4 Typology of Learning Environments

Literatur:

Rolf Schulmeister: Grundlagen hypermedialer Lernsysteme: Theorie – Didaktik – Design. Oldenbourg 2007

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)?***

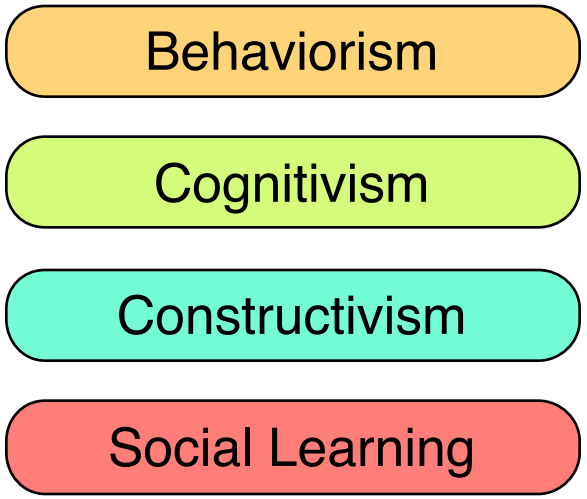
Ruth Clark/Richard Mayer: e-Learning and the Science of Instruction, Pfeiffer, 2nd ed. 2011

Approaches to Classify Learning Environments

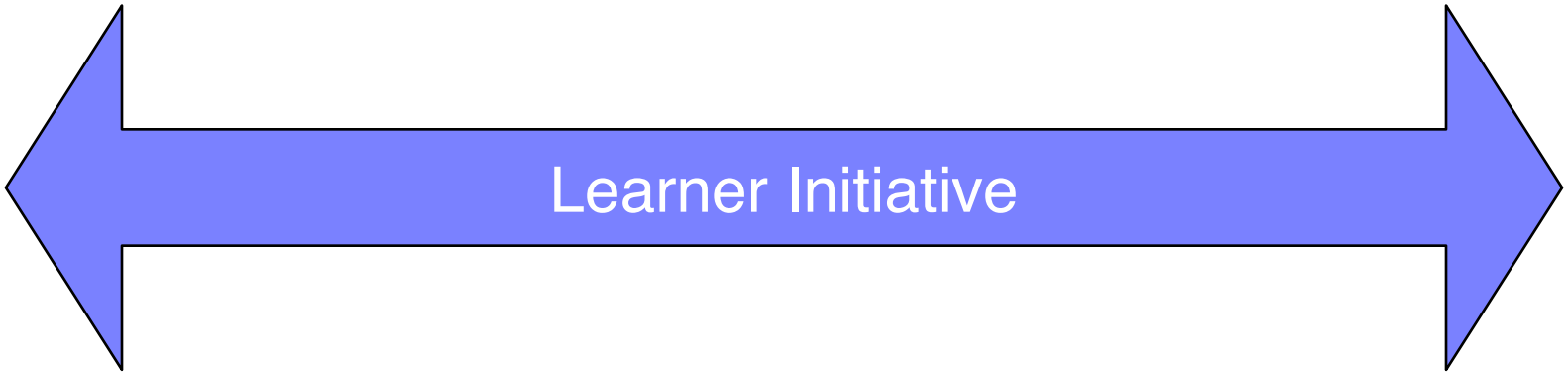
- By usage situation:
  - Remote learning / co-located learning
  - Isolated / connected learners
  - Usage modalities, including physical activities (embodied learning)
- By technology usage:
  - Local / networked
  - Web-supported / Web-enhanced / Web-based (Amy Wilson)
- By learning methodology:
  - 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



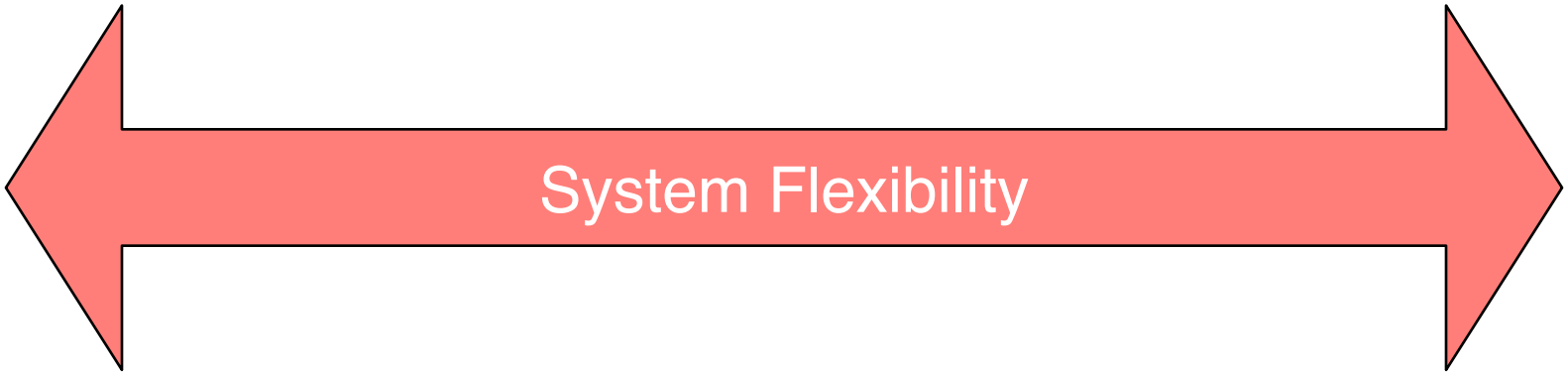
low

high

Exercises
Tests

Simulations
Cooperative systems

System Flexibility



low

high

Fixed sequences
Static structure

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

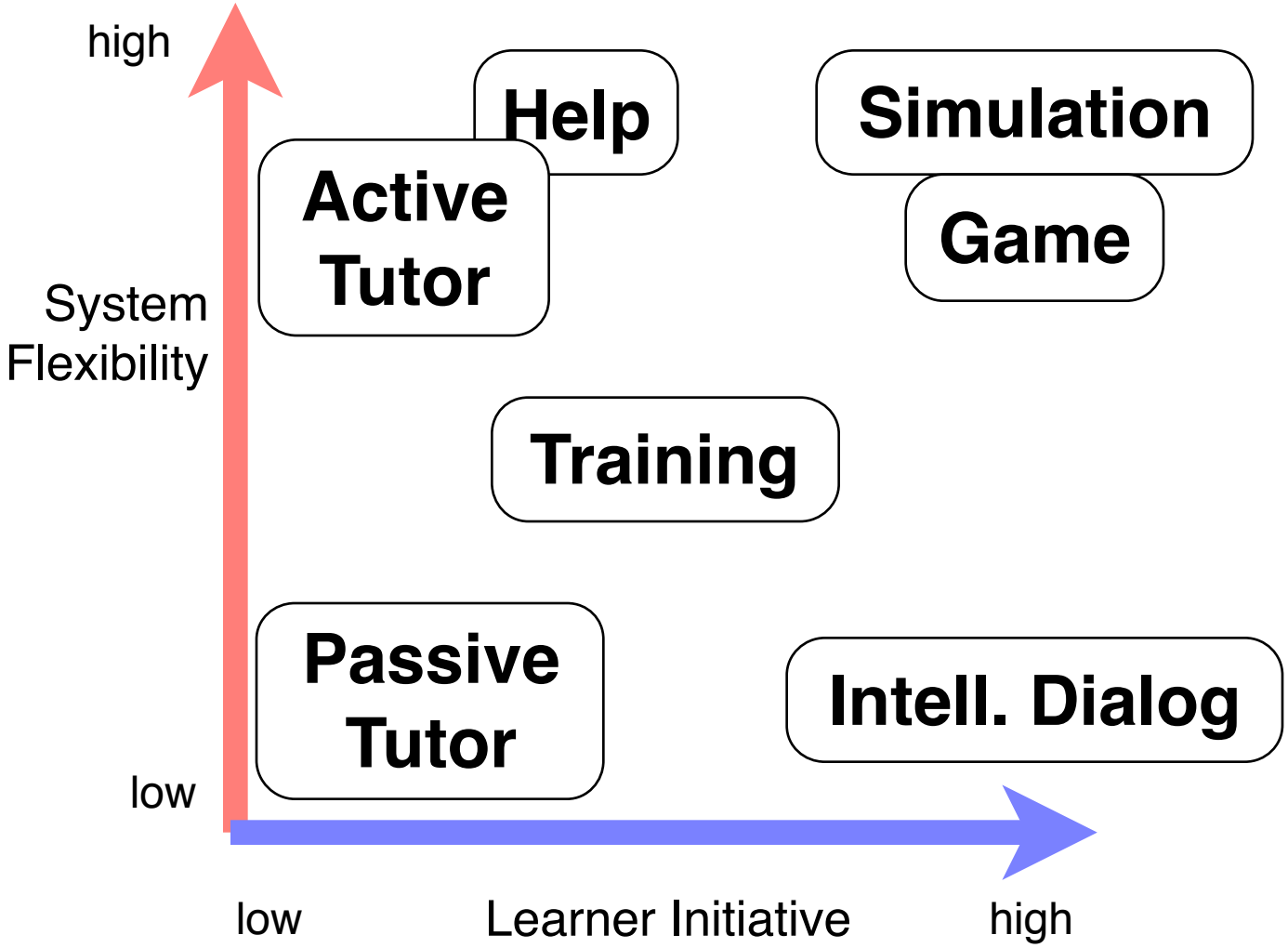
Game
Entertained learning

Problem Solving
Learning-by-Doing

Intelligent Dialog
Socratic learning

Bodendorf
1993

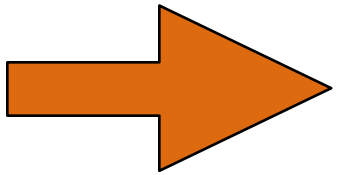
Two-Dimensional Schema



4 Typology of Learning Environments

Behaviorism

Black Box

Stimulus  Response

Conditioning

Reinforcement

Programmed Instruction

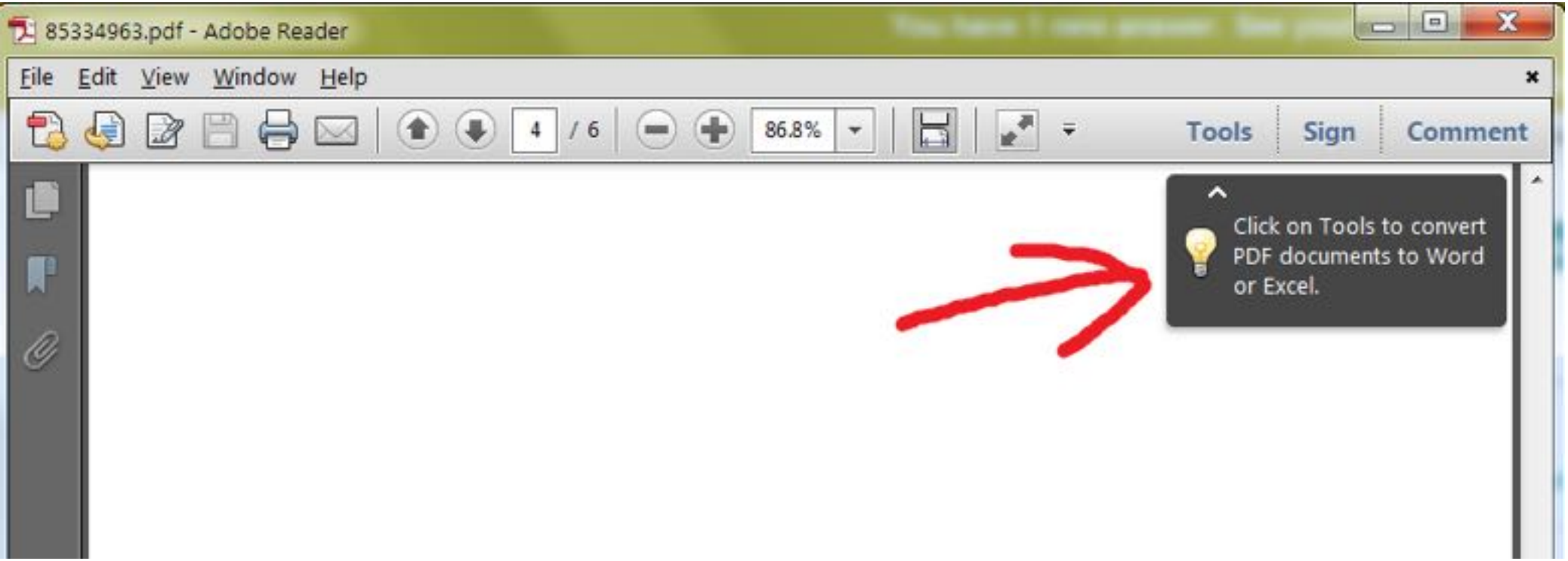
- Content is broken down into *frames*
  - Frame contains statements and questions
- Learners read a frame at a time and immediately answer a question
  - Filling a blank
  - Selecting among alternatives
  - Solving a problem
- Learner receives immediate feedback

1. Words are divided into classes. We call the largest class nouns. Nouns are a class of _____. words

2. In English the class of words called *nouns* is larger than all the other _____ of words combined classes

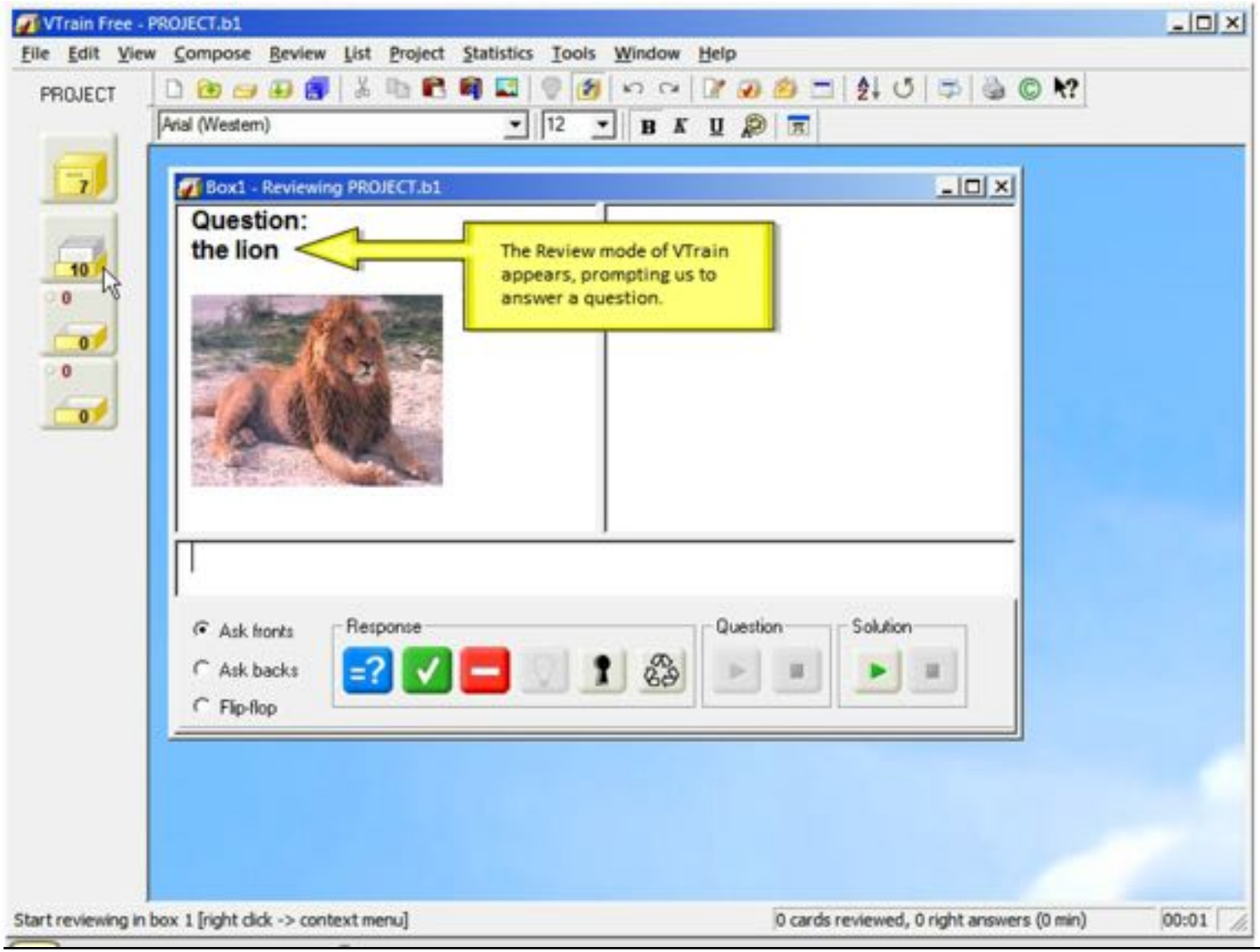
http://edutechwiki.unige.ch/en/Programmed_instruction

Example: Passive Tutoring



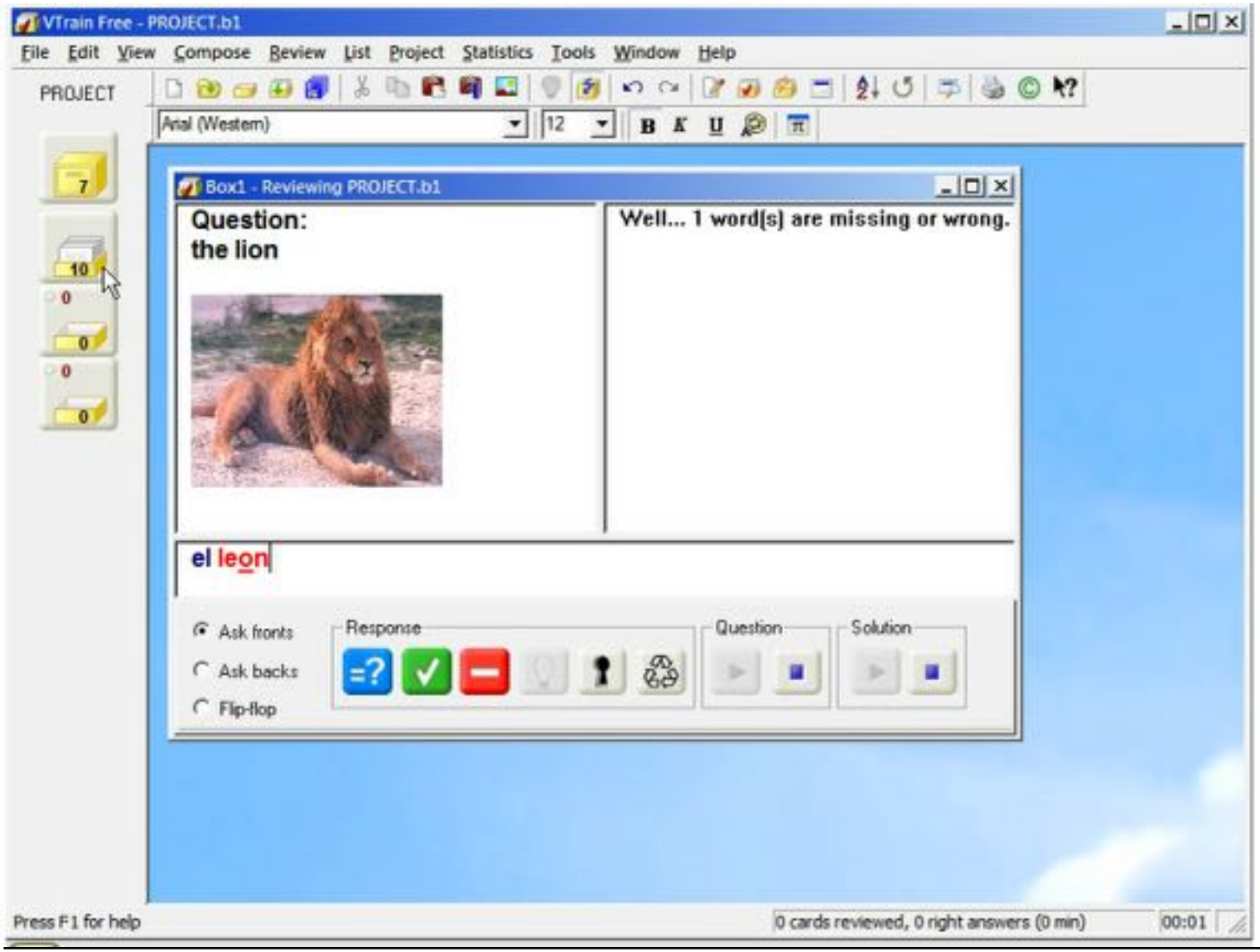
What is the degree of user initiative?
What is the degree of system flexibility?
Is this related to a learning theory?

Example: Training of Language Vocabulary (1)



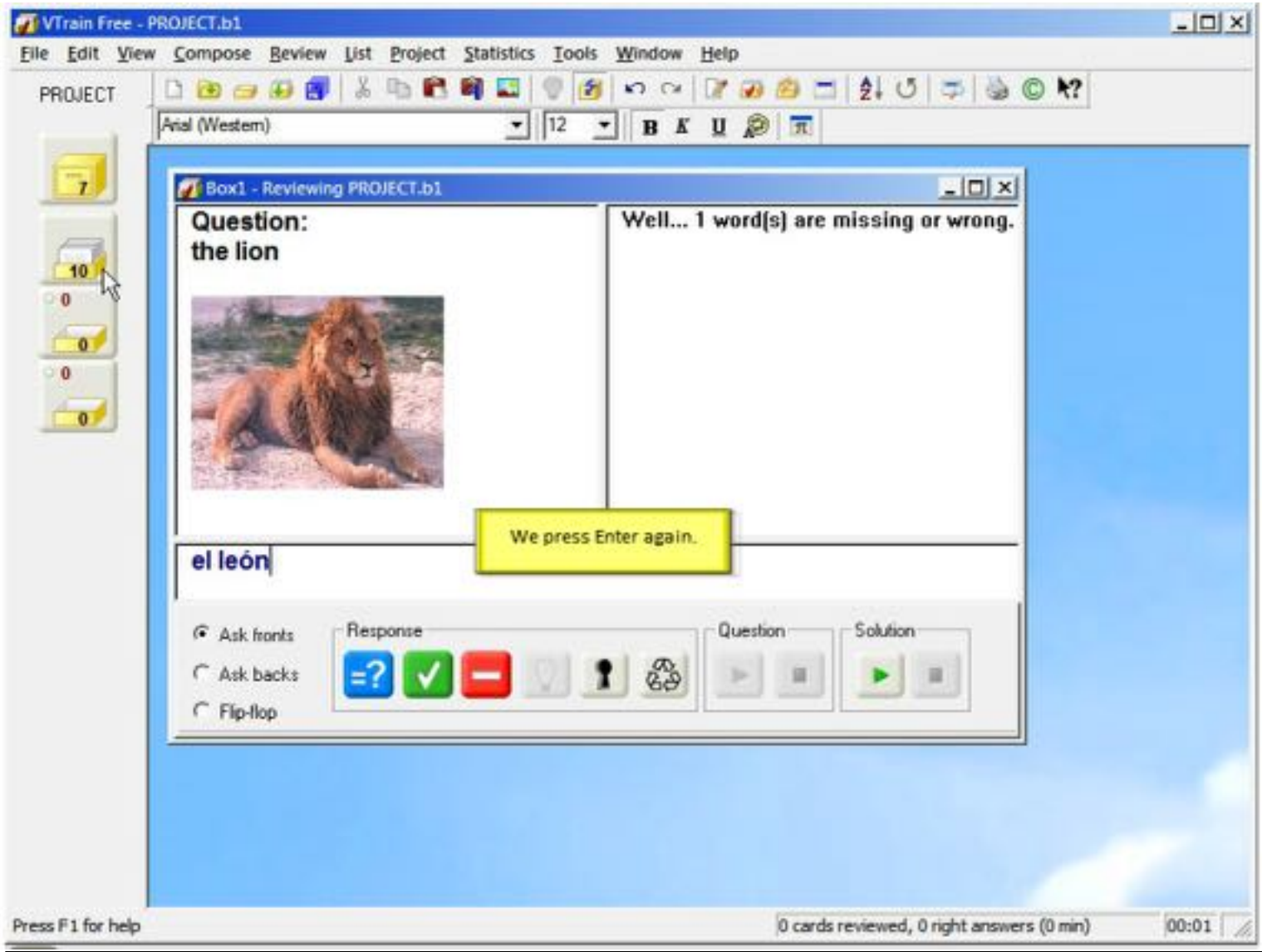
vtrain.net

Example: Training of Language Vocabulary (2)



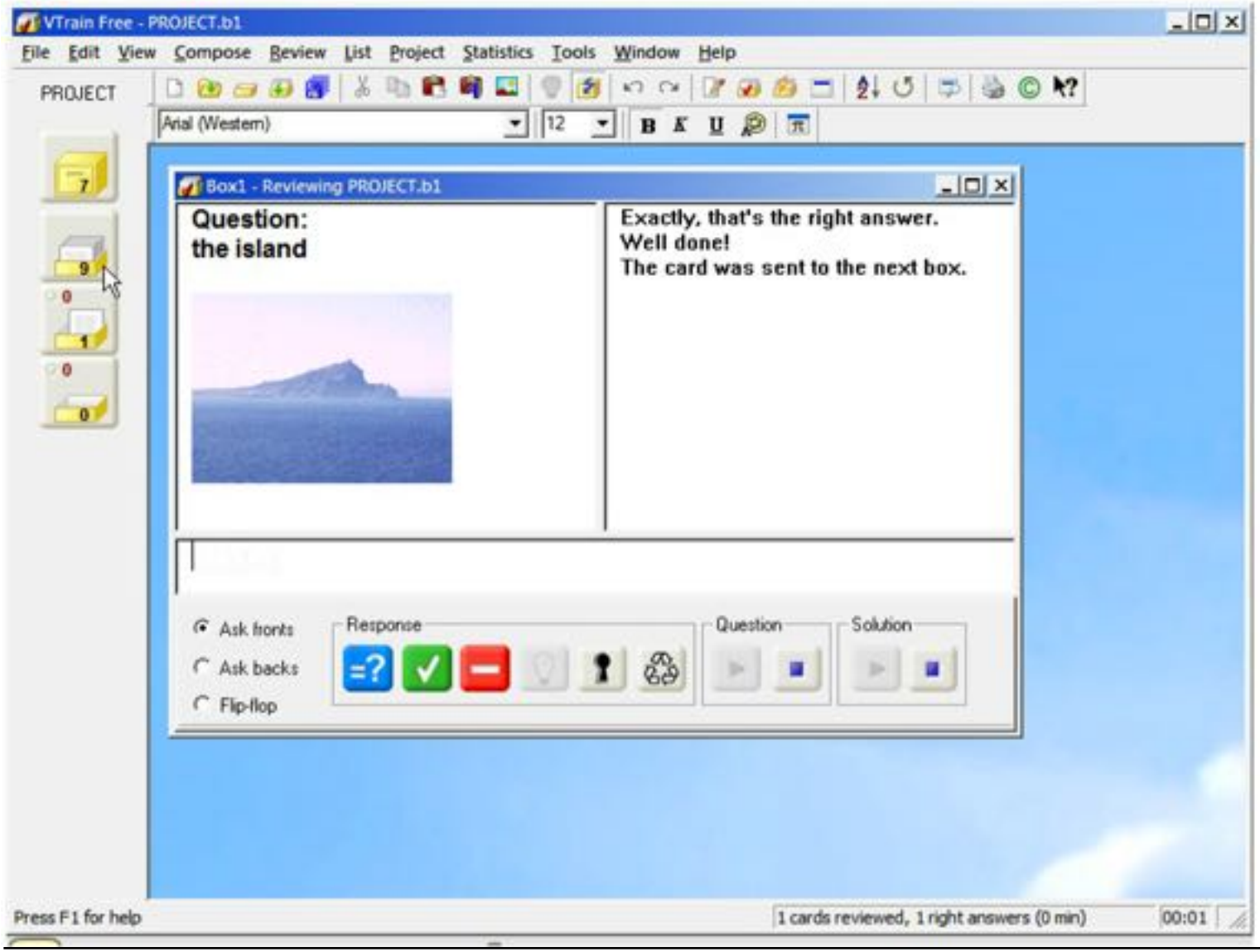
vtrain.net

Example: Training of Language Vocabulary (3)



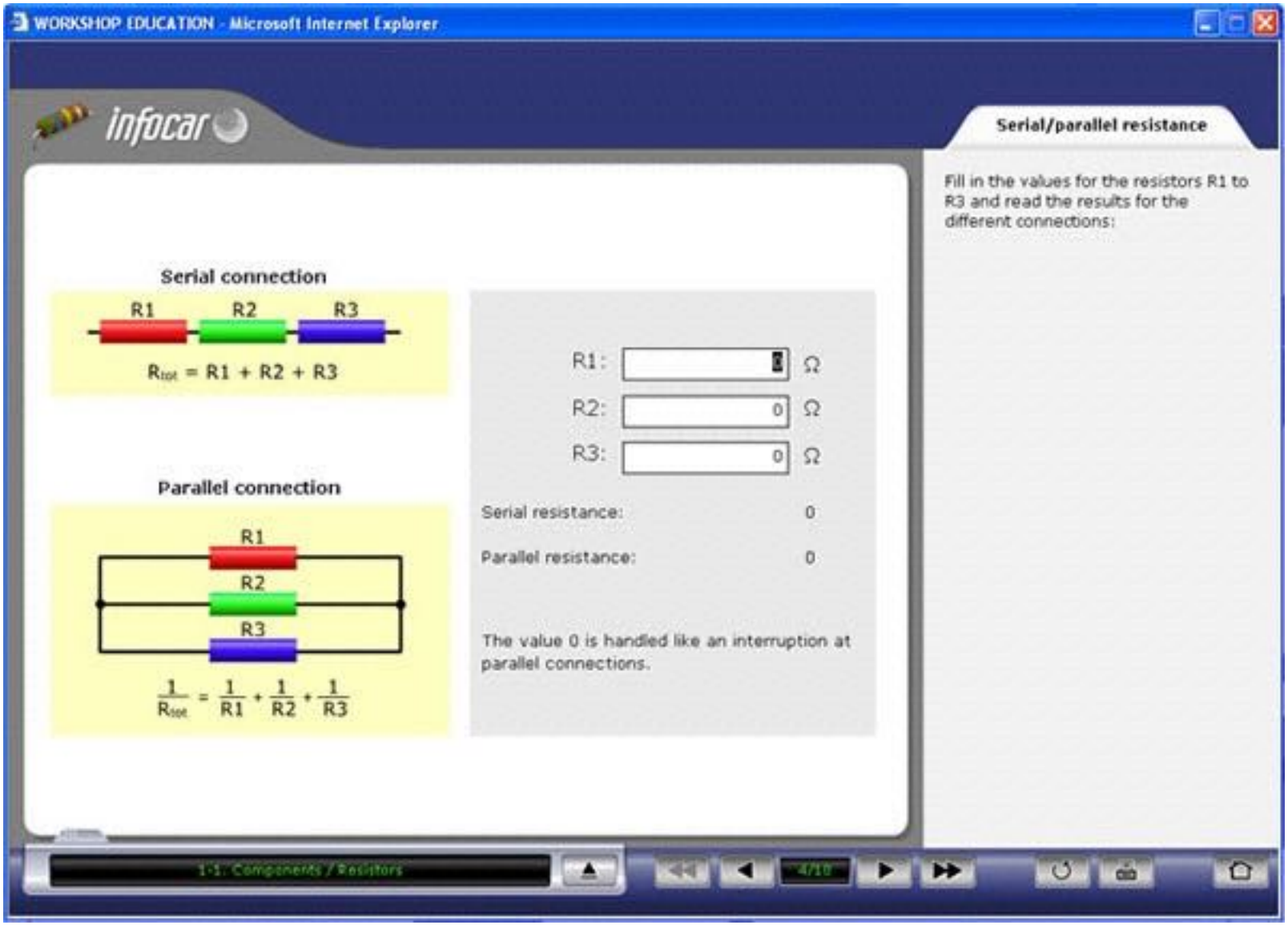
vtrain.net

Example: Training of Language Vocabulary (4)



vtrain.net

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 signifcant 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.

New Problem

4 Enter your answer here

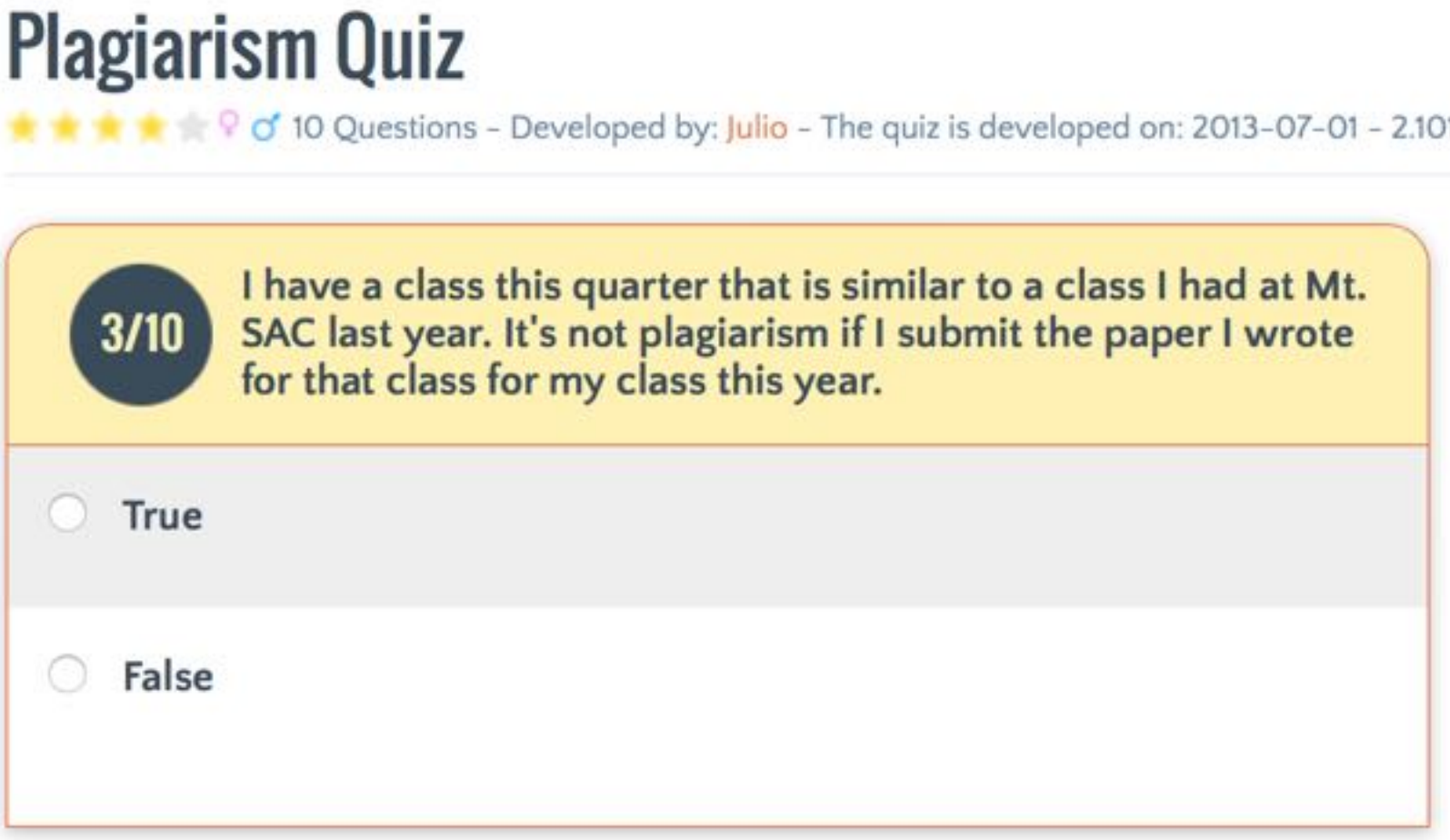
Check Answer Show Answer

Results	Total Done	Total Correct
correct	17	10

Determine the number of signficant figures in $4.000*10^{+2}$

http://science.widener.edu/svb/tutorial/

Example: Test (Quiz)



http://www.allthetests.com/knowledge-tests-trivia-Copyright-and-plagiarism.php?katb=070C

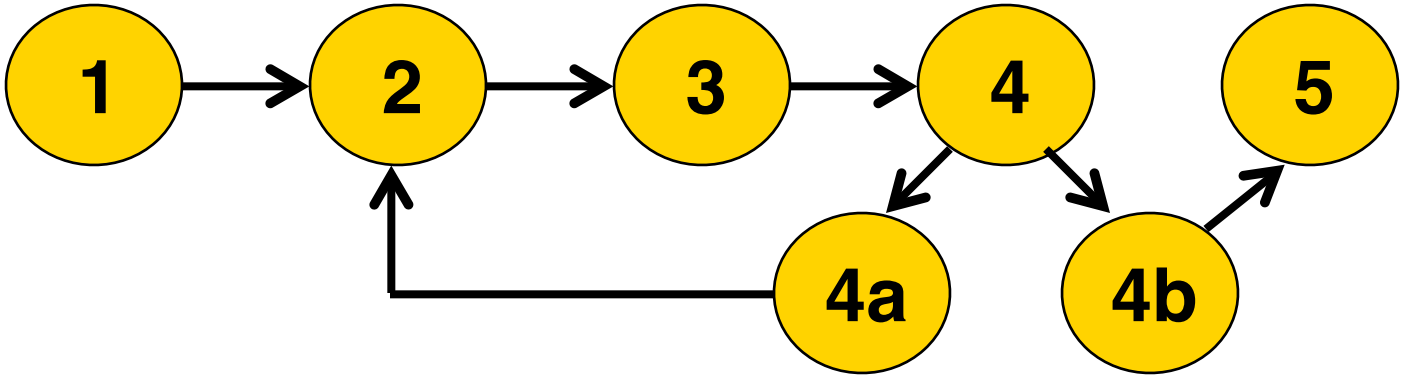
Design Decisions

- 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?

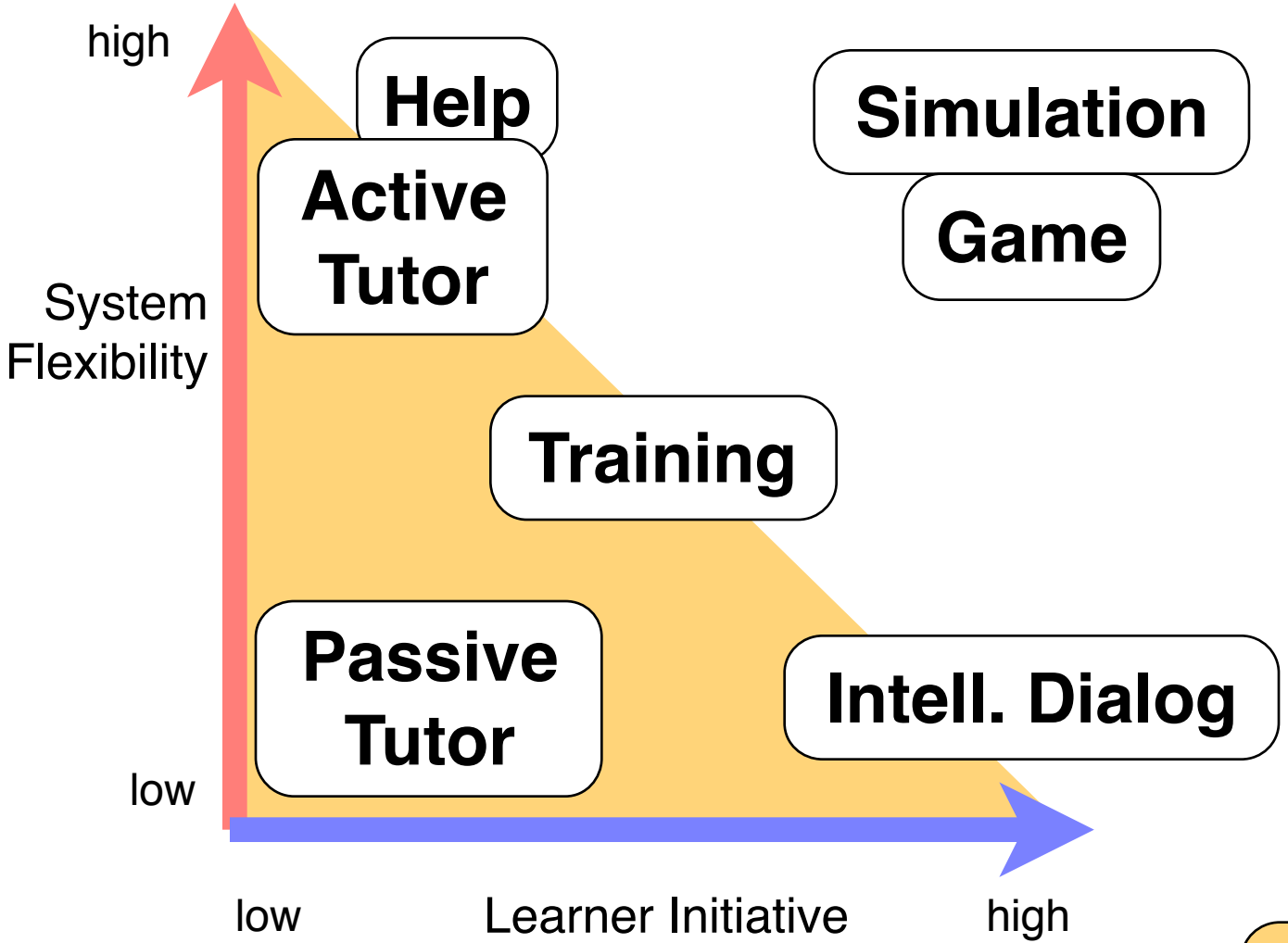
Linear and Branching Programming

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

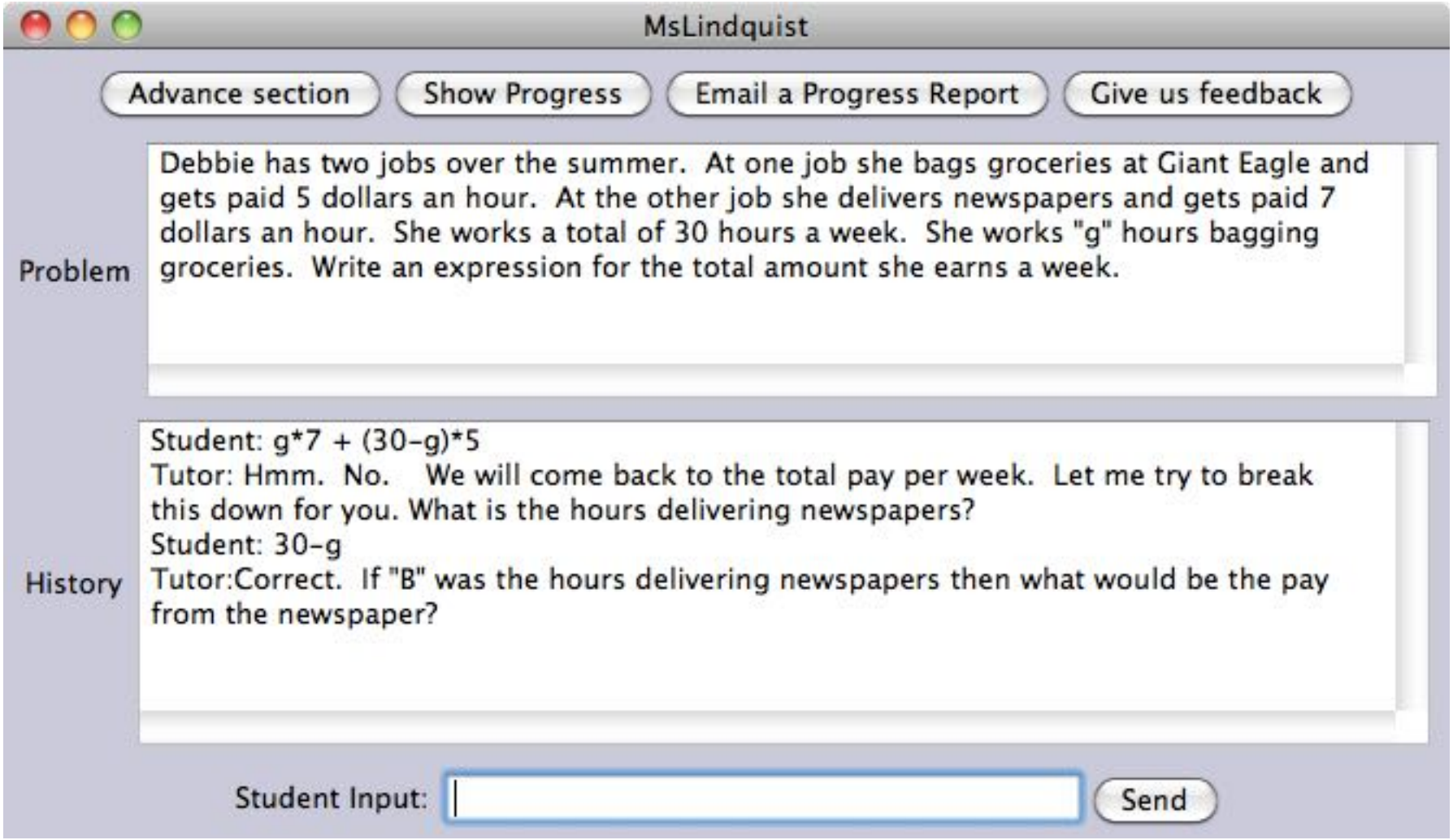
- Stimulus-centered approach (Norman Crowder):
  - Feedback also on negative answers
  - Feedback control loops to enable repetition of sub-sequences



Behaviorism-Oriented Systems



Learning Algebra with Ms. Lindquist



http://www.algebratutor.org/

4 Typology of Learning Environments

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)

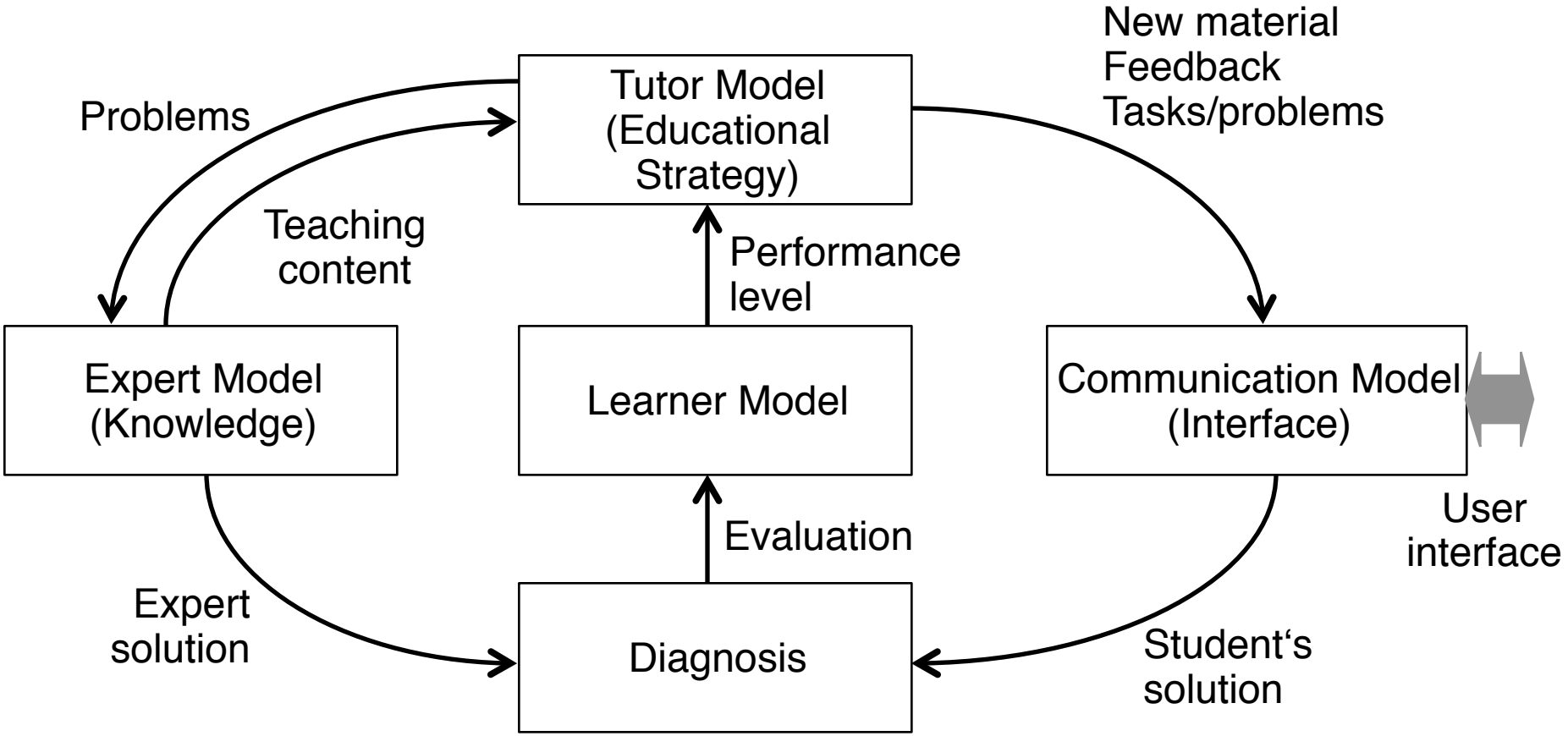
Cognitivism

Schemata

Assimilation & Accommodation

Processing Information to Knowledge

Architecture of an ITS



Learner Models

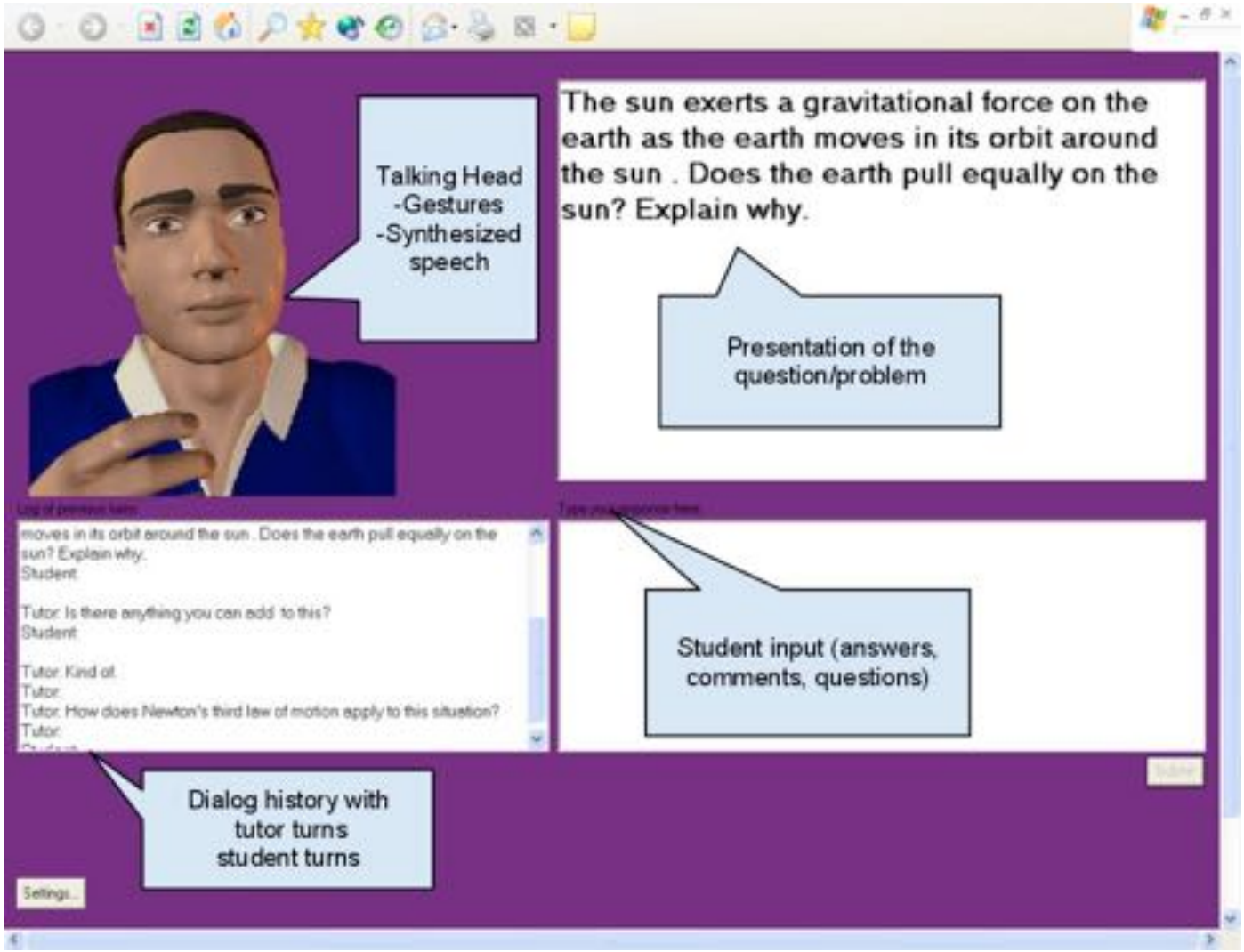
- Main approaches:
  - Subset model (or overlay model):
    Which subset of the expert knowledge has been mastered?
  - Difference model:
    Which are the differences between expert solution and learner solution?
- Functions of learner models (according to Self 1988)
  - Corrective function
  - Elaborative 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

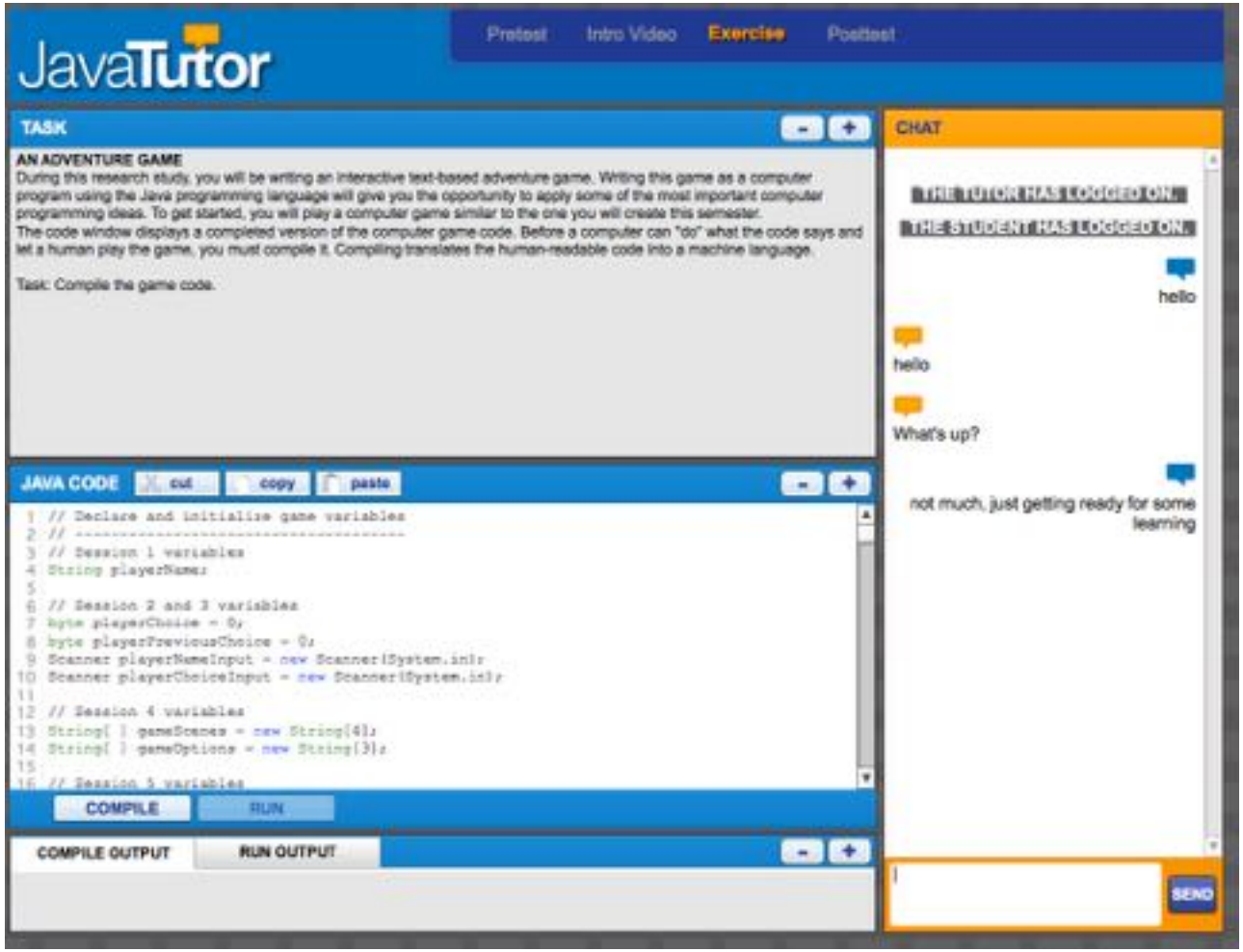
Example: AutoTutor



Art Graesser, University of Memphis

Picture:
V. Catete,
ncsu.edu

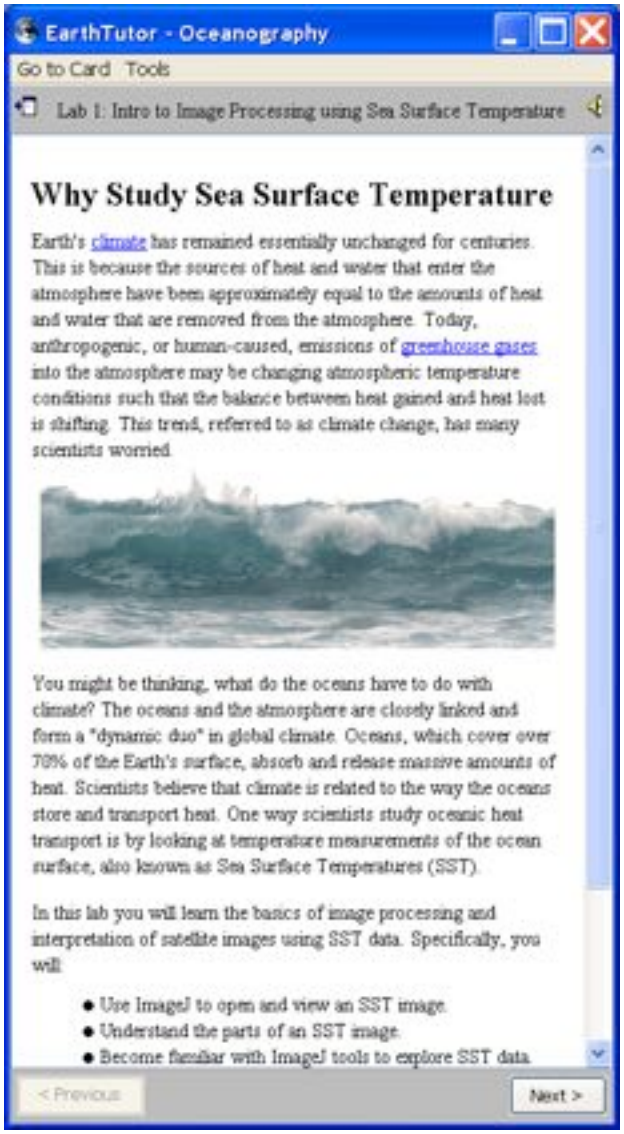
Example: JavaTutor

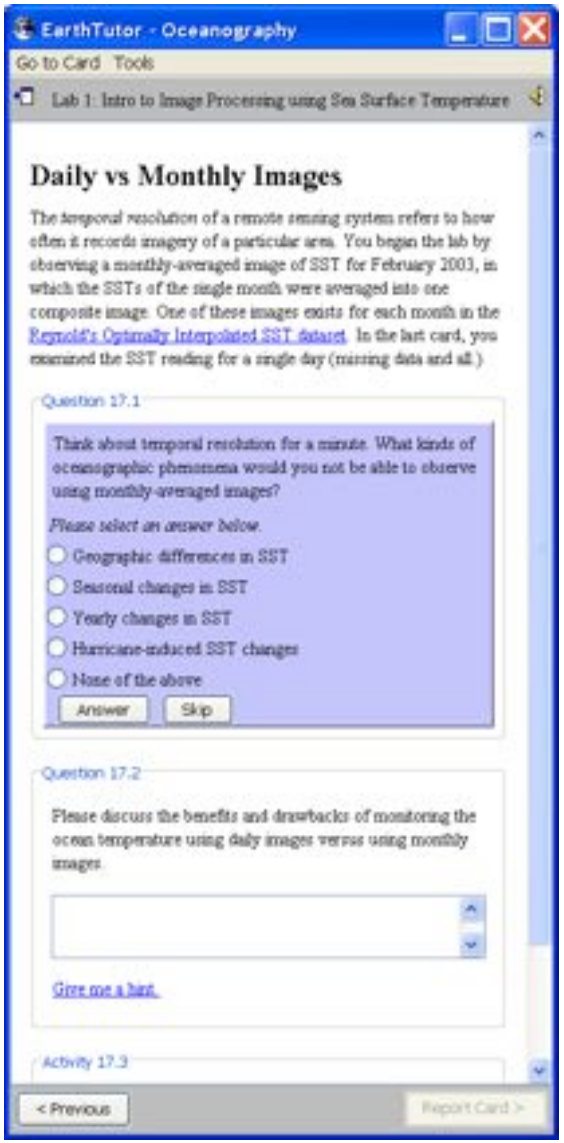


Investigating human-human(!) tutoring language

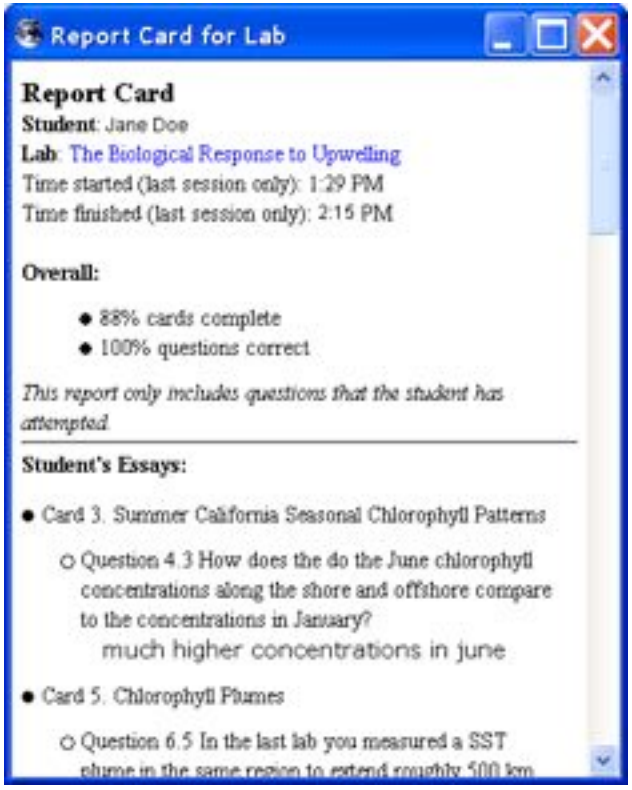
Kristy Boyer, NCSU, 2010

Example: EarthTutor, 2005 (1)

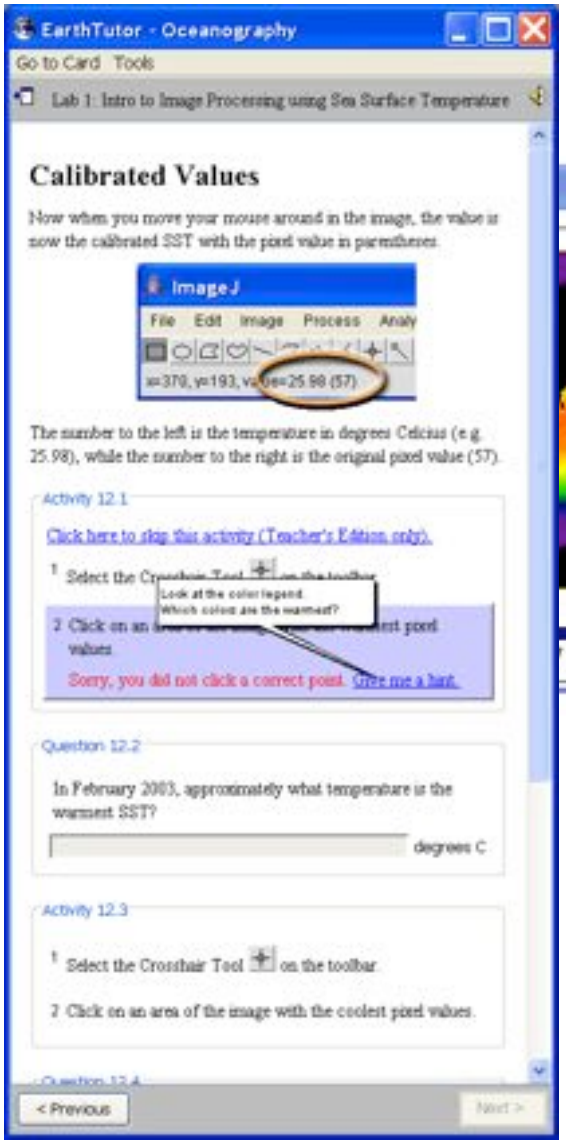


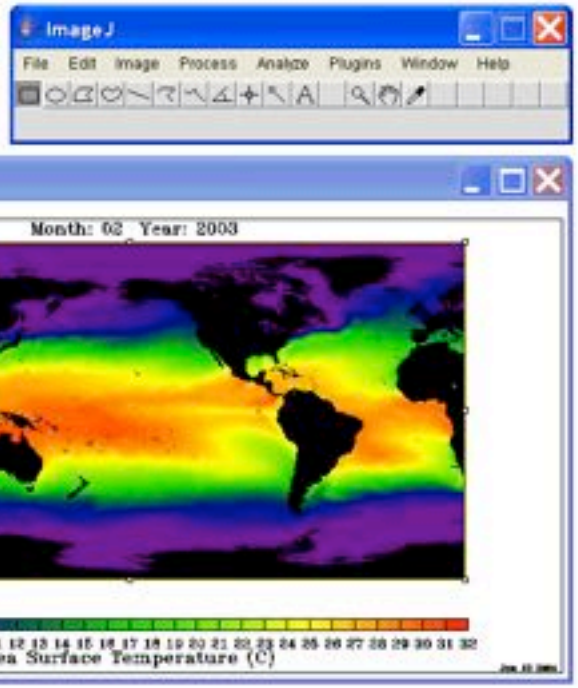


Earth science (remote sensing), in particular usage of image processing software from NASA and NIH



Example: EarthTutor, 2005 (2)





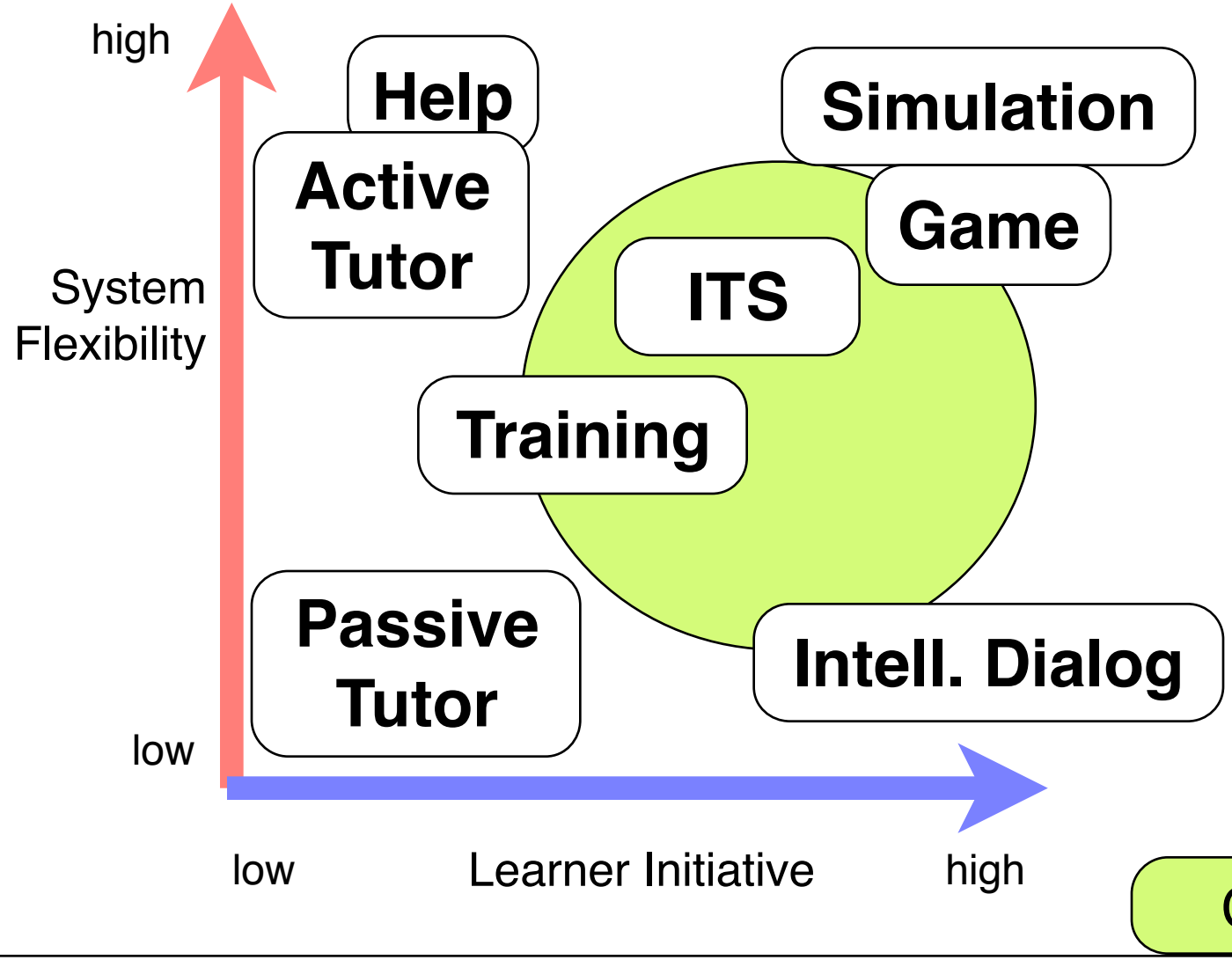
http://www.stottlerhenke.com/earthtutor/

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



4 Typology of Learning Environments

Constructivism

It's All Invented!

Active Learners

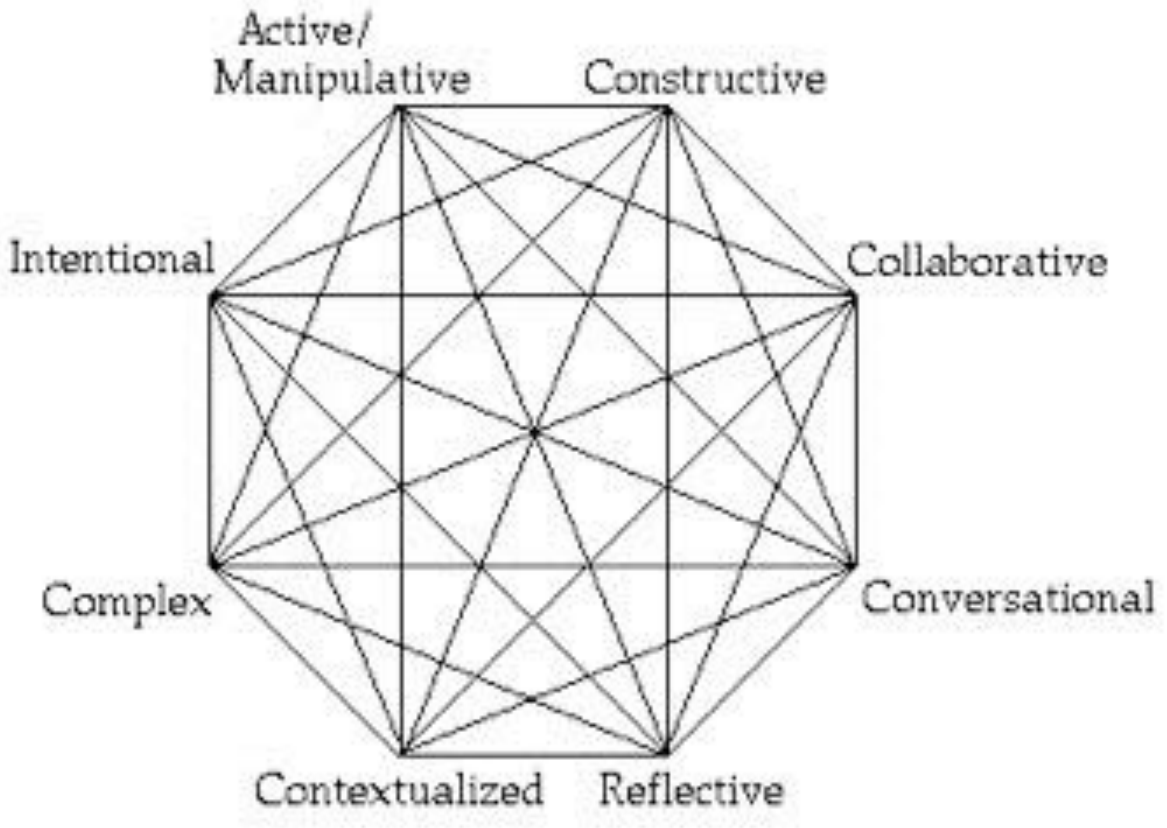
Construction by sense-making activities

Individual Differences

Properties of Constructivist Learning Environments

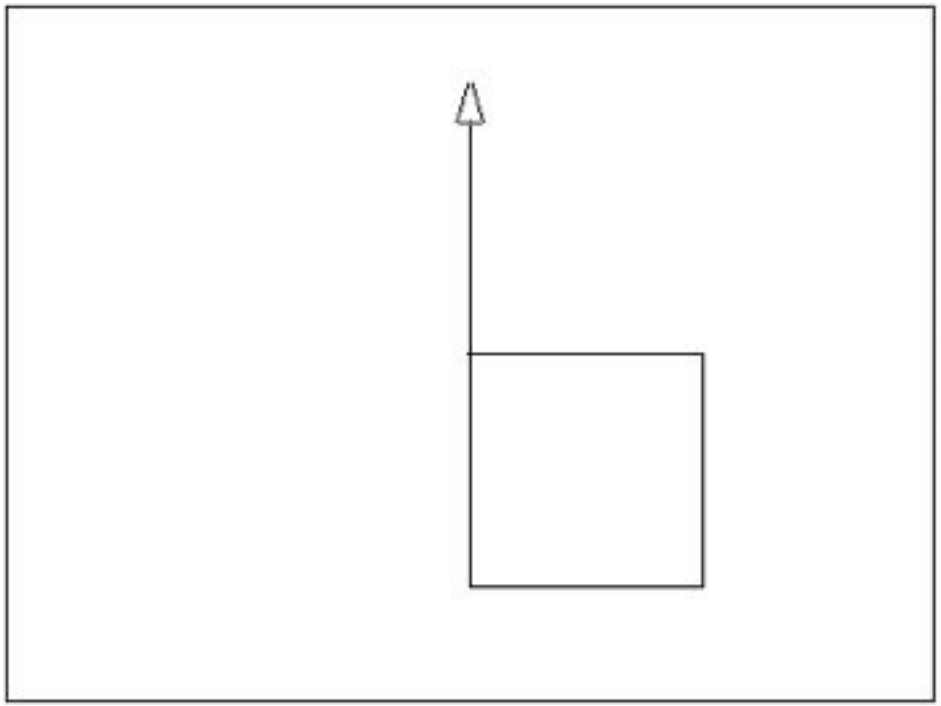
"Web of Constructivism" according to D. Jonassen 1994

D. Jonassen, Thinking technology: towards a constructivist design model, *Educational Technology* 34(4), 1994



Example for a MicroWorld: Logo

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

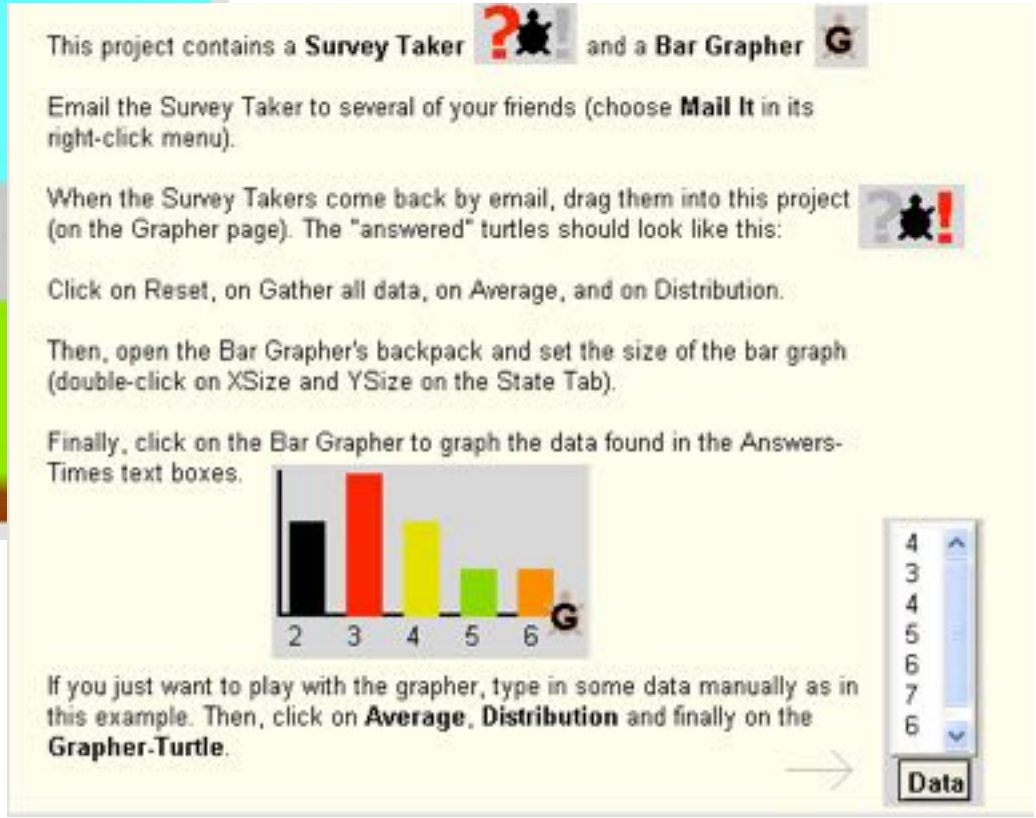


```
Welcome to Berkeley Logo version 5.5
? right 90
? forward 100
? right 90
? forward 100
? right 90
? forward 100
? right 90
? forward 100
? forward 100
?
```

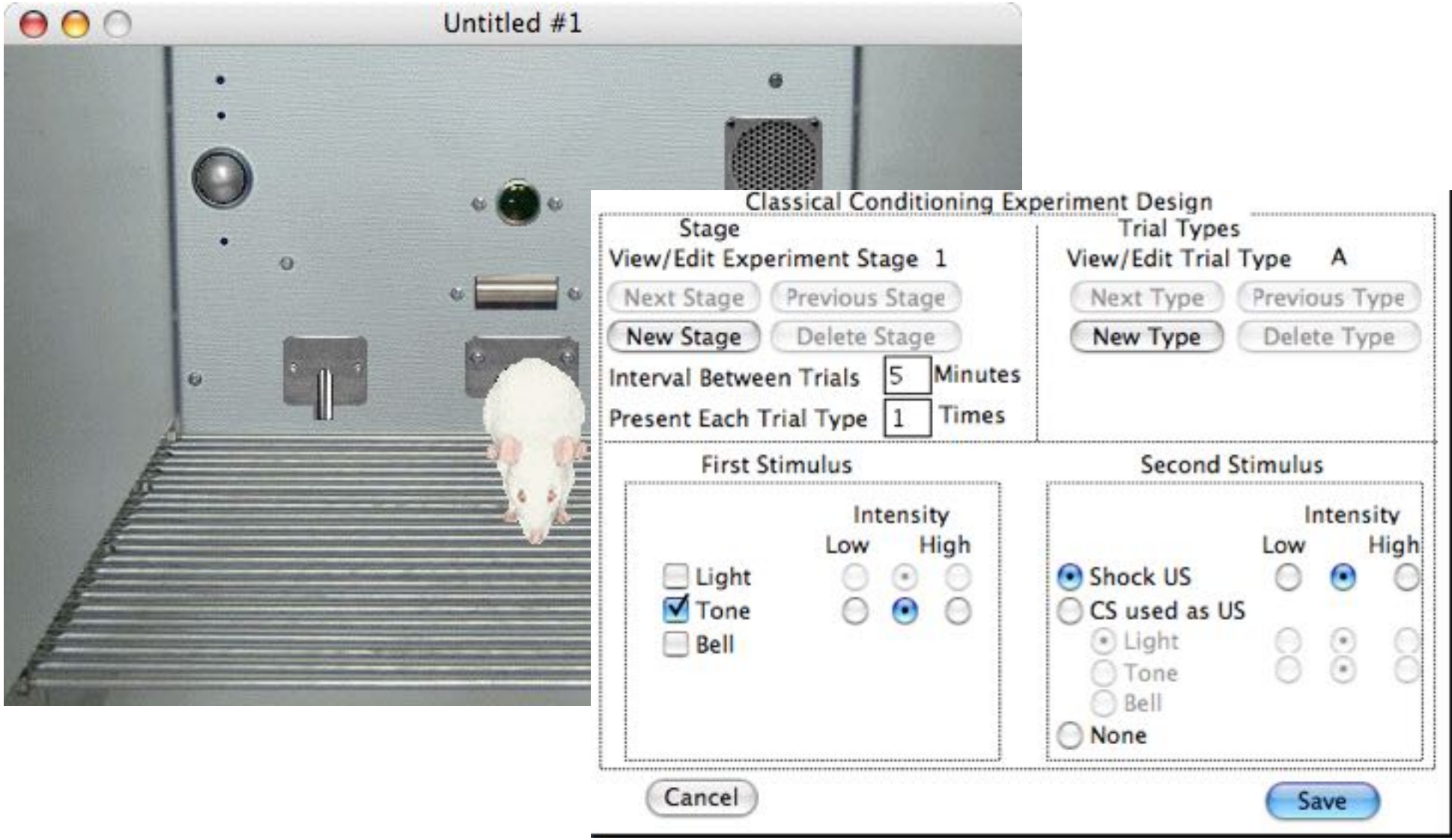
Example: Wikipedia

Example: MicroWorlds

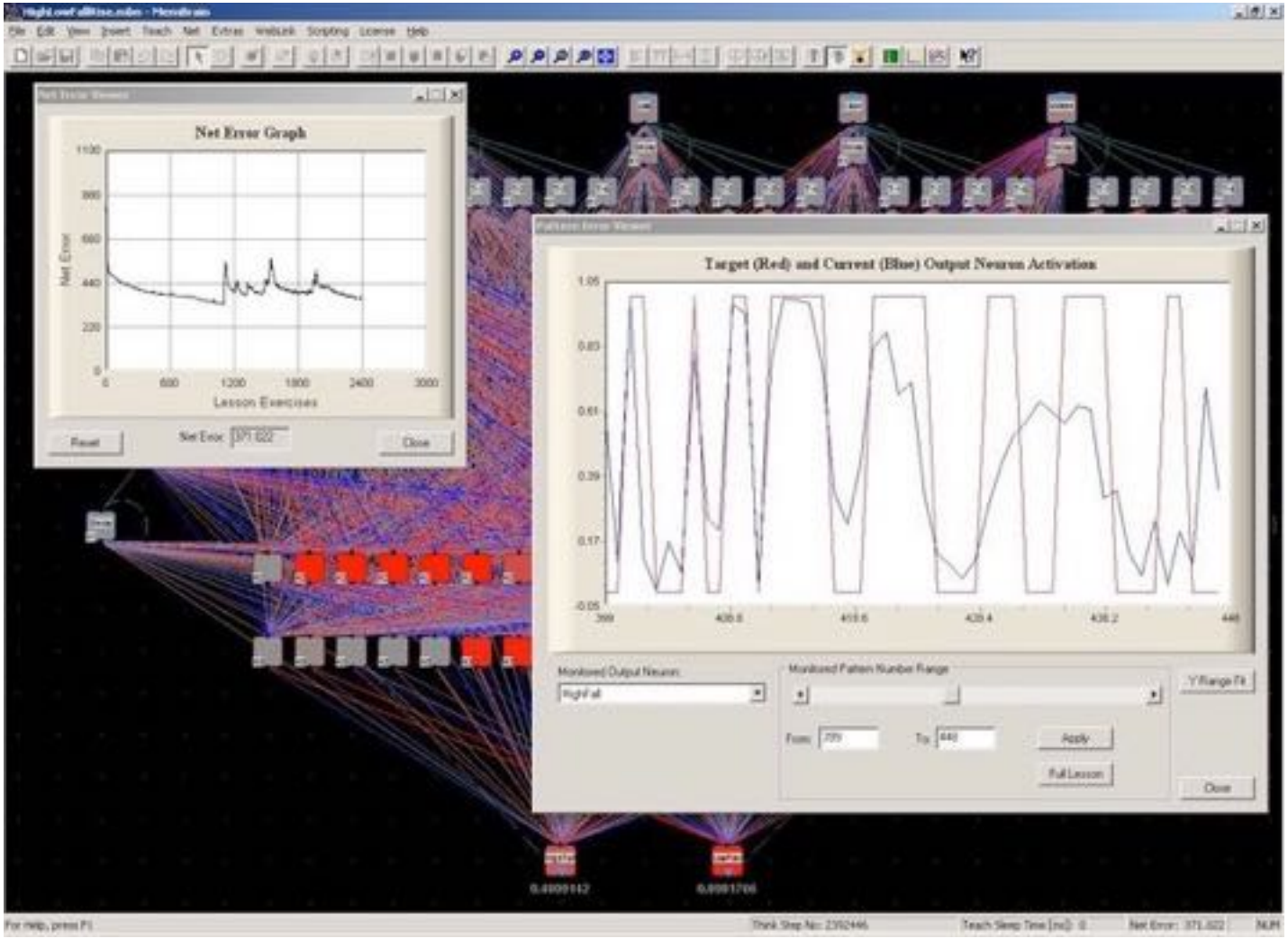
- Squish and SurveyGraph, written in MicroWorld EX



Example: Sniffy the Virtual Rat



Example: Simulation of Neuronal Networks

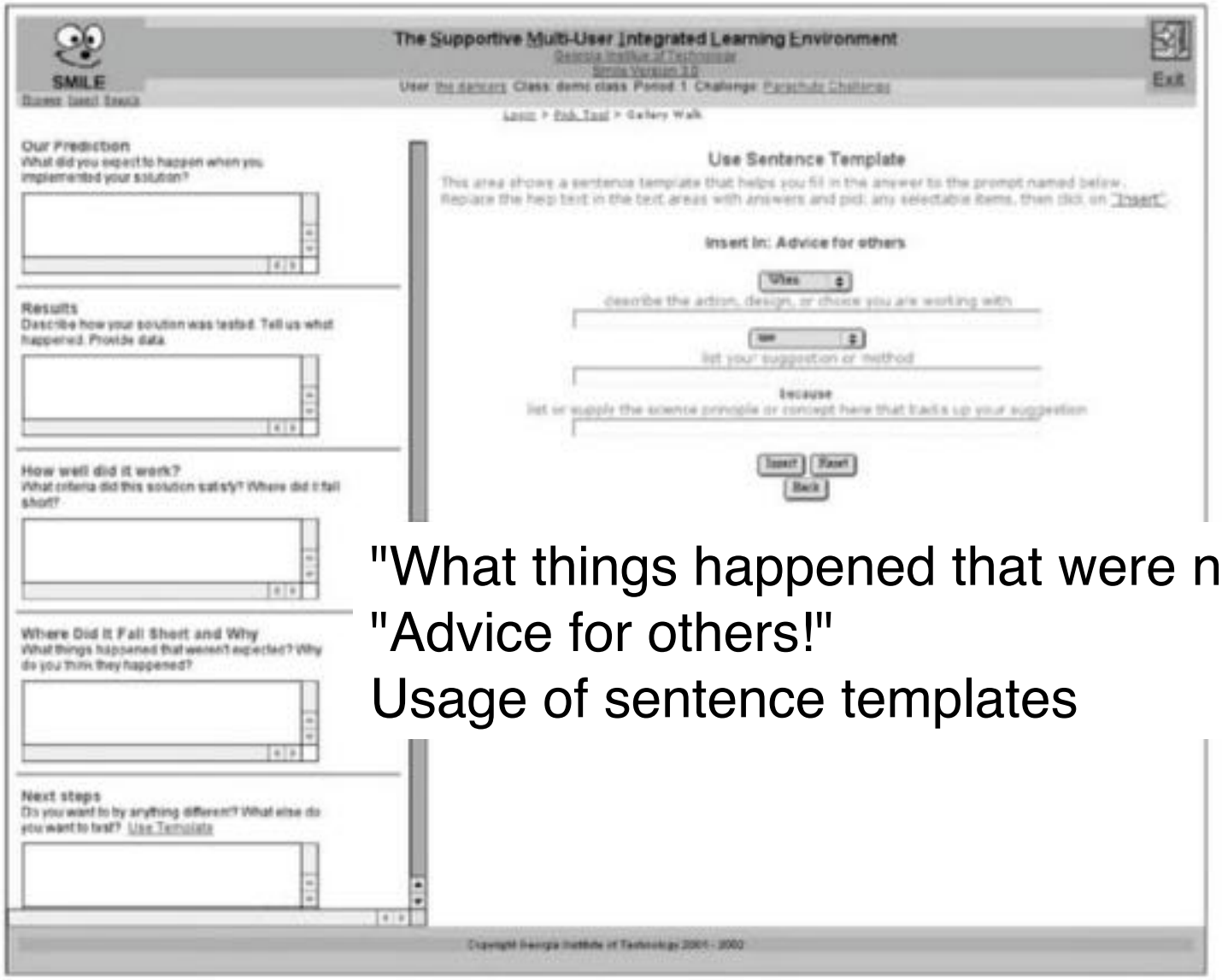


http://www.membrain-nn.de/

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

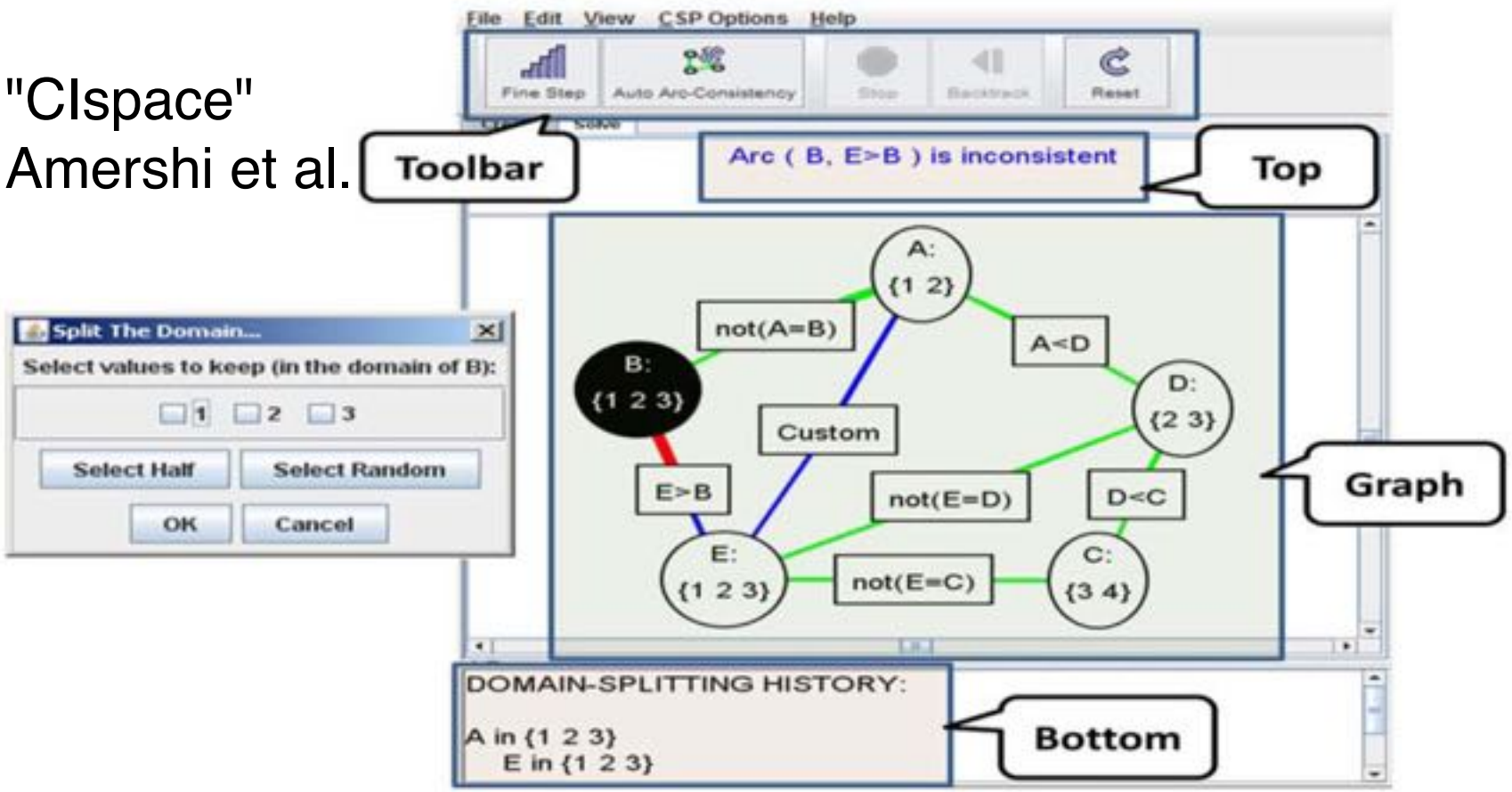
SMILE, Kolodner/Nagel 1999

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

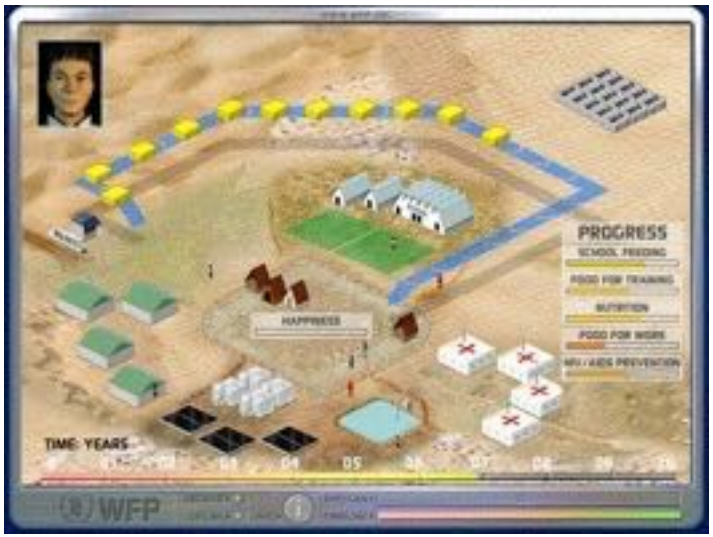
"CIspace"
Amershi et al.



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

Written by Deborah Allen. August, 1993; Revised August, 1995.

(page 1)

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 botttles) 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.

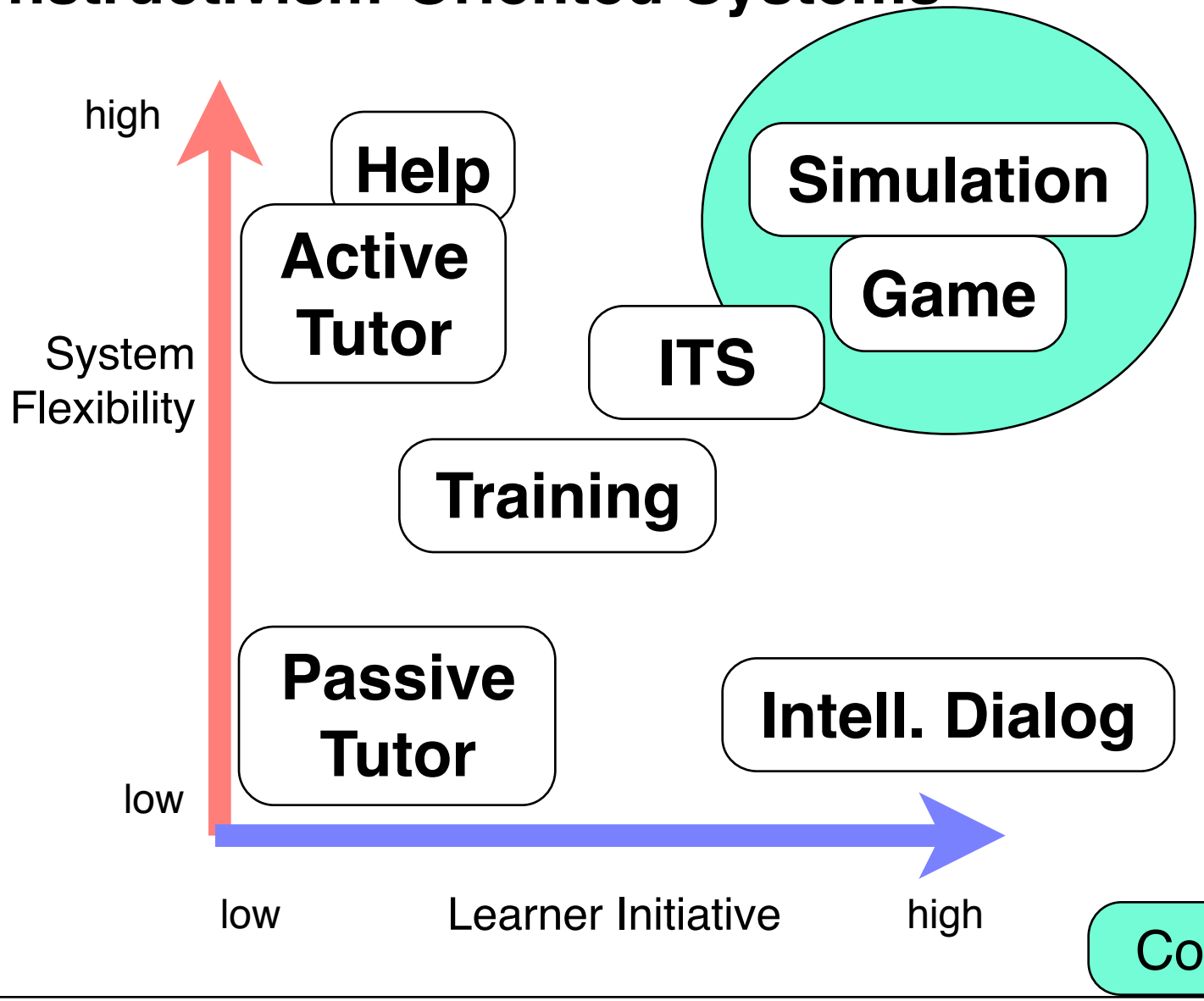
Martin's degree of confidence in his proposal is reflected in a remark he (half-jokingly) made during a lecture at the Woods Hole Oceanographic Institute: "Give me half a tanker of iron and I'll give you an Ice Age."

Questions

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

http://www.udel.edu/pbl/curric/bisc207prob.html

Constructivism-Oriented Systems



4 Typology of Learning Environments

Social Learning

Learning in Groups

Model Learning

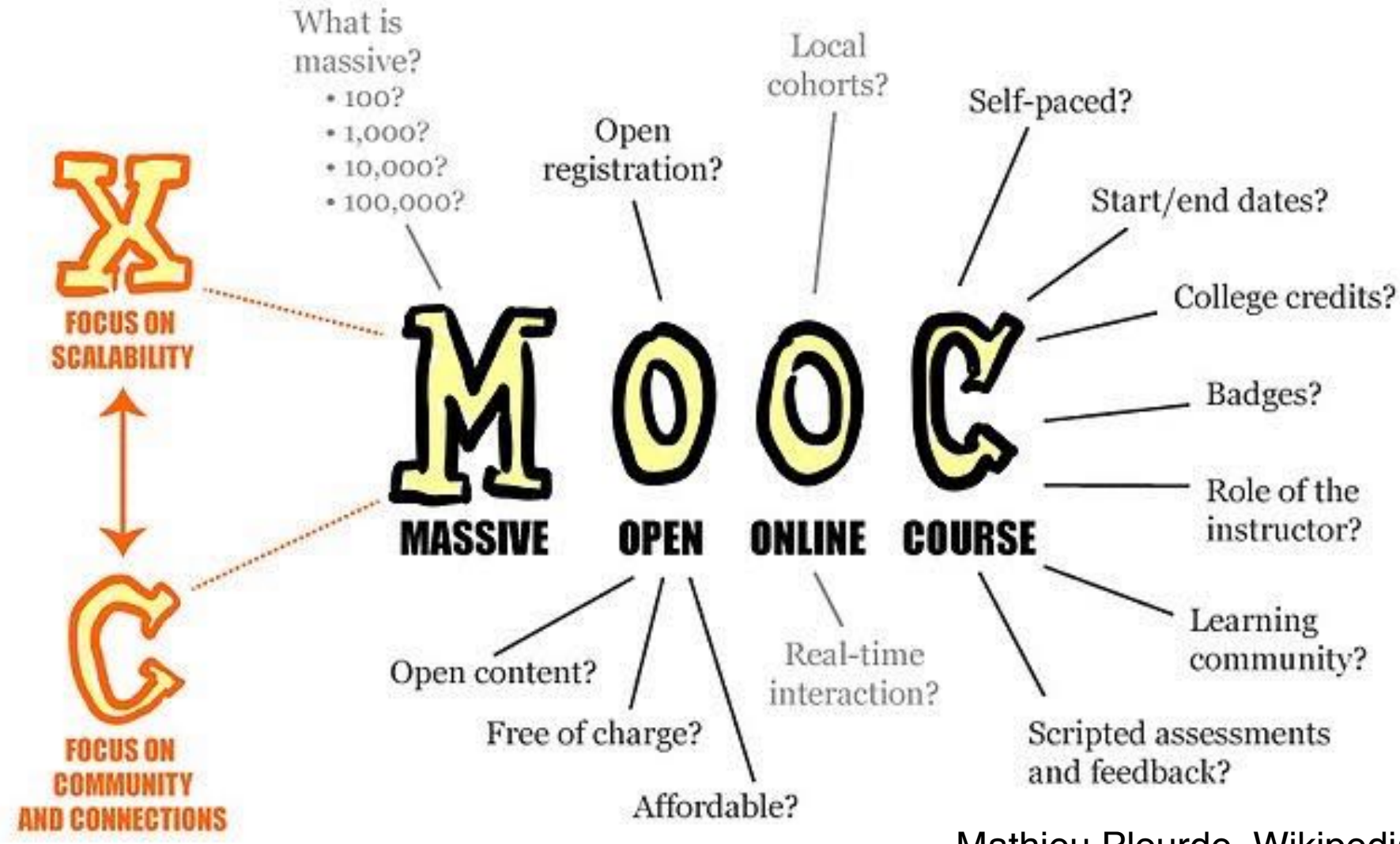
Zone of
Proximal Development

Situated Cognition

Online Learning Communities

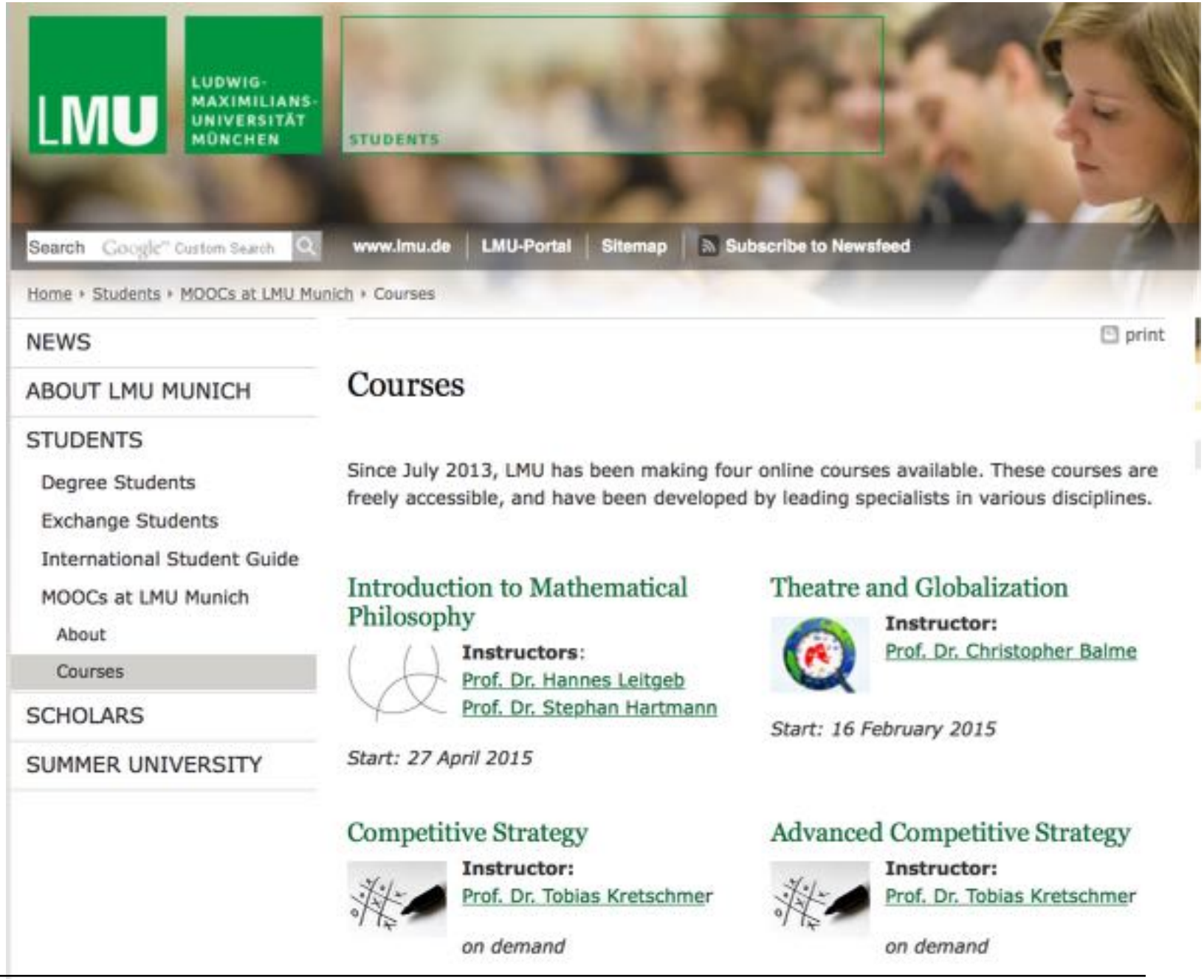
- From the isolated e-learner to an active community
- System support required for:
  - Creating awareness of the activities of others
  - Supporting individual learning styles
  - Supporting individual control of learning speed
  - Making it easy to share products
- System architectures:
  - Either 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)



Mathieu Plourde, Wikipedia

MOOCs at LMU (Coursera)

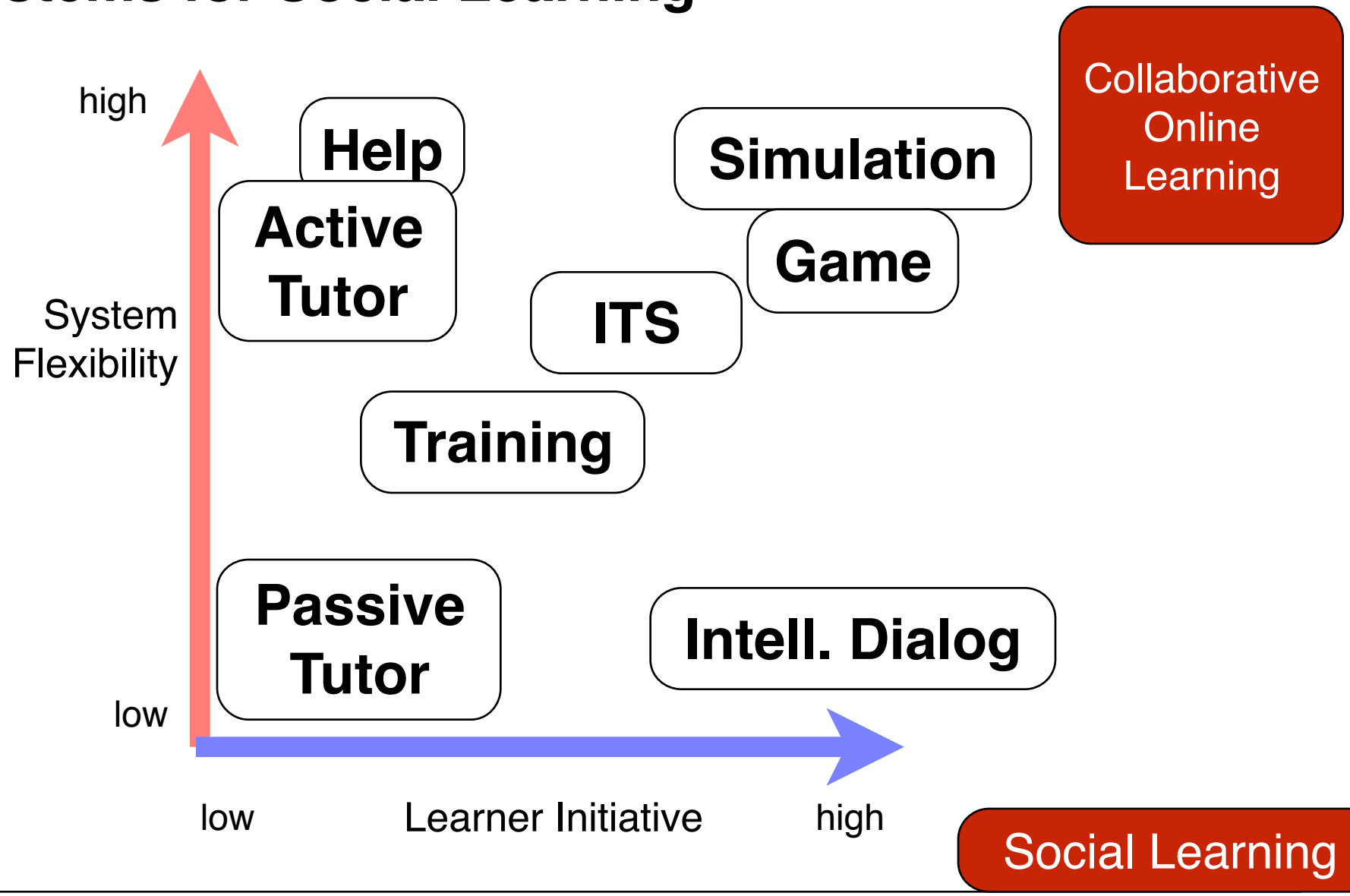


iSocial: 3D Virtual Learning World

Based on *Second Life*

http://blogs.sun.com/wonderland/entry/isocial_3d_virtual_learning

Systems for Social Learning



4 Typology of Learning Environments

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
- 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