# 7 Development of Learning Applications

References:

http://www.nwlink.com/~donclark/history_isd/isdhistory.html

William Horton: E-Learning by Design, Pfeiffer/Wiley 2006

# E-Learning and Design

At its best, e-learning is as good as
best classroom learning.
And at its worst, it is as bad as
worst classroom learning.
The difference is design.

(W. Horton, 2006)

# Instructional Design

- "Instructional Design"
  - Broad meaning: All design activities related to instruction
  - Specific meaning: *Instructional Systems Design* (ISD)
    - » Different approaches, some of them complex
- Instructional design
  - Translates high-level project goals into choices for technology and content
  - Directs development of content and selection of media
  - Orchestrates management decisions (budget, schedule)

# ADDIE Model

Analysis

↓

Design

↓

Development

↓

Implementation

↓

Evaluation
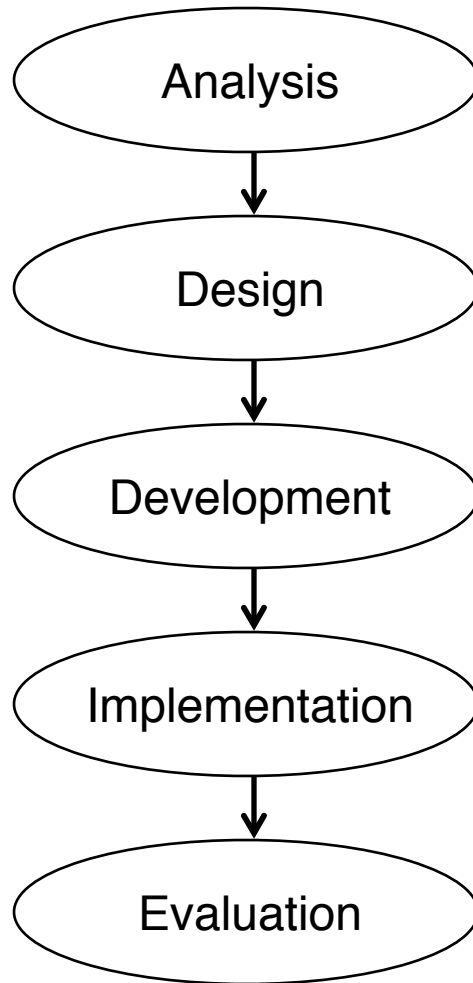
Based on ideas from the early 1950s

Developed by FSU for the US Armed Forces
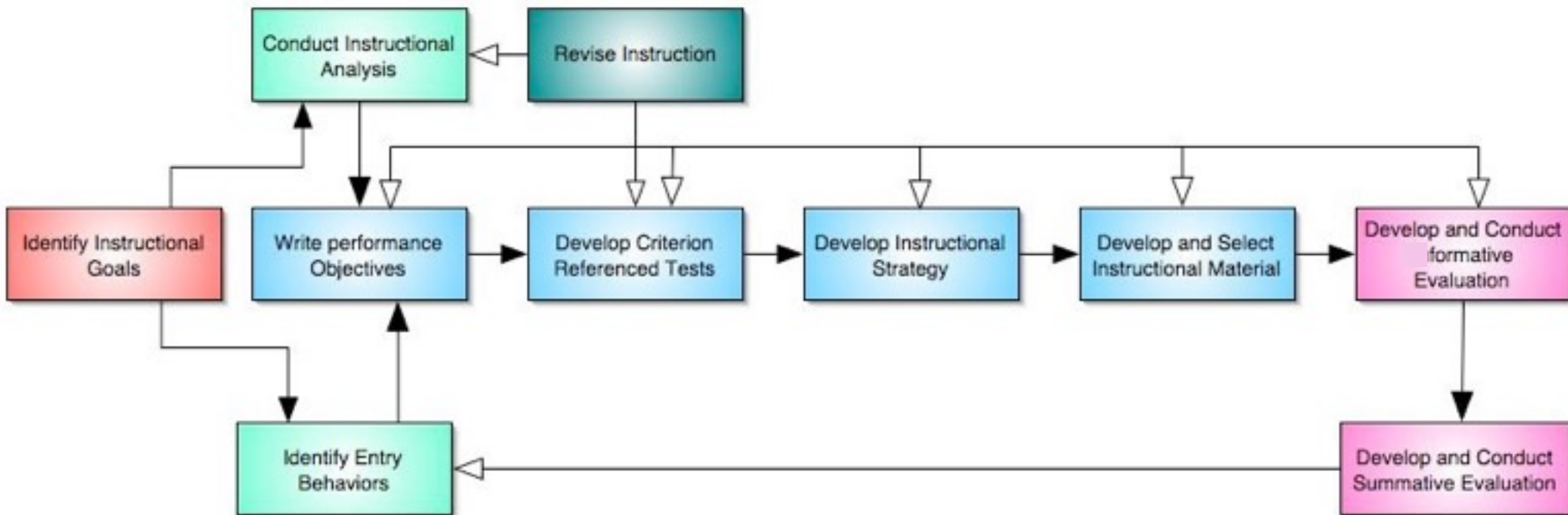
– based on USAF's previous "Five Step Model"

Incorporates other models (e.g. Dick & Carey)

Each step comprises:

- Search for alternatives
- Analyzing alternatives
- Definition of decision criteria
- Decision for a certain alternative

All the steps depend on good results in step 1 (analysis)!
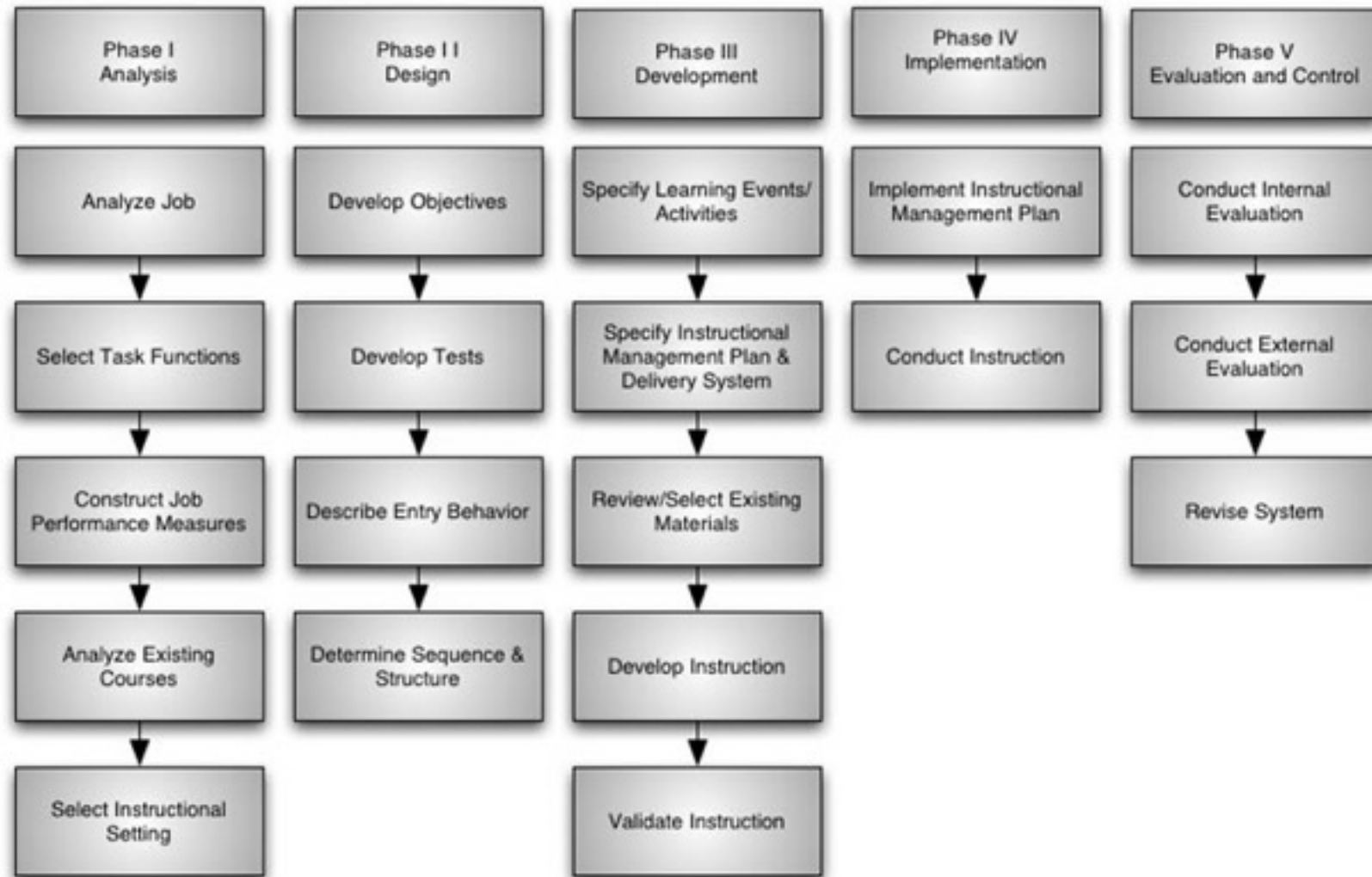
# Dick & Carey Instructional Design (1978)



Dick and Carey Instructional Design Model

http://www.nwlink.com/~donclark/history_isd/carey.html

# ISD According to ADDIE in 19 Steps



Florida State University Five Phases of ISD (1975)

# Non-Linear ADDIE Model



**Figure 6-1. The non-linear ADDIE process**

# Minimalist Approach (Horton)
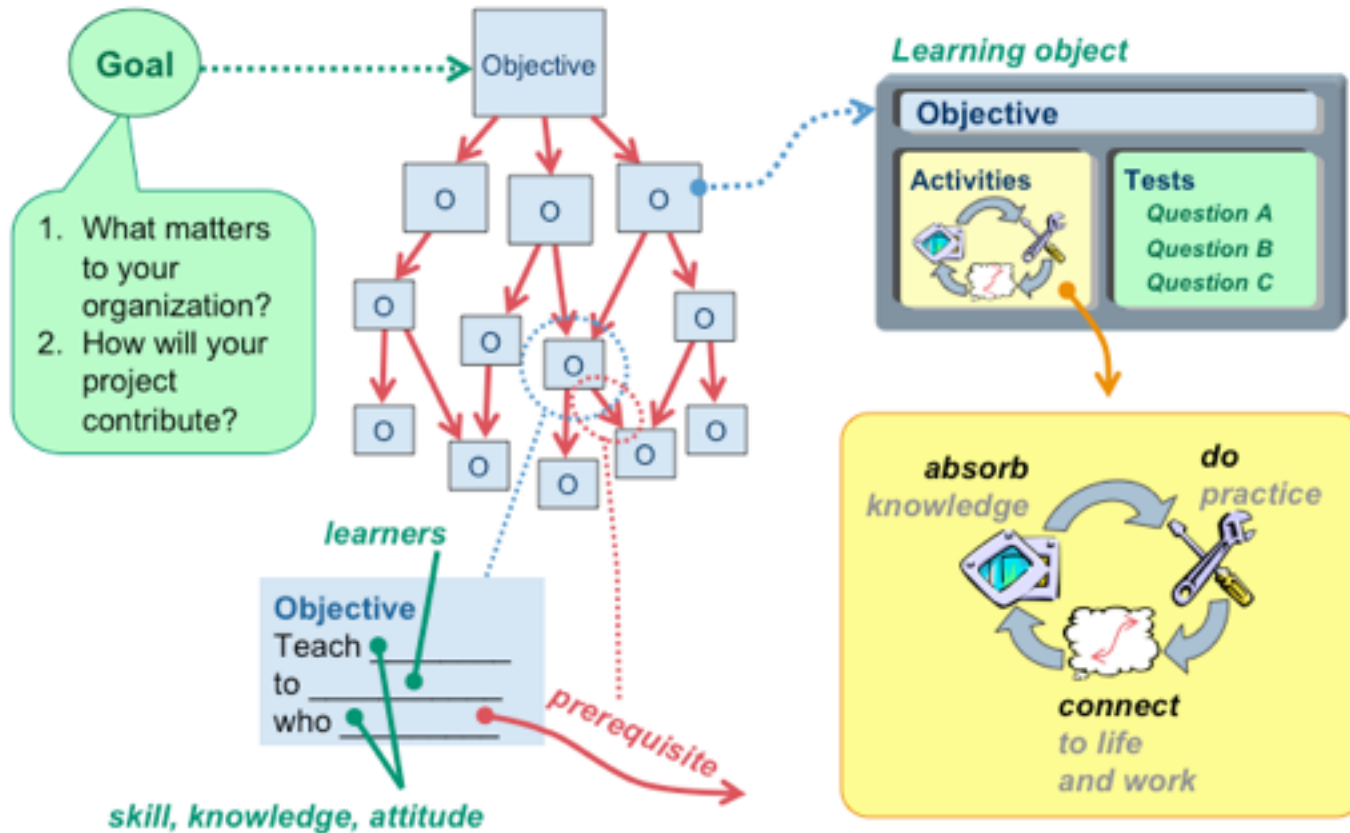
# Iterations in Development



Build

Design

Analyze

Evaluate

Re-design

Re-analyze

Re-build

Re-evaluate

Sketches

Product

Concepts

Details
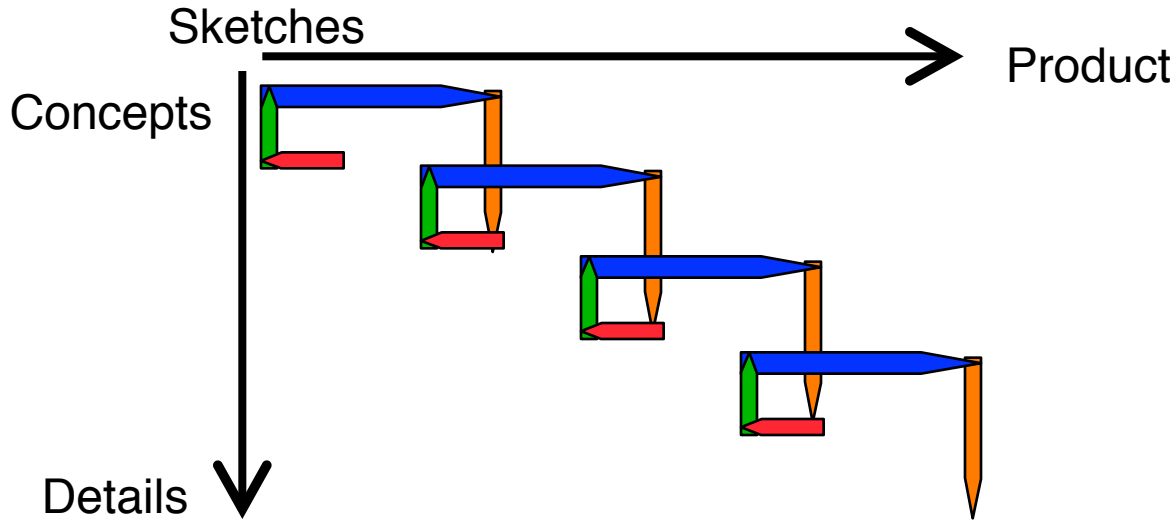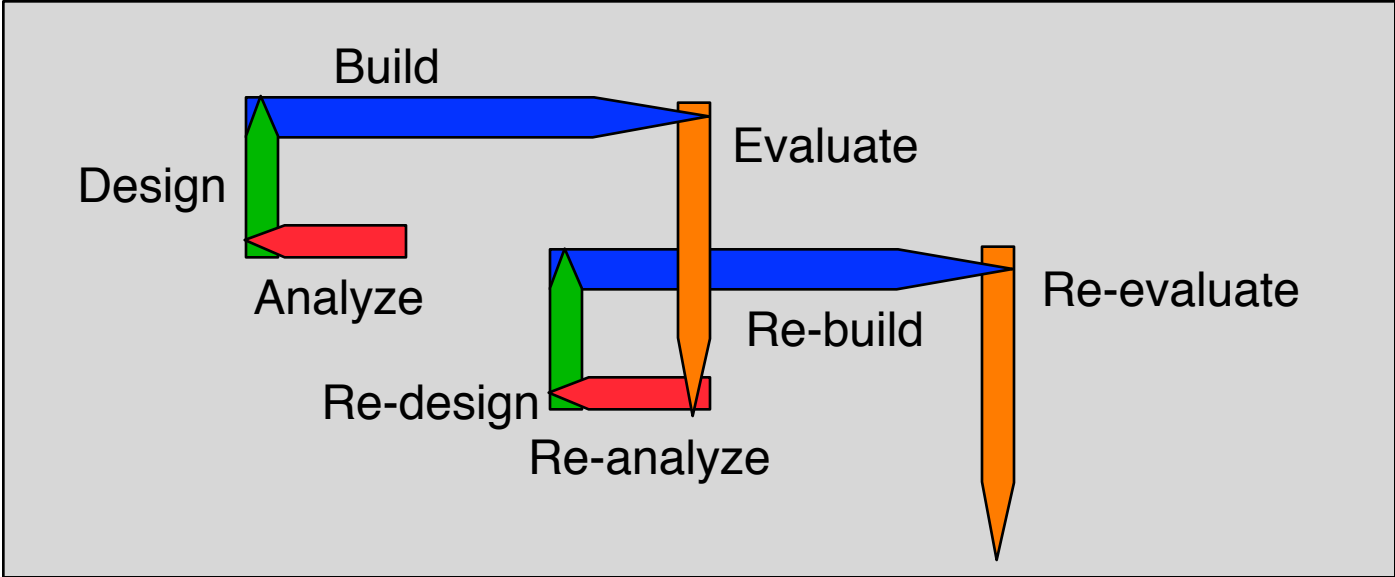
Horton 2006

# 7 Development of Learning Applications

References:

Niegemann et al. Kap. 3

Horton Ch. 1

Roger Schank: Lessons in Learning, e-Learning, and Training. Perspectives and Guidance for the Enlightened Trainer, Pfeiffer/John Wiley 2005

# Application Areas of E-Learning

- Support for established learning processes
  - School, additional qualifications (e.g. foreign languages)
  - Mass market, standardized material
  - Differentiating through didactics and presentation
- Individual advanced qualification
  - Targeted mainly at private individuals
  - Mass market
  - Differentiating through didactics and presentation
- Corporate training
  - "Master-tailored" solutions
  - Quite dominant in literature (e.g. Schank)
  - Differentiating through precision on target, integration in enterprise, and didactics/presentation

# Beispiel (Roger Schank) (1)

- There was this large German utility company.
- They had decided that e-learning was important to their future.
  - They told one of their HR guys to investigate and gave him a budget.
- After a while, they called out for help. (Remarkable.)
- Rules of thumb for building e-Learning:
  - Ask experts about what goes wrong in their companies.
  - Start people thinking about training as a kind of just-in-time remediation.
  - See e-learning as being about doing.
- Example: New hire training
  - Ask the expert, but what…
  - Development team: "What does a new hire need to know?"
    » Expert: "There is a new hire manual covering all that."
  - What was the problem with the *question*?

# Beispiel (Roger Schank) (2)

- Contd.
  - Development team: "What should a new hire know how to do?"
    - » Expert: (absurdly long list of things which are in the manual)
  - Development team (with help): "What is the biggest mistake that new hires make when they are first on the job?"
    - » Expert: (lengthy explanations about complex software and how new hires cannot answer customer's questions when they are called…"
  - Development team: "What is it that new hires actually *do*?"
    - » Expert: "They answer the phone about complaints."
  - Development team: "So you do not need a new hire training program at all!"
    - » Expert: "We don't?"
  - Development team: "No, you need a program to train people to answer the phone and to do customer service."
- Think about what the customers need, *not* what they ask for !!!

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# Types of Analyses

- Problem analysis
- Requirements analysis
- Addressee analysis
- Knowledge and task analysis
- Ressource analysis
- Cost analysis

# Roger Schank's Five Questions

- What are employees having trouble doing properly?

- Can you tell me a story of when an employee did not know what to do and caused a big problem for the company?

- Under what circumstances do employees do the wrong thing, even though they have been told how to do the right thing?

- What problems are causing the company real trouble right now?

- What are the key things an employee needs to know how to do in this company?

# Requirements Analysis

- Which competences of the addressees need to be trained?
  - Questionnaires
  - Interviews (with executive management)
- Determination of training requirements/needs (qualitative and quantitative)
- Types of requirements:
  - Normative need: Standards
  - Relative need: Comparison group
  - Subjective need: Individual statements
  - Demonstrated need: E.g. long waiting times
  - Anticipated need: Proactive about upcoming changes
  - Need based on critical incidents: Weakness analysis, failure analysis

# Goals and Objectives

- Horton's two questions about goals:
  - For your organization, what is the single most important measure of success? [3 words maximum]
  - How will your project help accomplish that goal?
- Learning objectives
  - Primary (top-level) objective
  - Derived tree of lower-level objectives

> Good objectives are a mission-critical, sine-qua-non, must-have, make-or-break requirement for effective e-learning. [...]
>
> In my experience, well over half the failures of e-learning projects would have been prevented by clear objectives.
>
> (W. Horton 2006)

# A Simple Structure for Objective Specification

- Template for objective:

  Teach      _____   *(what)*

  to         _____   *(target group)*

  who      _____   *(prerequisites)*

Intent:
- Do
- Decide
- Create

**Objective**

Teach      how to shorten projects

to         mid-level managers

who      recognize the critical path of a project

Learners

Prerequisites:
- Skills
- Knowledge
- Attitudes

Horton

# Types of Objectives

**"By experiencing this lesson or topic, the learner will be able to**

Primary objectives

- **Do** procedure X to accomplish Y

- **Create** or design an X that does Y

- **Decide** X, given Y

Secondary objectives

- **Believe** X

- **Feel** X about Y

- **Know** X about Y "

Horton

# Addressee Analysis

- Personal characteristics, in particular in corporate training
  - Previous knowledge and experience
  - Position and function within enterprise
  - Training history
  - Education level
  - Learning motivation, attitude towards learning goals
  - Personal preferences, priorities, and goals
- Intercultural aspects
- Handicaps
- Structure of addressee population:
  - Homogeneity
  - Intra-group relations
  - Social atmosphere

# Example: Learner Analysis (Horton)

**Gantt chart readers** — **Learners** — Form copyright ©2005 William Horton Consulting, Inc.

**ID**

| Project | Scope | Identification | Owner |
|---|---|---|---|
| Course:<br>**Reading Gantt Charts** | Entire course | RGC-Consumers-01<br>Version 1.1 – (2003.5.1) | Copyright ©2005 William Horton Consulting, Inc.<br>... Spruce Street, Boulder, CO 80302 – +1 303 545 9444<br>– hon@horton.com |

**Learners**

| Description | Job function | Education | Experience | Demographics | |
|---|---|---|---|---|---|
| Middle and upper managers who need to read and interpret Gantt charts. Typically supervise those who actually construct the Gantt charts.<br><br>Portion of total audience: 100% | General management duties, including management of complex projects<br><br>Time value: $100K per year | Business degree and training in corporate policies but no specific training in reading and constructing Gantt charts. | 85% have seen Gantt charts, understand that they show project schedules, and perhaps recognize task bars. | Age range — 30-65<br>Gender mix — 60% male<br>Nationality — 65% US & Canada | |

**Goals**

| What do they hope to gain? | Why do they take the learning? | | | Financial involvement |
|---|---|---|---|---|
| Learn to interpret Gantt charts, especially how to use them to make better decisions regarding the scheduling and supervision of complex projects | 65% To accomplish current job<br>Required by boss<br>20% To qualify for new job<br>To pass certification test | 15% | To make more money<br>Curiosity & self-improvement<br>Other | Paid for time learning? Yes<br>Costs they pay themselves: (none) |

**Where**

| When will they learn? | Where will they learn? | Geographic distribution | Environment |
|---|---|---|---|
| Designated times<br>85% Normal work hours<br>5% Evenings<br>10% Weekends<br>Other | 80% Private office<br>30% Cubicle<br>Factory floor<br>Training center<br>5% Hotel<br>15% Home<br>Other: | All in one building<br>All on one campus<br>All in one city<br>60% All in one country<br>40% over 24 time zones | Space: No room for more than one piece of paper beside the computer<br>Lighting: OK<br>Noise: Normal office noise with frequent interruptions (every 10 minutes or so) |

**Abilities**

| Computer skills | | Language skills | Typing | Disabilities |
|---|---|---|---|---|
| X E-mail<br>X Web browser<br>X Word processor<br>X Other desktop applications<br>Discussion forums | Chat and messaging<br>Install software<br>Writing macros<br>Programming | Reading  10th Grade level<br>Writing  10th Grade level<br>Languages<br>English  60% 1st language<br>40% 2nd language | E-mail quality  15 words/min<br>Letter quality  10 words/min | None beyond those implied by the demographics of learners.<br>Note: This course is not required to comply with Section 508 or W3C WAG |

**Technology**

| Hardware | | Software | Network connection | | | | |
|---|---|---|---|---|---|---|---|
| Processor  P2 100+ MHz<br>Memory  24 MB<br>Display size  800 x 600<br>Colors  Thousands | Disc  CD-ROM 4X<br>Audio out  16-bit<br>Audio in  (none)<br>Video in  (none) | OS  Windows 98<br>Browser  IE 4+, NS 4+<br>Players  Flash 4<br>Applications  MS Project | %<br>60%<br>20%<br>20%<br>- | Type<br>Intranet<br>Broadband<br>Dialup<br>Wireless | Up<br>1 M<br>.2 M<br>.02 M | Down<br>1M<br>1M<br>.02 M | Cost<br>-<br>-<br>- |

# Knowledge and Task Analysis

- Observation of learning content from learner perspective
  - Determination of suitable learning strategies
- Collaboration with content experts
- Declarative knowledge:
  - Topics, structured, possibly hierarchically
  - "Mind-Mapping" may be helpful
- Procedural knowledge:
  - Activities:
    - » Observable actions
    - » Unobservable (mentale) actions
    - » Mixtures thereof
  - Background knowledge
  - Cues



Source: infiniteminds.info

# Resource Analysis

- Which resources are available?
  - Materials
  - Staff
    - » Qualifications, relative to target platforms
  - Time
    - » Work packages, milestones
  - Money
  - Rights on copyrighted material
- Problem:
  - Difficult to fully determine in advance

# Costs Analysis

- Staff costs
  - Development
  - Project management
  - Administration
  - External consultants
- Hardware, software
- Rights
- Services
- Telecommunication
- Travel
- Rent
- Maintenance, repair
- Miscellaneous

# 7  Development of Learning Applications

7.1   Structure of Development Processes

7.2   Preliminary Analysis

7.3   Design: Didactic Concept   ⬅

7.4   Design: Storytelling

7.5   Design: Segmenting & Sequencing

7.6   Design: Interactivity & Adaptivity

7.7   Development Tools and Platforms

References:

Niegemann et al. Kap. 4

Klimsa Kap. 11

# Design Decisions for Learning Applications

| | |
|---|---|
| **Strategic-Didactic Decisions** | • Abstraction level<br>• Social form of learning<br>• Direction of communication flow<br>• Locus of control |
| **General Design Decisions** | • Structure of material<br>• Coding and modalities<br>• Pedagogic methods<br>• Interaction design<br>• Motivation design<br>• Technical basis |
| **Detailed Design Decisions** | • Layout<br>• Icons<br>• … |

# Learning Activities

- Structure for learning activities according to Horton:

| **Absorb** activities | **Do** activities | **Connect** activities |
|---|---|---|
| Read, watch, listen | Excercise, experiment, discover | Link to prior learning, to work and life |
| • Presentations and demos<br>• Stories by the teacher<br>• Readings<br>• Field trips | • Practice<br>• Discovery<br>• Games | • Ponder activities<br>• Stories by the learner<br>• Job aids<br>• Research<br>• Original work |

*On which level would you place these design decisions (strategic, general, detailed)?*

# Transfer of Design Experience

- Good design: Creativity, intuition, experience, domain knowledge
  - Learning environments: Design by non-professional designers
- Encoding of design experience and design principles
- Architecture:
  - „Design Patterns" (Christopher Alexander)
- Software Engineering
  - „Design Patterns" (Gamma/Helm/Johnson/Vlissides 1998)
- Industrial Design
  - "Universal Principles of Design" (Lidwell/Holden/Butler 2003)
- Pedagogical Patterns
  - Pattern language by Oser/Baeriswyl 2001: "Choreographies of teaching
  - Various initiatives for pattern repositories (e.g. http://www.pedagogicalpatterns.org)

> A design pattern "describes a problem which occurs over and over and again […] and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice."
> (Alexander et al., 1977)

# Basis Models (Oser & Baeriswyl)

|  | Learning Through Experience | Problem Solving | Concept Building |
|---|---|---|---|
| Step 1 | Planning of actions | Problem presentation | Activation of pre-knowledge |
| Step 2 | Performance of actions | Reformulation of problem task | Introduction of the new concept with an example |
| Step 3 | First reflection, construction of meaning | Development of hypotheses | Development of characteristics of the new concept |
| Step 4 | Generalisation of experience | Test of hypotheses | Active application of the new concept |
| Step 5 | Abstraction of experience | Evaluation of solution | Application in other contexts |

Oser, F. & Baeriswyl, F. (2001). Choreographies of teaching: Bridging instruction to learning. (pp. 1031-1065) In V. Richardson (ed.). *Handbook of research on teaching.* 4th edition. Washington, D.C.: American Educational Research Association.

# Opeartionalisation of Steps (Oser & Baeriswyl)

| | Step | Indicators teacher | Indicators students | Control question |
|---|---|---|---|---|
| 1 | Planning of possible activities (e.g. setting of an experiment), inner representation of these actions in a context | Teacher announces an activity, gives instructions, clarifies goal of the activity, makes sure that students know what to do | Students prepare an activity, describe the planned procedure, explain the necessary steps | What is the planned activity? (Procedure, order of steps) Why are they doing this? What is the aim of the planned activity? |

# Structure of a Design Pattern

- NAME of the pattern
- ABSTRACT (short description of the pattern)
- PROBLEM (what kind of problem should be solved by using the pattern)
- ANALYSIS (what makes the problem to be solved a problem)
- KNOWN SOLUTIONS (are there alternative solutions?)
- RESEARCH QUESTIONS (open research questions concerning the pattern)
- CONTEXT (description of the context/s the solution is applicable to/not applicable to)
- CONDITIONS/RATIONALE (reasons for the applicability of this solution in the context)
- DISCUSSION/CONSEQUENCES (consequences of use, side effects, implementation issues)
- REFERENCES (documentation, URLs)
- RELATED PATTERNS (alternative patterns, patterns to discriminate…)
- AUTHOR/S
- REFERENCES

Rusman, van den Broek, & Ronteltap, 2003, cited according to Niegemann et al.

# Bergin's Fourteen Patterns

- Early Bird
- Spiral
- Consistent Metaphor
- Toy Box
- Tool Box
- Lay of the Land
- Fixer Upper
- Larger Than Life
- Student Design Sprint
- Mistake
- Test Tube
- Fill in the Blanks
- Gold Star
- Grade it Again Sam

http://csis.pace.edu/~bergin/PedPat1.3.html