



## CENTER FOR TEXTUAL STUDIES AND DIGITAL HUMANITIES

402 - Instructional Design and e-Learning

Spring Semester 2016

Week 9 - Extra

## Learning by example

### Worked examples

- a powerful tool in building cognitive skills
- popular with learners
- learners often bypass verbal descriptions for examples
  - Anderson, J.R., Farrell, R., & Sauers, R. 1984. "How subject matter knowledge affects recall and interest." American Educational Research Journal 31. PP.313-337.
- worked examples or textual descriptions
  - LeFevre, J.A., & Dixon, P. 1986. "Do written instructions need examples?" Cognition and Instruction 3. PP. 1-30.

## Learning by example

Worked examples - what are they?

- step by step demonstration of how to perform a given task or solve a particular problem
- designed to teach learners procedural skills or strategic skills
  - make a proper cup of tea, complete a formula in a spreadsheet, or how to conduct a negotiation
- not a new method for learning environments

## Learning by example

Worked examples - how do they work?

- role of working memory in learning processes to help build new knowledge in long-term memory
  - 'practice makes perfect...'
- assumption of benefit of working through many practice problems
- solving problems requires a lot of working memory resource
  - working memory for building new knowledge
  - working on practice problems consumes a lot of working memory capacity
- greater reliance on worked examples can lead to more efficient learning
- studying a worked example compared to solving a problem
- manage cognitive load with worked examples and transition into practice
- fading

## Learning by example

### Leveraging worked examples - intro

- 'completion' problems
- guidelines and principles to consider
  - transition worked examples to full examples using fading
  - self-explanation question with worked example
  - supplemented explanations with worked example
  - application of multimedia principles to design of worked examples
  - learning transfer through correct use of context of worked examples

## Learning by example

### Principle 1 - transitioning worked examples to problems with fading

- worked examples most effective path during initial stages of learning
- 'expertise reversal effect'
- novices benefit from the cognitive load relief of studying an example
- knowledge in memory changes the impact of such examples
- 'fading' process allows growth of expertise from worked examples to full problems

## Learning by example

### Principle 1 - evidence for benefits of fading

- probability lessons with three step faded worked examples

- Atkinson, R.K., Renkl, A., & Merrill, M.M. 2003. "Transitioning from studying examples to solving problems: Effects of self-explanation prompts and fading worked out steps." Journal of Educational Psychology 95. PP. 774-783

## Learning by example

### Principle 2 - promoting self-explanation

- learners may ignore worked out steps or give them cursory attention
- learners self-explain worked out steps using meaningful questions
- self-explanation question is an interaction between the learner and the knowledge
  - identify underlying principles and concepts

**Problem:** From a ballot box containing 3 red balls and 2 white balls, two balls are randomly drawn. The chosen balls are not put back into the ballot box. What is the probability that a red ball is drawn first and a white ball is second?

First  
Solution  
Step

Please enter the letter of the rule/principle used in this step:

Next

Probability Rules/  
Principles:

- a) Probability of an Event
- b) Principle of Complementarity
- c) Multiplication Principle
- d) Addition Principle



## Learning by example

### Principle 2 - evidence for benefit of self-explanation

- compared learning of school students from faded worked examples that included self-explanation questions

- Atkinson, R.K., Renkl, A., & Merrill, M.M. 2003

## Learning by example

### Principle 3 - Worked examples with explanations

- learning can be improved due to transition from examples to practice through fading
- also improved with self-explanation questions
- such techniques free working memory...
- obvious concern is with learner understanding of steps provided
- this naturally impacts learner's ability with self-explanation questions
- consider use of accompanying brief explanation
- explanation can be optional and require explicit call

## Learning by example

### Principle 3 - evidence & suggestions for designing explanations

- Reed, S.K., Dempster, A., & Ettinger, M. 1985. "Usefulness of analogous solutions for solving algebra word problems." *Journal of Experimental Psychology: Learning, Memory and Cognition* 11. PP. 106-125
- Renkl, A. 2002. "Learning from worked-out example: Instructional explanations supplement self-explanations." *Learning and Instruction* 12. PP. 529-556.

A few suggestions for design:

- consider providing detailed explanations of initial worked example for beginners
- modify explanations as lesson progresses, making explanations shorter and available on demand, or in response to a self-explanation question error
- explanations should show the connection between the steps and underlying principles clearly
- position explanations close to the location of the worked step

## Learning by example

### Principle 4 - multimedia principles and examples

- illustrate worked examples with relevant visuals
- present steps with audio
  - consider modality and redundancy principle
- present steps with integrated text
  - contiguity principle
- present steps in conceptually meaningful groupings or chunks
- allow learners to progress under their own pace
  - segmenting principle

## Learning by example

### Principle 4 - design summary

- relevant visual illustrations
- audio to present steps related to visual
- text for steps when no visual available or presented
- text to present steps for faded worked examples or for including self-explanation questions
- provide explanations of worked examples in text
- avoid presenting words as both audio and text
- segment worked examples with many steps in conceptually meaningful groupings
- use labels to identify conceptually meaningful groupings
- allow learners to access each grouping at their own pace

## Learning transfer

### Near and Far Transfer - intro

- certain scenarios simply require training of procedures
- goal of the training is to achieve 'near transfer'
  - apply steps learnt to similar work situations
- training goal is often to build job skills
  - requires judgement to adapt strategies to new work situations
- teach strategies that can then be adapted
- help learners achieve 'far transfer'

## Learning transfer

### Far Transfer - psychology

- thorough grounding and understanding of underlying principles of a subject
  - differentiation between expert and novice
- ability to abstract principles and apply to a given problem
- identification and resolution of a problem
- experiential practice and learning
- abstraction of flexible strategies
- more flexible knowledge derived from multiple examples
- different contexts or stories but the same underlying principles

## Learning transfer

Far Transfer - deep vs surface

- "Tumour Problem"

  - Duncker, K. 1945. "On problem solving." Psychological Monographs 58. PP.270.

- different groups, different pre-work assignments testing principles

  - Gick, M.L., and Holyoak, K.J., 1980. "Analogical problem solving." Cognitive Psychology 12. PP. 306-355.

- convergence principle



## Learning transfer

### Far Transfer - design

- present several varied context based worked examples
- encourage learners to engage with examples to help promote strategic knowledge
- examples need to illustrate common set of principles
- vary cover story but maintain underlying principle...
- probability question with red and white balls...
- at least two worked examples to vary cover story but maintaining underlying principle