4 Typology of Learning Environments

4.1 Classification Schemata for Learning Software
4.2 Systems Oriented Towards Behaviorism
4.3 Systems Oriented Towards Cognitivism
4.4 Systems Oriented Towards Constructivism
4.5 Systems Supporting Social Learning
4.6 Learning Management Systems

Literatur:

Main Pitfalls of E-Learning

• High Dropout rates in E-Learning
  – 35 percent and above are common!

• Pitfall One (Clark/Mayer): **Loosing Sight of the Job**
  – "There is no one set of skills that support expertise across the diverse contemporary workforce."
  – *Do you see connections to Learning Theories, to HCI theory?*

• Pitfall Two (Clark/Mayer): **Media Abuse**
  – "Balance between technophile an technostic approaches"
  – See later

• *Do you see further problems with the concept of e-learning (or its current implementations)?*

Approaches to Classify Learning Environments

• By usage situation:
  – Remote learning / co-located learning
  – Isolated / connected learners
  – Usage modalities, including physical activities (embodied learning)

• By technology usage:
  – Local / networked
  – Web-supported / Web-enhanced / Web-based (Amy Wilson)

• By learning methodology:
  – Based on learning theories:
    Behaviorism, Cognitivism, Constructivism, Social Learning
  – Used here
Our Classification Schema

• Characteristics
• Examples
• Sub-Categories
• Placement in a two-dimensional schema
  – Based on Bodendorf 1990
  – Dimension x: Learner Initiative
  – Dimension y: System Flexibility
Learner Initiative

low
Exercises
Tests

high
Simulations
Cooperative systems
System Flexibility

- Low
  - Fixed sequences
  - Static structure
- High
  - Multiple pathways
  - Adaptive/dynamic structure
Interaction Styles

**Help**
Learning by hints

**Passive Tutor**
Self-controlled learning

**Training**
Learning by practice

**Active Tutor**
Directed learning

**Simulation**
Explorative learning

**Game**
Entertained learning

**Problem Solving**
Learning-by-Doing

**Intelligent Dialog**
Socratic learning

Bodendorf
1993
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Behaviorism

Stimulus \rightarrow Response

Conditioning

Reinforcement
Programmed Instruction

• Content is broken down into *frames*
  – Frame contains statements and questions
• Learners read a frame at a time and immediately answer a question
  – Filling a blank
  – Selecting among alternatives
  – Solving a problem
• Learner receives immediate feedback

---

1. Words are divided into classes. We call the largest class nouns. Nouns are a class of ________________.  
   
2. In English the class of words called nouns is larger than all the other ________________ of words combined  

---

http://edutechwiki.unige.ch/en/Programmed_instruction
Example: Passive Tutoring

What is the degree of user initiative?  
What is the degree of system flexibility?  
Is this related to a learning theory?
Example: Training of Language Vocabulary (1)

The Review mode of VTrain appears, prompting us to answer a question.
Example: Training of Language Vocabulary (2)
Example: Training of Language Vocabulary (3)
Example: Training of Language Vocabulary (4)
Example: Training in Electronics

http://www.v-techuk.com/
E-Reinforcers

- *Do you remember the definition of reinforcement?*
- How to reinforce in an e-learning situation?
  - Historical solution: Sweet dispenser…
- Known types of reinforcement:
  - Experience reinforcement
  - Self-esteem reinforcement
  - External reinforcement
- *Which reinforcers have you met in real life, and to which category do they belong?*
Example: Drill-And-Practice

**Significant Figures**

Here you will be presented questions regarding significant figures. When you hit "New Number", a question will appear to the right of the table. Enter the number of significant figures in the answer cell and press "Check Answer". The results appear in the second table.

- If you miss a problem three times, pressing "Show Answer" will display the complete solution and you will no longer be able submit an answer for that problem.

Determine the number of significant figures in $4.000 \times 10^2$.
Example: Test (Quiz)

Plagiarism Quiz

I have a class this quarter that is similar to a class I had at Mt. SAC last year. It's not plagiarism if I submit the paper I wrote for that class for my class this year.

3/10

- True
- False

Design Decisions

• User guidance
  – Degree of learner control

• Dealing with wrong answers
  – No reaction (no reinforcement)
  – Feedback that answer is wrong
  – Show the right answer
    » Show the right answer after a certain number of attempts
  – Give additional explanations?
  – Branching sequences (see next slide)

• Dealing with correct answers
  – Give additional explanations?
Linear and Branching Programming

• Reaction-centered approach (Skinner/Holland):
  – Feedback only for correct answers
  – Strictly linear

  \[ \begin{array}{c}
  1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5
  \end{array} \]

• Stimulus-centered approach (Norman Crowder):
  – Feedback also on negative answers
  – Feedback control loops to enable repetition of sub-sequences

  \[ \begin{array}{c}
  1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5 \rightarrow 4\text{a} \rightarrow 4\text{b}
  \end{array} \]
Behaviorism-Oriented Systems

System Flexibility

- Passive Tutor: low Help, low System Flexibility
- Active Tutor: high Help, high System Flexibility

Learner Initiative

- Passive Tutor: low Learner Initiative
- Active Tutor: high Learner Initiative

Applications

- Simulation: low Help, high Learner Initiative
- Game: high Help, low Learner Initiative
- Intell. Dialog: high Help, high Learner Initiative
- Training: low Help, low Learner Initiative

Behaviorism
Learning Algebra with Ms. Lindquist

Debbie has two jobs over the summer. At one job she bags groceries at Giant Eagle and gets paid 5 dollars an hour. At the other job she delivers newspapers and gets paid 7 dollars an hour. She works a total of 30 hours a week. She works "g" hours bagging groceries. Write an expression for the total amount she earns a week.

Student: \( g\times 7 + (30-g)\times 5 \)
Tutor: Hmm. No. We will come back to the total pay per week. Let me try to break this down for you. What is the hours delivering newspapers?
Student: 30-\( g \)
Tutor: Correct. If "B" was the hours delivering newspapers then what would be the pay from the newspaper?

http://www.algebratutor.org/
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Intelligent Tutoring Systems (ITS)

• Combining Artificial Intelligence (AI) and education methods
  – Ideas from the 1960s, implementation in the 1980s
• Key characteristics:
  – Representation of domain knowledge, modeling of student + adaptation
  – Mixed initiative: Student can ask questions
• Typical interaction techniques:
  – Socratic dialogue: System guides learner by (adaptive) questions
  – Coaching: Assistance function in background until requested
  – Learning by doing: System closely guides learner through activities
  – Learning while doing: System passively observes learner and gives occasional hints
• Knowledge representation:
  – E.g. Semantic network
  – E.g. Collection of rules (expert system)
Cognitivism

Schemata

Assimilation & Accommodation

Processing Information to Knowledge
Architecture of an ITS

- Expert Model (Knowledge)
- Tutor Model (Educational Strategy)
- Communication Model (Interface)
- Learner Model

Processes:
- Problems
- Teaching content
- Performance level
- Evaluation
- New material
- Feedback
- Tasks/problems
- User interface

Feedback:
- Expert solution
- Student's solution
- Evaluation
- Learner performance level
Learner Models

• Main approaches:
  – Subset model (or overlay model): Which subset of the expert knowledge has been mastered?
  – Difference model: Which are the differences between expert solution and learner solution?

• Functions of learner models (according to Self 1988)
  – Corrective function
  – Elaborative function
  – Strategic function
  – Diagnostic function
  – Predictive function
  – Evaluative function
Diagnosis: Finding the Reason for Errors

• Ideally, the tutorial system can find the “wrong schema” which causes a wrong answer
  – Problem: All possible “mal-rules” are clearly intractable

• Examples for error diagnosis by tutorial system:
  – “Proust” tutor for Pascal programming (Johnson 1986)
    » Context: Line 12 in student’s program: NEW = NEW + 1;
    » Tutor: It appears you were trying to use line 12 to read the next input value. Incrementing NEW will not cause the next value to be read in. You need to use a READ statement here.
  – The Algebra Tutor (Anderson et al 1990)
    » Student rewrites the equation “15 - 3x = -x” as “15 = -4x”.
    » Tutor: “15 = -4x” is wrong because you added -3x instead of its inverse to -x. Try again.

Example source: Merrill et al 1992
Example: AutoTutor

Art Graesser, University of Memphis

Picture: V. Catete, ncsu.edu
Example: JavaTutor

Kristy Boyer, NCSU, 2010

Investigating human-human(!) tutoring language
Example: EarthTutor, 2005 (1)

Earth science (remote sensing), in particular usage of image processing software from NASA and NIH
Example: EarthTutor, 2005 (2)

http://www.stottlerhenke.com/earthtutor/
Criticism on ITS Principles

• Mark Elsom-Cook 1993:
  – “takes no account of the rich range of learning styles and capabilities for which there is psychological evidence”

• Ohlson/Langley 1988:
  – “there are disappointingly few psychological principles that can be used for [evaluating the psychological plausibility of a solution or mistake]”

• Bredo 1993:
  – “the assumption of a given task and given expertise puts students in a passive role with respect to finding their own problems and developing their own expertise”

Quotations based on talk by Martin Homik, published on slideshare.net
Cognitivism-Oriented Systems

- Help
- Active Tutor
- Passive Tutor
- Simulation
- Game
- ITS
- Training
- Intell. Dialog

System Flexibility

Learner Initiative

Cognitivism
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Constructivism

It's All Invented!

Active Learners

Construction by sense-making activities

Individual Differences
Properties of Constructivist Learning Environments

“Web of Constructivism” according to D. Jonassen 1994

Example for a MicroWorld: Logo

- Seymour Papert
- Programming by moving a turtle through commands
- Learning concepts by abstraction from experience
Example: MicroWorlds

- Squish and SurveyGraph, written in MicroWorld EX
Example: Sniffy the Virtual Rat
Example: Simulation of Neuronal Networks

http://www.membrain-nn.de/
Simulations and MicroWorlds

• “Learning by Doing”
  – Real (ill-structured) problems
  – Self-directed problem solving
  – Limited guidance (scaffolding)

• System components:
  – Realistic views on simulated world (also 3D / immersive)
  – Simulation
  – Tool selection and manipulation
  – Real input / output devices (e.g. driving or flight simulator)
  – Tutorial mode
  – Interactive help
  – Evaluation of progress
  – Triggers for reflection / meta-cognition
Example: Reflection Triggers

"What things happened that were not expected?"
"Advice for others!"

Usage of sentence templates

SMILE, Kolodner/Nagel 1999
Criticism of Learning with Simulations

- Günter Daniel Rey 2009 and others
- Learners struggle to design experiments
  - Variables, hypotheses
  - Interpretation, reasoning
- Learners struggle with self-management
  - Self-monitoring
  - Time planning
- Tendency:
  - Simulations often are too demanding
  - Lead to time-inefficient learning
Current Research: Observing Learners

"CiSpace"
Amershi et al.

Kardan/Conati, UBC (e.g. paper on CHI 2015):
Exploring Gaze Data for Determining User Learning with an Interactive Simulation,
Designing adaptive interventions
Games for Learning: Serious Games

America’s Army (2002)

Food Force (2005)

Latin America (2008)

The Magi and the Sleeping Star (2009)
Problem-Based Learning (PBL)

• Authentic, ill-structured problem
• Self-directed learning process, often in teams
• Computer usage: Access to resources, documentation, communication

The Geritol Solution

John H. Martin, the director of the Moss Landing Marine Laboratories, thinks the potential problem of global warming could be addressed by dumping iron into the ocean waters off Antarctica. He and his coworkers have demonstrated that the amount of chlorophyll found in ocean water samples collected (in 30 L bottles) from the Gulf of Alaska can be increased up to nine-fold by the addition of iron.

When they repeated this fertilization experiment with samples collected from a few hundred miles off the Antarctic coast, he and his colleagues found that for every unit of iron added to antarctic sea water, the organic carbon content increased by a factor of 10,000.

Martin's degree of confidence in his proposal is reflected in a remark he (half-jokingly) made during a lecture at the Woods Hole Oceanographic Institute: "Give me half a tanker of iron and I'll give you an Ice Age."

Questions
• What is the basis for Martin's premise that seeding the ocean with iron would help combat potential greenhouse warming?…
Constructivism-Oriented Systems

- System Flexibility
  - Low
  - High

- Learner Initiative
  - Low
  - High

- Help
- Active Tutor
- Passive Tutor
- Simulation
- Game
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Constructivism
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Social Learning

Learning in Groups

Model Learning

Zone of Proximal Development

Situated Cognition
Online Learning Communities

• From the isolated e-learner to an active community
• System support required for:
  – Creating awareness of the activities of others
  – Supporting individual learning styles
  – Supporting individual control of learning speed
  – Making it easy to share products
• System architectures:
  – Either centered on one medium
    » Forum
    » Document management, assignments, grading
    » E-Portfolios
    » Multimedia materials like video recordings
  – Or providing a general integrative platform
    » Learning management systems, see below
Massive Open Online Course (MOOC)

- Massive: What is massive?
  - 100?
  - 1,000?
  - 10,000?
  - 100,000?

- Open:
  - Open registration?

- Online:
  - Local cohorts?
  - Self-paced?

- Course:
  - Start/end dates?
  - College credits?
  - Badges?
  - Role of the instructor?
  - Learning community?
  - Scripted assessments and feedback?

- Focus on Scalability:
  - Free of charge?
  - Affordable?
  - Real-time interaction?

- Focus on Community and Connections:
  - Open content?

Mathieu Plourde, Wikipedia
MOOCs at LMU (Coursera)

Since July 2013, LMU has been making four online courses available. These courses are freely accessible, and have been developed by leading specialists in various disciplines.

**Introduction to Mathematical Philosophy**

**Instructors:**
- Prof. Dr. Hannes Leitgeb
- Prof. Dr. Stephan Hartmann

**Start:** 27 April 2015

**Theatre and Globalization**

**Instructor:**
- Prof. Dr. Christopher Balme

**Start:** 16 February 2015

**Competitive Strategy**

**Instructor:**
- Prof. Dr. Tobias Kretschmer

**Advanced Competitive Strategy**

**Instructor:**
- Prof. Dr. Tobias Kretschmer

**on demand**
iSocial: 3D Virtual Learning World

Based on Second Life

Systems for Social Learning

- Help
- Active Tutor
- Simulation
- Game
- ITS
- Training
- Intell. Dialog

System Flexibility

Learner Initiative

Collaborative Online Learning

Social Learning
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Literatur:

U. Höbarth: Konstruktivistisches Lernen mit Moodle, Verlag Werner Hülsbusch 2010
C. Wiegrefe: Das Moodle-2 Praxisbuch, Addison-Wesley 2011
Learning Management System (LMS)

• Software application for the administration, documentation, tracking, and reporting of training programs, classroom and online events, e-learning programs and training content. (Ellis 2009)

• LMSs combine functionalities on a common platform which have been available and have been used as separate instances for a long time.
  – Administrative systems for enrollment and access to materials and examinations
  – Content management for learning materials
  – Online tests
  – Communication tools for learners and advisors

• LMSs are radically different from authoring systems for individual learning materials
  – The authored products become materials or modules in the LMS
Example Moodle

• Moodle = *Modular Object Oriented Learning Environment*
• Open source product, see [http://moodle.org](http://moodle.org)
• Key inventor: Martin Dougiamas (Curtin University, Australia)
  – Start of development 1999
  – First version published in August 2002
  – Moodle Version 2: November 2010, current 2.9 (May 2015)
• Modular system for establishing a virtual course room
  – Containing
    » working materials (Arbeitsmaterial) and
    » activities (Aktivitäten)
• Social-constructivist approach to teaching and learning
Standard Activities in Moodle

- Assignment (Aufgabe)
- Chat
- Data base (Datenbank)
- Feedback
- Forum
- Glossary (Glossar)
- Lesson (Lektion)
- Quiz (Test)
- SCORM (Lernpaket)
- Survey (Umfrage) – according to COLLES or ATTLS
- Wiki
- Workshop – collaborative team work