong></td>
<td>in the world</td>
<td>in the world</td>
<td>in the world</td>
<td>in the world</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in the classroom</td>
<td>in the classroom</td>
<td>in the classroom</td>
</tr>
<tr>
<td><strong>Coping</strong></td>
<td>physical</td>
<td>physical</td>
<td>cognitive</td>
<td>cognitive</td>
</tr>
<tr>
<td></td>
<td>cognitive</td>
<td>cognitive</td>
<td>physical</td>
<td>physical</td>
</tr>
<tr>
<td><strong>Projection</strong></td>
<td>moving</td>
<td>moving/paused</td>
<td>moving/paused</td>
<td>paused</td>
</tr>
<tr>
<td><strong>New Media Literacies</strong></td>
<td>Play Multitasking</td>
<td>Distributed Cognition</td>
<td>Collective Intelligence</td>
<td>Visualization Judgment</td>
</tr>
</tbody>
</table>
Contexts of Interaction

- Outside Interaction
- Classroom Interaction
- Social Interaction
- Task Interaction

Legend:
- r = digital
- r = sight
- r = arm length
- r = reach

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Expanded Features

- An Emerging Landscape that is more firmly in the space of the body’s active engagement in its surroundings, in the ‘practical mastery’ of everyday tasks (Bourdieu 1997).

- Coping issue of physicality and cognitively
Different spheres for design

- **Research space**
  - Researchers
  - Organizations
  - Theory
  - Peers

- **Design space**
  - Designers
  - Outcome
  - Users

- **User space**
  - Learners
  - Organizations
  - Teachers
  - Create
  - Deliver

- **Hypothesis**
  - Data
Conceptual Toolkit
6. Take aways

Different media designs stimulate different potentials in human nature. We shouldn’t seek to make the pack mentality as efficient as possible. We should instead seek to inspire the phenomenon of individual intelligence.

-Jaron Lanier
Discussion

• Why a toolkit?

  ▶ Framework = basic structure underlying a system, concept, or text

  ▶ Toolkit = may refer to an assembly of tools

  ▶ **Toolkits for user innovation** (the process) is an innovation process in which the user itself does part of the innovation within a set environment.

  ▶ User toolkits for innovation and it is based on his belief in innovation made by lead users. The process is based on the idea that manufacturers possess the knowledge of the solution possibilities, while the users possess the knowledge about needs. This information is sticky and can therefore not be transferred easily between the user and the manufacturer.

Why a toolkit?

• Role of the designer, & design thinking
• Complex interaction problems + learning
• Design-based research
• The need to create space for creation, sharing, and reflection with action
• How to balance coping with “center of gravity”
Cycles of Research

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Toolkit

- Cycles and Spaces
- Common Language
- Open Standard Technologies
- Management of the innovation process
Ending Thoughts

• Seamless learning landscapes - seamless design

• Classroom Orchestration

• m4action.com
Next Steps

The International Conference of the Learning Sciences
Palmer House Hilton Hotel, Chicago, IL, June 29 - July 2 2010 (Preconference June 28-29)

Three perspectives on technology support in inquiry learning: Personal inquiry, mobile collaboratories and emerging learning objects

http://icls2010workshop.collide.info

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