Immersive Smart Learning Environments

Studienfach: Informatik Bachelor, FU Berlin
Modul: Wissenschaftliches Arbeiten in der Informatik
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- Studienordnung 35/2014
http://www.fu-berlin.de/service/zuvdocs/amtsblatt/2014/ab352014.pdf#G2235722
- 30 Min. Vortrag mit 10 Min. Diskussion
- Ausarbeitung: Vortrag in Textform

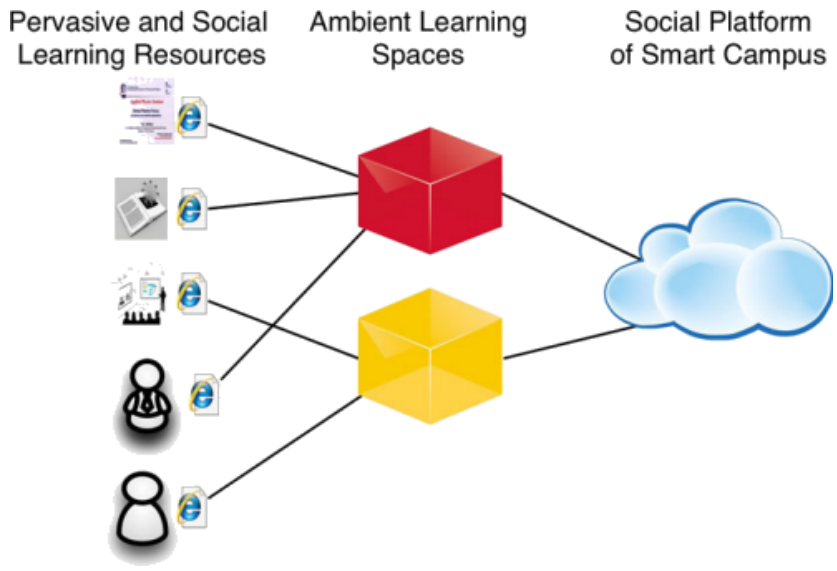
Immersive Smart Learning Environments - Introduction

- Overview on the evolution of learning spaces

- Yacine Atif et al. (2014) Building a smart campus to support ubiquitous learning
- Yacine Atif et al. (2017) A Cyberphysical Learning Approach for Digital Smart Citizenship Competence Development
- István Koren, Ralf Klamma (2016) Smart Ambient Learning with Physical Artefacts Using Wearable Technologies
- István Koren, Ralf Klamma (2017) Community Learning Analytics with Industry 4.0 and Wearable Sensor Data
- Jan Schneider et al. (2014) Augmenting the Senses: A Review on Sensor-Based Learning Support

Ambient Learning Space (ALS)

- Example: Chemistry Lab
  - → Functionality and availability
  - → define schedules and restrictions
- Network of
  - augmented physical learning resources
    - → clusters
  - human beings: faculty members



Ambient Learning Space (ALS)

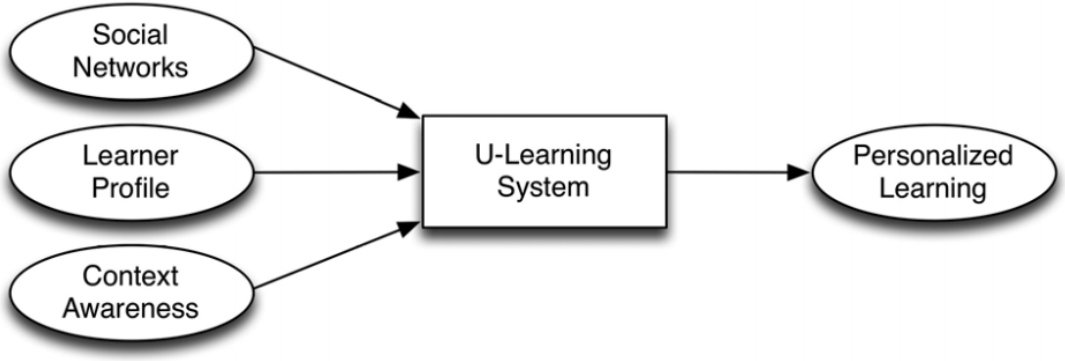
- Formal learning context
- Later: informal learning
- Outlook on examined contexts:

  - Smart Campus
  - Smart Cities
  - Sensor-based learning
    - → Wearable technologies
    - → Industry 4.0

Smart Campus

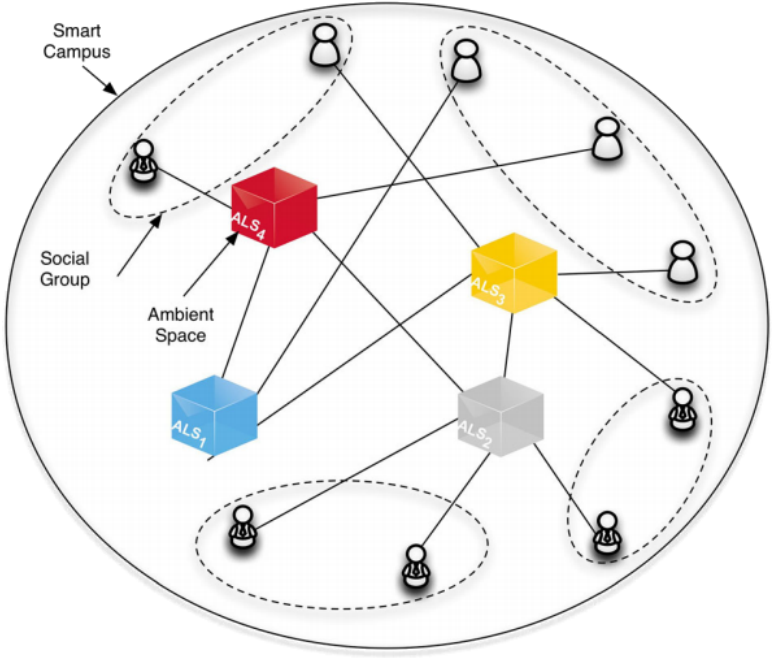
- Make learning better in a formal context

  → exploit technological advances
- Composition of ALSs
- Personalized learning agendas
  - U-learning: context data
  - Lots of social interactions
  - Learner profiles



Smart Campus

- PLOM (Pervasive Learning Object Metadata)
- Importance of Clustering
- Testing



Smart Cities

- Informal and context-dependent learning
- Smart cities → New learning approaches → New competences

→ Cyberphysical learning

→ augmented

→ situational

→ Digital Smart Citizenship Competences

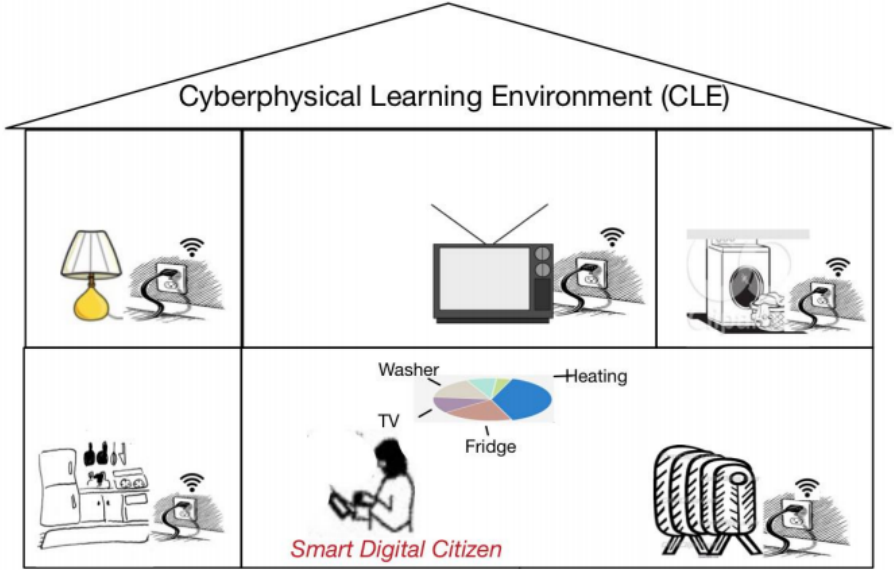
Smart Cities

- Energy Consumption Use Case
  - Washing-machine → increased awareness on value of energy
- Competences
  - Energy Use Data: Visualization of consumption
  - Energy Use Footprint: Realized + Forecasted consumption
  - Energy Use Control: Not exceeding given threshold

Smart Cities

- Learning paths + profiles
- Rely on inhabitants‘ engagement
- Feedback on lifestyle

  → behavioural changes



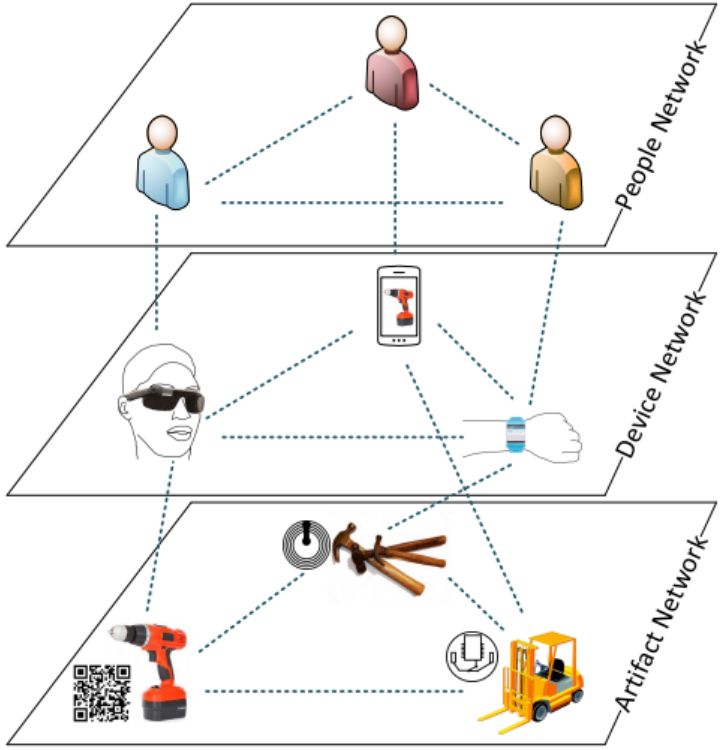
Wearables Technologies

- Constant availability
- Understanding of interactions between learners and entities

  → Community Learning analytics

Wearable Technologies - Examples

- Construction sector
  - List of tasks and tools
  - Videotutorials, Smart helmets
- Challenge: Service Discovery, Identifiability
  - QR-Codes
  - NFC (Near Field Communication)
  - BLE (Bluetooth Low Energy)



Actor–Network of Learning with Physical Artifacts

Wearable Technologies - Examples

- Exhibition Concept
  - Smartphone = Tour Guide and more
  - Interact with exhibition items
  - Successful feasability studies
- Overall challenges
  - Data ownership
  - Privacy and intellectual property issues

Community Learning Analytics – Industry 4.0 and Wearable Sensors

- How to methodologically analyze ‘interaction data‘?
  - Highly heterogeneous
  - Need for sustainable solution

  → ‘SWEVA‘: Social Webbased Environment for Visual Analytics
- Data source → visualization

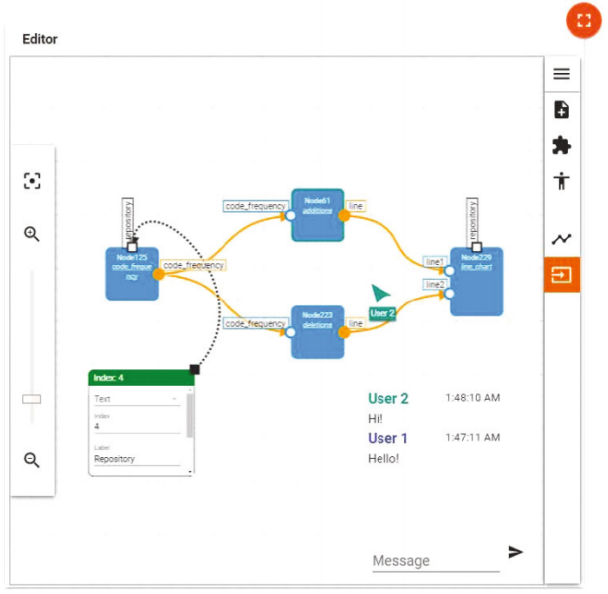
  + output of experts
- In near real time

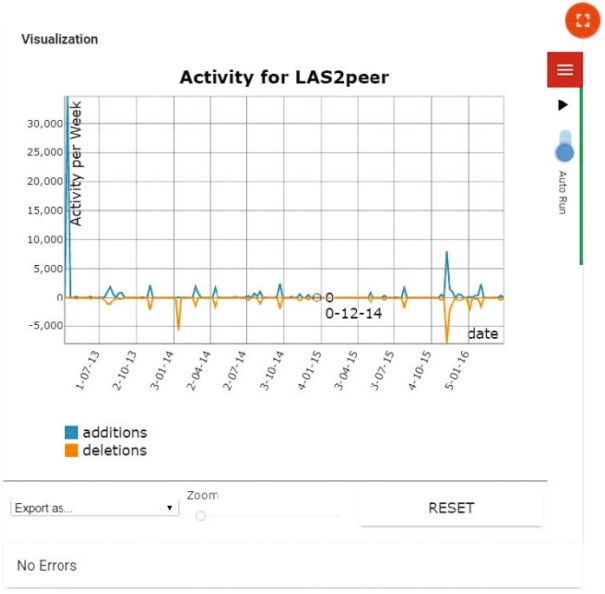
SWEVA – the five stages

Entities	Layers
Wearables, Smartphones, Industry 4.0 Machines	Data Sources
Databases, Services, ...	Data Aggregation
Collaborative Modeling Tool	Data Processing Model
Core Framework	Data Processing
Collaborative Visualization Tool	Data Visualization

Chronological Order

Data processing pipeline





Example

SWEVA - Simulation

- Tested with IoT Dataset

  → Hurricane Katrina (2005)
- 70 nodes → 30fps
- 110 nodes → 20fps

- Challenges: Data quality, privacy, machine learning

Sensor-Based Learning Support

- Sensors: tracking, recording, measuring
- + Software → Sensor-based Platforms
- Formative assessment: check for understanding while learning
- How to implement formative assessment?

  → 79 sensor-based prototypes analyzed:

  Learning domains (Bloom‘s taxonomy),

  formative assessment? feedback?

Sensor-Based Learning Support

- 56/79 prototypes → cognitive learning domain
  - e.g. movement tracker after heartstroke prototype
- 17/79 prototypes → psychomotor learning domain
- 6/79 prototypes → affective learning domain

- 35 gave feedback
- Why is feedback so important?

Sensor-Based Learning Support - Feedback

1) Where Am I Going?

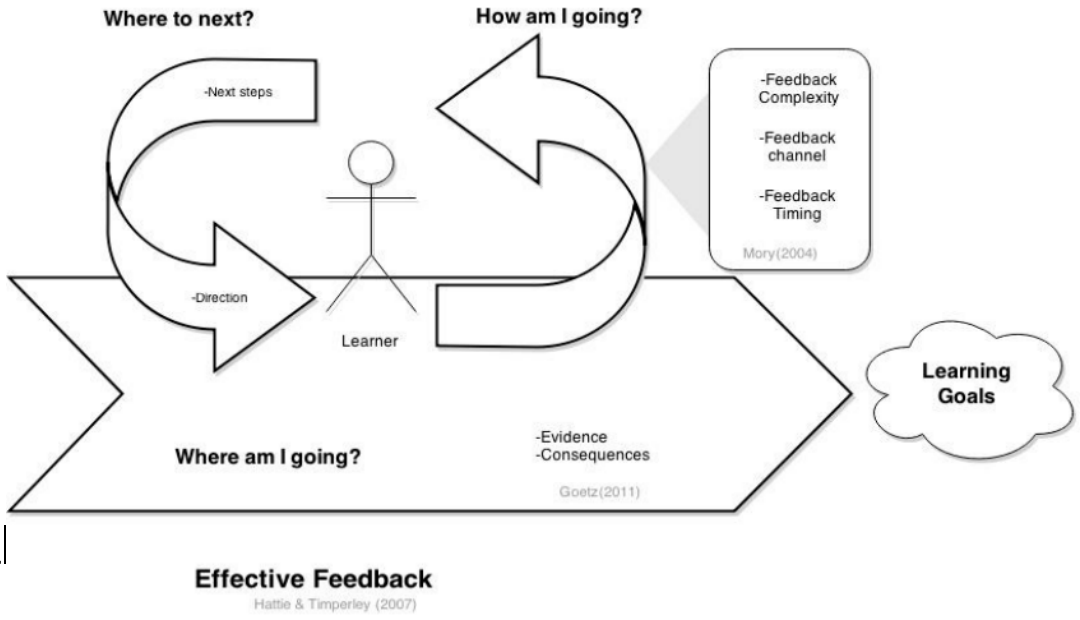
   → Goals, e.g. virtual garden prototype

2) How Am I Going?

   → Actions, e.g. martial artist prototype

3) Where To Next?

   → Advice on next step: personal learning paths



Sensor-Based Learning Support

- Feedback and formative assessment

  → but no prototype could answer all 3 questions
- Main two research branches:
  - Acquisition of data
  - Presentation of data to the user

Conclusion

- New technological advances
  - → revolutionize learning
- New opportunities but also new challenges
  - Framework for u-learning
  - Learning approaches for Smart Citizenship Competences
  - Interactions between learners and objects in informal contexts
  - Visual analytics tool ‘SWEVA‘
  - Sensor-based platforms implementing formative assessment

Conclusion II

- The future of learning
- Speed of innovation and progress >

  Answers to legal, moral, ethical questions?

Thank you.

All images used have their source in the papers listed.