


10 Rückblick und Ausblick

- 10.1 Geschichte der Lernmaschinen: Vorgeschichte 
- 10.2 Historische Beispiele zum Behaviorismus
- 10.3 Computer-Based Education ab 1960
- 10.4 Intelligente Systeme, exploratives Lernen ab 1980
- 10.5 Standardisierung für Lernsysteme
- 10.6 Trends

Literatur:

- A. Holzinger: Basiswissen Multimedia Band 2, Modul 4
- J. Hasebrook: Multimedia-Psychologie, Kapitel 7 und 8

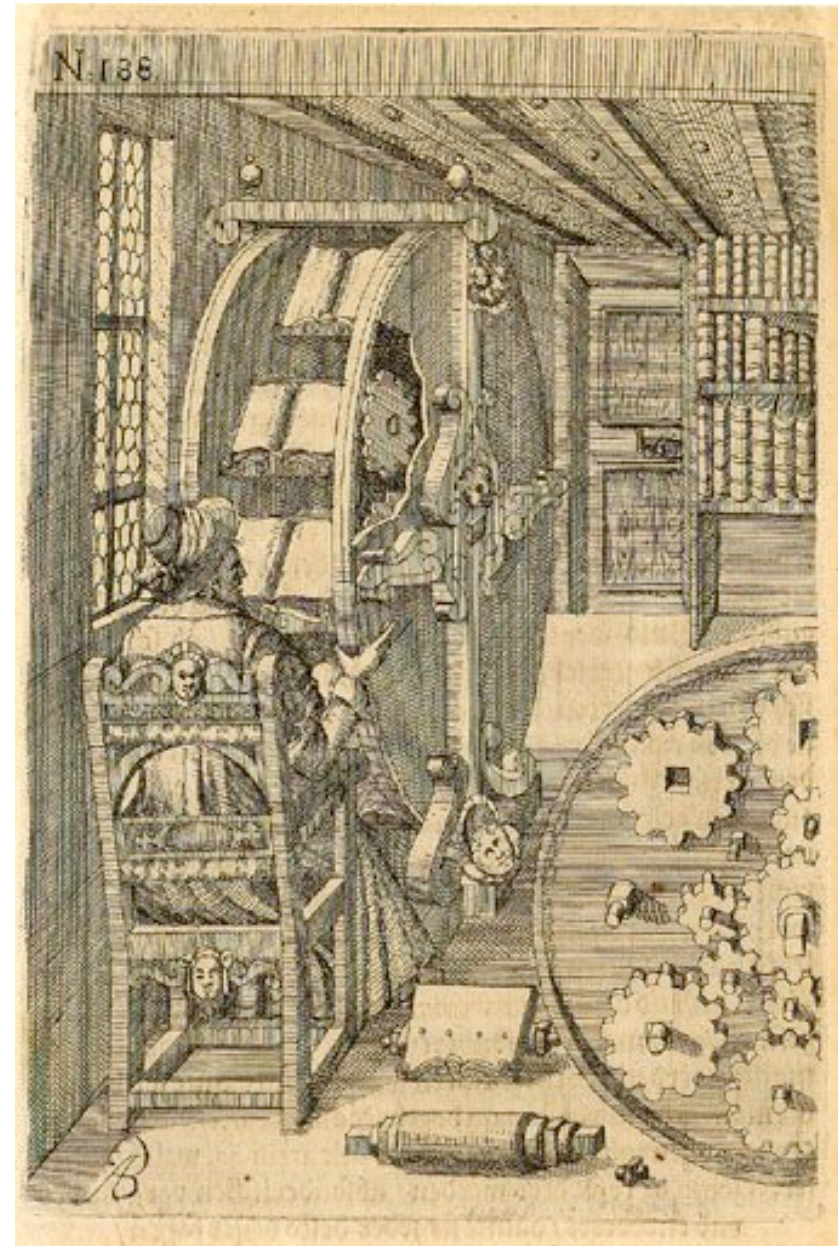
Römische Lernhilfen



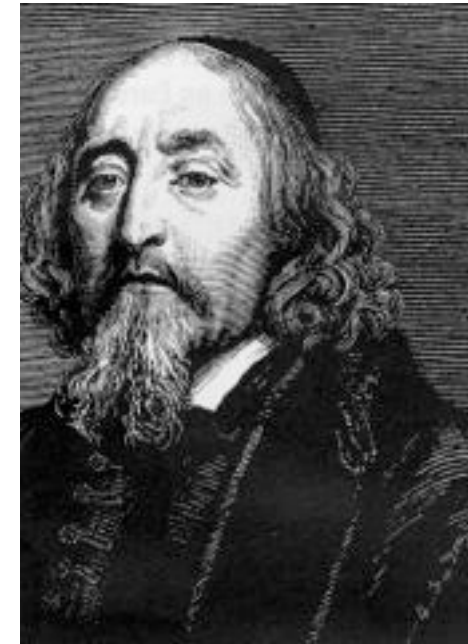
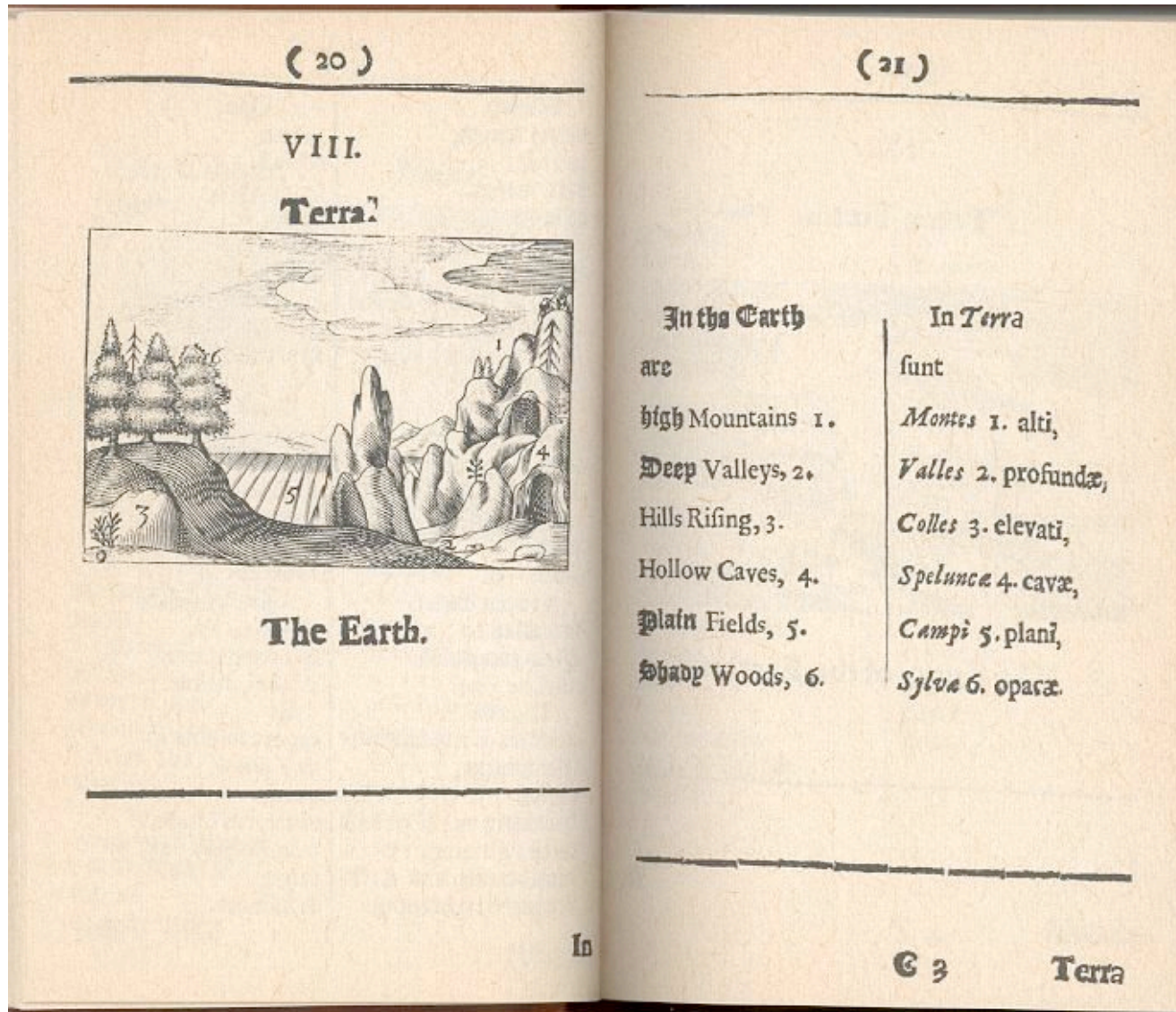
- Römisch, ca. 200 v. Chr.
- Studenten mit Schiefertafeln (*slates*)
- Quelle: http://www.leerbeleving.nl/wbts/1/history_of_elearning.html

Ramellis Lesemaschine

- Agostino Ramelli (1531 – 1600)
- Rotierendes Leseputz zur gleichzeitigen Lektüre mehrerer aufgeschlagener Bücher (1588)
- Paralleler Informationszugang
- „Bookmarking“



J. A. Comenius: Orbis sensualium pictus (1658)



Jan Amos Komensky
(= Comenius)
(1592 – 1670)

Integrierte
Text-Bild-Kombination
(Multimedia?)


Anfänge des Fernunterrichts

- 1728, Caleb Phillips und 1840, Isaac Pitman:
 - Stenographie-Unterricht per Post
- 1874, Illinois Wesleyan University:
 - Offizieller Start von institutionellem Fernunterricht
- 1909, E. M. Forster: “The Machine Stops” (Kurzgeschichte)
 - Audiovisuelle Fernvorlesung zu australischer Musik
 - <http://archive.ncsa.illinois.edu/prajlich/forster.html>

“The clumsy system of public gatherings had been long since abandoned; neither Vashti nor her audience stirred from their rooms. Seated in her armchair she spoke, while they in their armchairs heard her, fairly well, and saw her, fairly well. “

http://en.wikipedia.org/wiki/History_of_virtual_learning_environments

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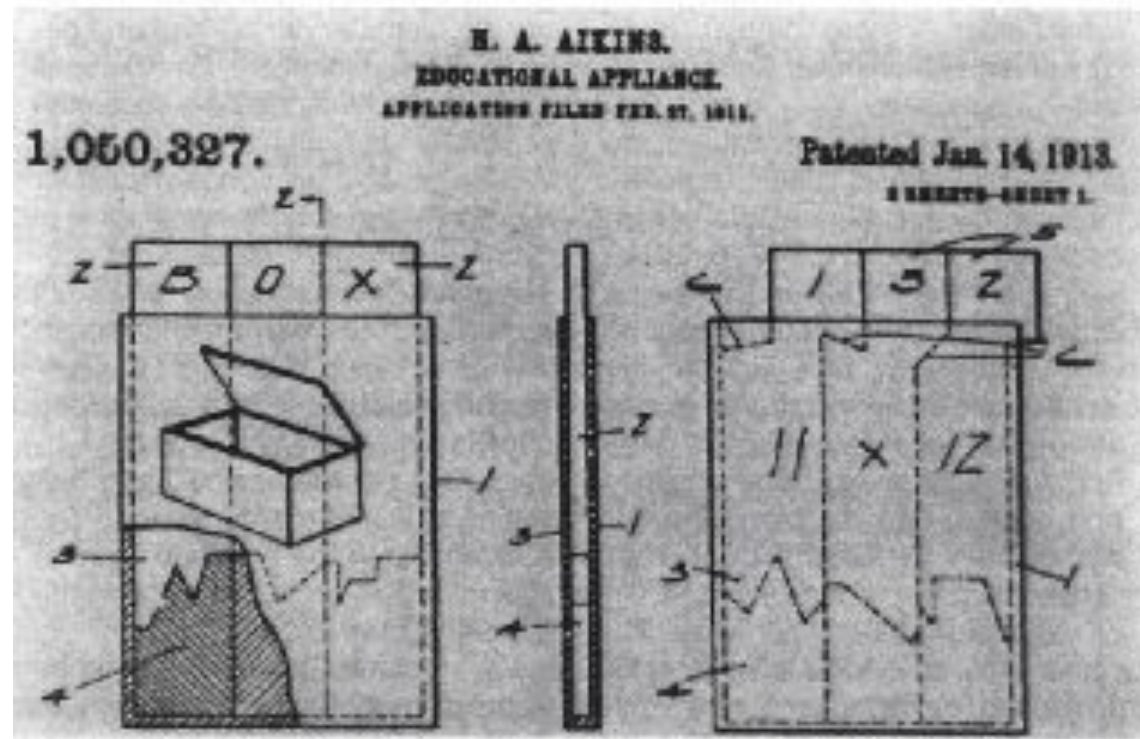
A. Holzinger: Basiswissen Multimedia Band 2, p. 176-182

J. Hasebrook: Multimedia-Psychologie, Kapitel 7 und 8

H. Niegemann et al.: Kompendium E-Learning, Kapitel 1

Buchstabiermaschinen

- Maschinen für das Buchstabieren und Schreiben von Wörtern
- Halcyon Skinner (patentiert 1866):
Kasten mit Bildanzeige, Handkurbel und Tastatur
 - Handkurbel → Neues Bild
 - Eintippen der Bezeichnung (akzeptiert jede Eingabe)
- Herbert Aikins (1911)
 - Beeinflusst von Thorndike
 - Buchstabenstreifen werden hinter Bild gesteckt
 - Nur richtiges Wort passt (Puzzle-artig)



Pressey's Intelligenztest-Maschine

- Sidney Leavit Pressey (1888 – 1979), beeinflusst von Thorndike
- Patentiert 1928 eine „Maschine für Intelligenztests“
- Mehrfachwahlaufgaben mit bis zu vier Antwortalternativen
- Nummerierte Tasten zur Eingabe der Antwort
- Zähler für richtige Antworten
- Lernmodus: Nächste Aufgabe erst, wenn aktuelle gelöst
- Bonbon-Spender!
 - Problem: intrinsische/ extrinsische Motivation



Burrhus Skinner: Programmierte Unterweisung

- Rezession lähmt auch Anwendung von Lernmaschinen
- Nach dem 2. Weltkrieg: „Babyboom“, „Sputnik-Schock“, ...
- Programmiertes Lernen nach Skinner (ca. 1958, angeblich aufgrund von Beobachtungen in Grundschule):
 - Jede Antwort bekommt eine sofortige Rückmeldung.
 - Jeder Schüler arbeitet in seinem individuellen Tempo.
 - Lernziele sind klar und objektiv formuliert.
 - Aufgaben sind so gestellt, dass sie mit hoher Wahrscheinlichkeit richtig gelöst werden.
 - Unterrichtsstoff zerlegt in „Frames“ (Frage- und Antwortkombinationen)
 - Lernende werden zur Aktivität angeleitet.
 - Ausdauerndes und gutes Arbeiten führt zu Zusatzbelohnungen.
- Basis vieler (der meisten?) Lernprogramme bis heute!

Example of Original Skinner Frames

- From Skinner, B.F. (1958).
Teaching machines.
Science, 128 (3330), 969-977.

Frame
1

MANUFACTURE means to make or build.

Chair factories manufacture chairs.

Copy the word here:

Frame
2

Part of the word is like part of the word
FACTORY.

Both parts come from an old word
meaning make or build.

M A N U _____ U R E

Frame
3


Part of the word is like part of the word
MANUAL.

Both parts come from an old word for
hand.

Many things are made by hand.

_____ F A C T U R E

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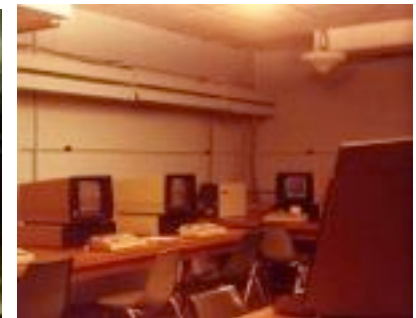
A. Holzinger: Basiswissen Multimedia Band 2, p. 176-182

J. Hasebrook: Multimedia-Psychologie, Kapitel 7 und 8

H. Niegemann et al.: Kompendium E-Learning, Kapitel 1

Project PLATO

- PLATO (from 1960)
 - (Programmed Logic for Automated Teaching Operation)
 - University of Illinois, Donald Bitzer
 - PLATO I – III (until 1966)
- PLATO IV (1972), Computer-based Education Laboratory (CERL)
 - Plasma display
 - Touch screen
 - TUTOR language for session design
 - Graphics, animations
 - Message exchange among users, message boards (notes), chat rooms
 - Flight simulator, multiplayer games
- Commercial product until 1986
- See www.cyber1.org



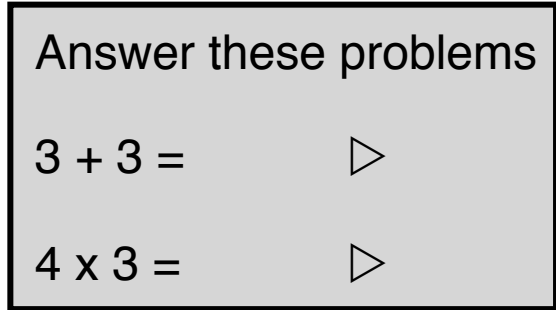
Example for TUTOR Script

```
unit    math
at      205
write   Answer these problems

        3 + 3 =

        4 x 3 =

arrow   413
answer  6
arrow   613
answer  12
```



[http://en.wikipedia.org/wiki/TUTOR_\(programming_language\)](http://en.wikipedia.org/wiki/TUTOR_(programming_language))

PLATO Evaluation

- No significant difference between learning with the system and traditional learning
- Drop-out quote not higher than in traditional learning
- Reasonable acceptance
- 70% of students used the system outside course times
- 88% of teachers planned to work with the system again
- However:
83% of students stated that a full course taught only by PLATO is unsatisfactory.

O'Shea and Self 1986

Project TICCIT

- TICCIT (1971 – 1977)
 - (Time-Shared Interactive Computer Controlled Information Television)
 - Developed at the University of Texas and Brigham Young University
 - Together with PLATO 60 mio \$ funding
 - Audience: adult learners, but later version for elementary schools
- Goal: Compare class-room and computer-based instruction
- Hardware:
 - Color monitor with loudspeaker (TV)
 - Special keyboard
 - Lightpen (Lichtgriffel)
 - Video tape player

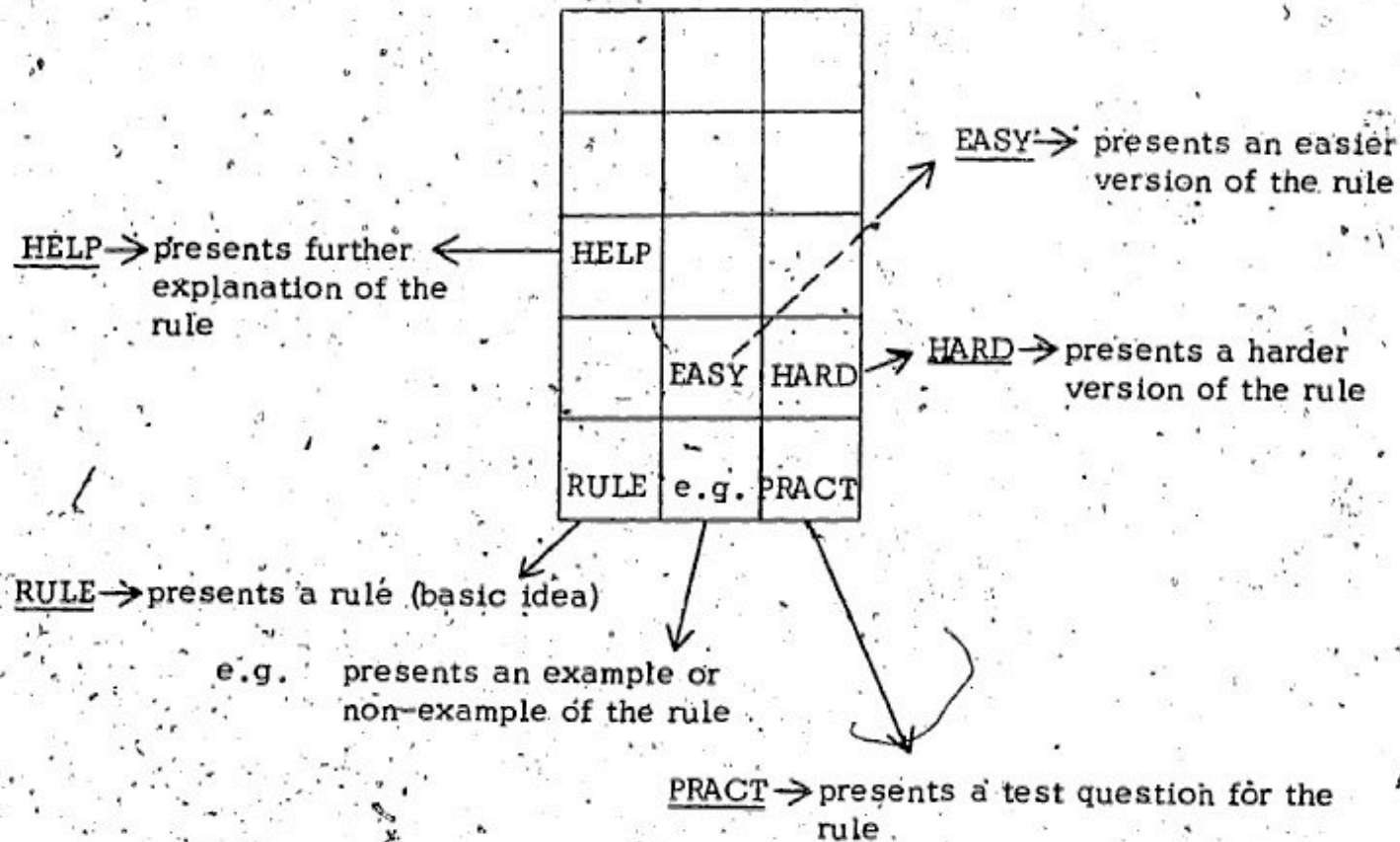


Interactive Television system : TICCIT

TICCIT Keyboard

Summary of Keyboard Controls

1. Control buttons

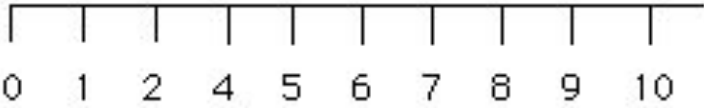



More:

- Attention
- Exit
- Repeat
- Go
- Skip
- Back
- Objective
- Map
- Advice

<http://eric.ed.gov>, document ED16006

Examples from TICCIT (1)

CI PO MO	NUMBER LINE OPERATIONS THE NUMBER LINE
<p>If we think of a straight line as a collection or set of points, we can associate all the numbers of arithmetic with points on the line. Such a line is called a number line.</p>	
	
<p>PRESS --> KEY TO VIEW THE NEXT PAGE PRESS --> KEY TO VIEW THE NEXT PAGE</p>	

POETIC METER		
What makes a poem a poem?		
Why is a poem different from prose?		
Name one characteristic of a poem?		
RHYME is one characteristic. Can you name another? 		
---LAST	[PET]REPEATS	NEXT ---

Examples from TICCIT (2)

Here is the general rule for grammar-referent agreement.

A pronoun agrees in number with its REFERENT. Singular referents take singular pronouns. Plural referents take plural pronouns. Singular referents which have no sex indicated take the generic pronouns him/he/his.

RULE page 1/1

- TICCIT lessons were designed according to Merrill's CDT

In the passage below, the pronoun in green agrees with its referent in light blue.

Neither John nor Henry brought his coat to the ball game.

This can be reviewed in lesson 4.2

EXAMP 1 easy page 1/1

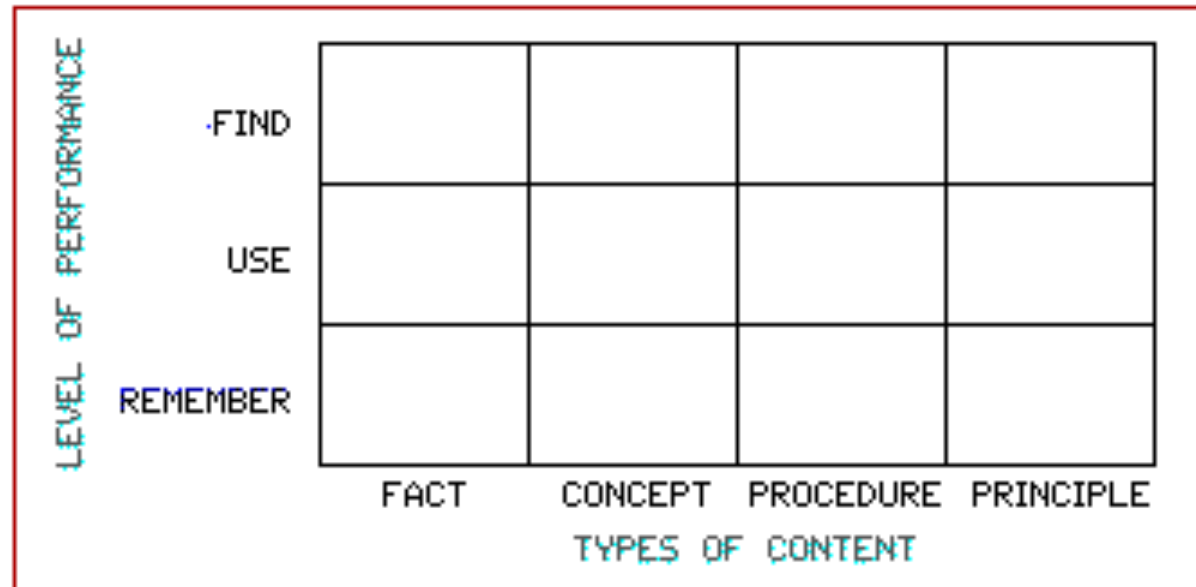
Edit any pronoun in the passage below that doesn't agree in number with its referent. If all pronouns are correct, press ENTER.

Several of the mechanics brought his tools.

PRACT 3 easy page 1/1

Component Display Theory

- M. David Merrill (1983):
CDT (Component Display Theory)
 - Basic ideas already used in the TICCIT-System!
- Performance/content matrix:
 - Level of learner performance
 - Types of content
- Presentation forms:
 - Rules
 - Examples
 - Repetition
 - Practice
 - ...
- Revised and extended theory by M.D. Merrill:
 - Instructional Transaction Theory (ITT)



The diagram is a 3x4 grid representing the Performance/Content Matrix. The vertical axis is labeled 'LEVEL OF PERFORMANCE' and has three levels: 'FIND', 'USE', and 'REMEMBER'. The horizontal axis is labeled 'TYPES OF CONTENT' and has four categories: 'FACT', 'CONCEPT', 'PROCEDURE', and 'PRINCIPLE'. The grid cells are empty, representing the relationship between these levels and content types.

LEVEL OF PERFORMANCE	FIND				
	USE				
	REMEMBER				
		FACT	CONCEPT	PROCEDURE	PRINCIPLE
		TYPES OF CONTENT			

Non-Computerized CDT Example

There are several important events in the invention of the microscope. You will be required to remember each of these events.

Learning Tip: Use the following cards for drill. Look at the front and say the information on the back. Shuffle the cards and try again. Repeat until you make no mistakes and your answers are immediate.

Front

First magnifying glass
What?

First magnifying glass
Who?

First solid glass lens
When?

First compound microscope
Who?

First compound microscope
When?

Back

Glass globe filled with
water

Used by engravers

Late 1200's A.D.

Zacharias Janssen

About 1590 A.D.

TICCIT Evaluation

- Evaluation by ETS (Educational Testing Service) was mixed:
 - TICCIT mathematics and English course students reported "significant achievement" over the traditional classroom formats
 - » For those students who completed the TICCIT courses!
 - Drop-out rate around 50%, 84% for math courses!
 - More students favored lecture classes over TICCIT math courses
 - Acceptance by teachers quite low

Computers in the Classroom

- Relatively cheap personal computers enable high penetration of schools with computer systems
- Wide-spread development of programmed instruction and simulations



Apple II
(1977–1993)
ca. US\$ 1300

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10.5 Standardisierung für Lernsysteme

10.6 Trends

Literatur:

A. Holzinger: Basiswissen Multimedia Band 2, S. 193 – 198

R. Schulmeister: Grundlagen hypermedialer Lernsysteme, Kap. 5 + 6

D.H. Jonassen (ed): Handbook of Research on Educational Communications and Technology, 2nd ed. 2004.

History of Intelligent Tutoring Systems

- SCHOLAR (Carbonell, Collins et al. 1979): Geography
 - Socratic dialogue (asking the learner)
 - Mixed initiative
- SOPHIE (Burton, Brown et al. 1982): Electronic Circuits
 - Computer simulation of faulty hardware, strategies to find errors
- BUGGIE (Suppes 1981): Mathematics
 - Identification of misconceptions using wrong (buggy) problems
- GUIDON (Clancey 1983): Medicine
 - Based on expert system MYCIN
 - Diagnose of diseases by natural language dialog
- MAIS (Tennison, Park 1987)
- Geometry Tutor (Koedinger, Anderson 1993)
- ISIS (Meyer, Miller et al 1999)
 - Ecology, simulation-based

Example for a MYCIN Rule

W. Clancey:
Use of
MYCIN's Rules
for Tutoring,
*Intl. Journal of
Man-Machine
Studies*
11:25–49
(1979)

Abstraction Level

RULE-SCHEMA: MENINGITIS.COVERFOR.CLINICAL
RULE-MODEL: COVERFOR-IS-MODEL
KEY-FACTOR: BURNED
DUAL: D-RULE577

Performance Level

D-RULE578

- IF: 1) The infection which requires therapy is meningitis, and
2) Organisms were not seen on the stain of the culture, and
3) The type of the infection is bacterial, and
4) The patient has been seriously burned

THEN: There is suggestive evidence (.5) that pseudomonas-aeruginosa is one of the organisms (other than those seen on cultures or smears) which might be causing the infection

UPDATES: COVERFOR

USES: (TREATINF ORGSEEN TYPE BURNED)

Support Level

MECHANISM-FRAME: BODY-INFRACTION.WOUNDS

JUSTIFICATION: "For a very brief period of time after a severe burn the surface of the wound is sterile. Shortly thereafter, the area becomes colonized by a mixed flora in which gram-positive organisms predominate. By the 3rd post-burn day this bacterial population becomes dominated by gram-negative organisms. By the 5th day these organisms have invaded tissue well beneath the surface of the burn. The organisms most commonly isolated from burn patients are Pseudomonas, Klebsiella-Enterobacter, Staph., etc. Infection with Pseudomonas is frequently fatal."

LITERATURE: MacMillan BG: Ecology of Bacteria Colonizing the Burned Patient Given Topical and Systemic Gentamicin Therapy: a five-year study, J Infect Dis 124:278-286, 1971.

AUTHOR: Dr. Victor Yu

LAST-CHANGE: Sept. 8, 1976

Example for a MYCIN Dialogue

1 You should now proceed to ask questions that will enable you
to make a hypothesis about the organisms (other than those
seen on cultures or smears) which might be causing the infection.

5 *{Initiative is given to the student; he or she may ask for more
data, make a hypothesis, or use a special option.}*

**** HOW IS THE FACT THAT THE PATIENT IS BURNED RELEVANT?**

10 *{One option is to ask how a piece of data is relevant to the current goal.}*

The fact that patient-326 is seriously burned will be used to
conclude that pseudomonas-aeruginosa is one of the organisms which
might be present (in addition to those seen on cultures or smears)
[Rule 578].

15 **** HELP**

*{The HELP option is a request for assistance: the student asks
"where do I go from here?"}*

20 Try to determine the type of the infection: bacterial,
fungal, viral, or Tb.

*{To provide help, GUIDON chose: (1) a rule to discuss (d-rule 578 was chosen
because the dialogue just focused on it); and (2) a method of presentation—"tell the
student to finish incomplete subgoals mentioned in the rule." Thus, a new topic
is set up, "the type of the infection." Initiative is returned to the student. . . .}*

25 **** WHAT IS THE PATIENT'S WBC?**

30 The white count from the patient's peripheral CBC is 1.9 thousand.

*{The tutor observes that this question is relevant to the new
topic and provides the requested data. The dialogue continues in
this goal-directed manner . . . }*

35

Example: GeoTutor, 1992

Sample Dialogue:

** Let's talk about Western Canada

Fine. What is the capital of British-Columbia?

** Vancouver.

No, the capital of British-Columbia is Victoria. Where is Victoria situated?

** Let's discuss Banff.

I do not know Banff. Is Banff the name of a place?

** Yes. It is a town.

Where is Banff located?

** In the Rocky Mountains.

Is Banff in British-Columbia or in Alberta?

** In B.C.

What is the population of Banff?

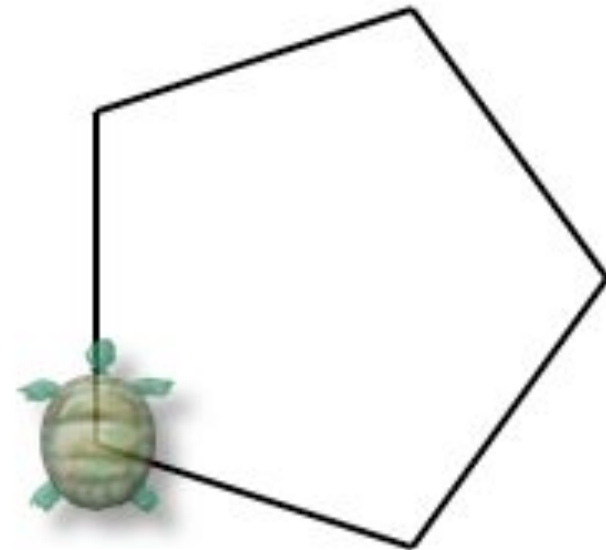
** 5000.

What other towns are near Banff?

** Tell me about Victoria.

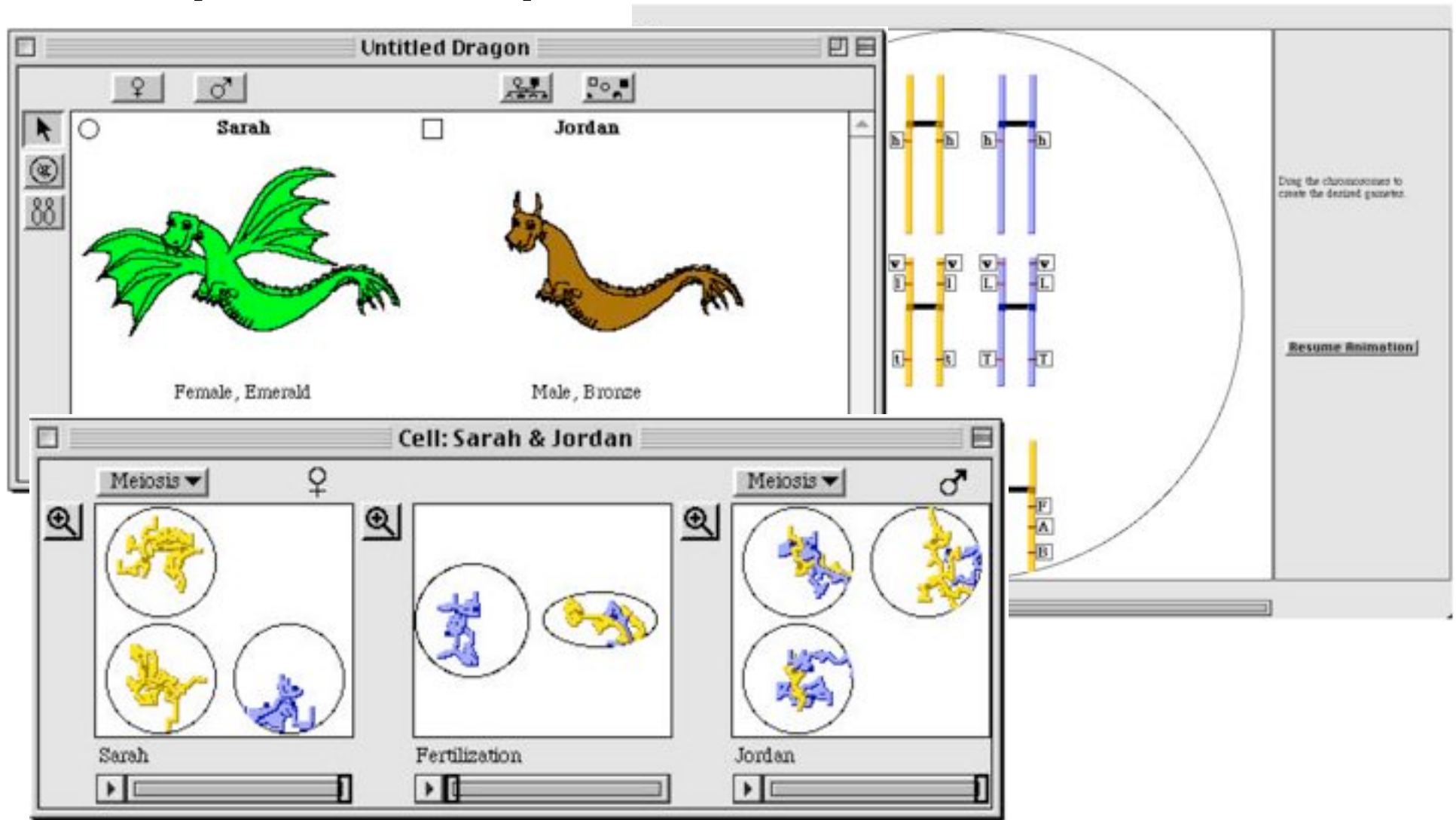
Victoria is situated on Vancouver Island. It is the second largest city in British-Columbia. What else would you like to know?

Logo (S. Papert, 1968): Physical and Virtual Turtles



```
to polygon
repeat :sides
  [ forward :size
    right 360/:sides ]
polygon 5 100
```

Example: GenScope, 1993



<http://genscope.concord.org/>


Online Learning Pioneer: CALCampus



- Computer Assisted Learning Center (CALC)
 - Since 1982 in Rindge, New Hampshire
- CALC Online Campus:
 - From 1985 through to 1995, starting with “QuantumLink Community College” using Commodore 64 computers on QuantumLink network
 - Using telecommunication networks like AppleLink, AOL, CompuServe
- CALCampus.com, 1995
 - Online campus on the Internet

CALCampus was the first to develop and implement the concept of a totally online-based school through which administration, real-time classroom instruction, and materials were provided, originating with the QuantumLink campus. This was a significant departure from earlier methods of distance education because no longer was the individual distance learner isolated from the teacher and from classmates.

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Niegemann et. al., Kap. 18

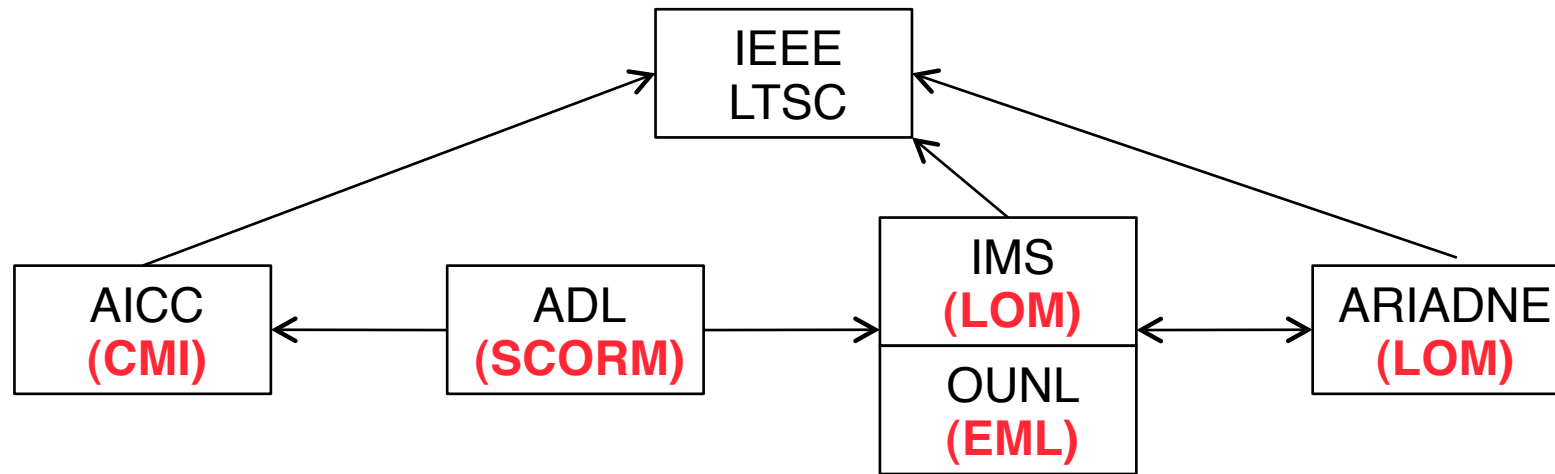
Hasebrook/Otte, Abschnitt 3.1

Haake et al., Kap. 4.6

Grundprinzip von E-Learning-Standards

- Zweck:
 - Unabhängigkeit der Inhalts-Autoren von speziellen Autorensystemen
 - Austauschbarkeit, Wiederverwendbarkeit, Anpassbarkeit von Lernressourcen
- Verfahren:
 - Beschreibung von Lernressourcen mit Metadaten
 - Analogie Bibliotheks-Metadaten
 - » MARC-Standard (Machine Readable Cataloging Record)
 - » Dublin-Core (DC)-Standard

Standard-Übersicht



AICC = Aviation Industry Computer Based Training Committee

ADL = Advanced Distributing Learning Initiative

ARIADNE = Alliance of Remote Instructional Authoring and Distribution Networks for Europe

IMS = Instructional Management Systems Project

LTSC = Learning Technology Standards Committee

OUNL = Open University of the Netherlands

CMI = Computer Managed Instruction Systems

EML = Educational Modeling Language

LOM = Learning Object Metadata

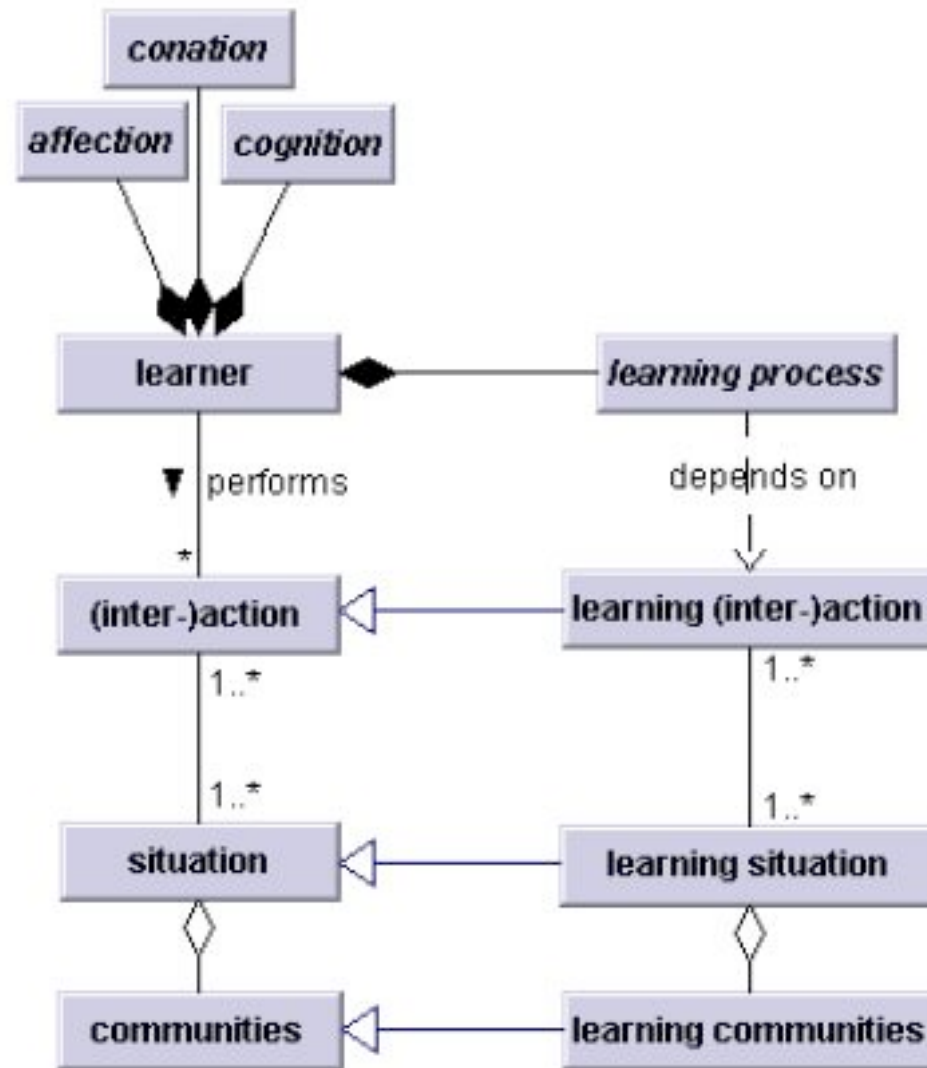
SCORM = Shareable Content Object Reference Model

LOM: Learning Object Metadata

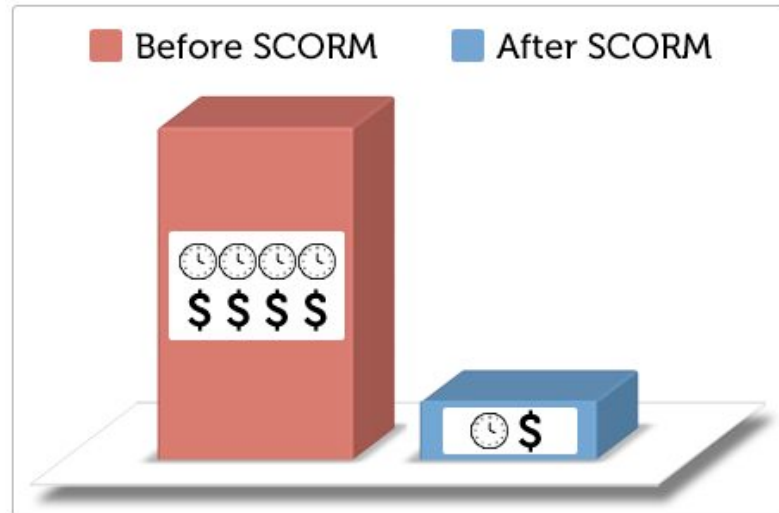
- <http://ltsc.ieee.org/wg12/>
- IEEE Standard P1484.12, XML-Based
- LOM Base Schema:
 - General information
 - Lifecycle (history)
 - Meta-metadata
 - Technical (requirements and characteristics)
 - Educational (educational and pedagogic characteristics)
 - Rights (Intellectual Property Rights)
 - Relation (to other LOMs)
 - Annotation
 - Classification
- Ongoing development: Integration with other metadata standards for the Web (e.g. RDF)

Educational Modeling Language EML

- Example:
Excerpt of metamodel
(learning model)



SCORM




scorm.com

SCORM is composed of three sub-specifications

- The **Content Packaging** section specifies how content should be packaged and described. It is based primarily on XML.
- The **Run-Time** section specifies how content should be launched and how it communicates with the LMS. It is based primarily on ECMAScript (JavaScript).
- The **Sequencing** section specifies how the learner can navigate between parts of the course (SCOs). It is defined by a set of rules and attributes written in XML.

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Life Cycle of Learning Systems

- as suggested by <http://www.leerbeleving.nl/>

