



## CENTER FOR TEXTUAL STUDIES AND DIGITAL HUMANITIES

DIGH 402 - Instructional Design and e-Learning

Spring Semester 2014

Week 3 - Extra

## 'e-Learning' and multimedia

a visual difference

- consideration of value and usage of multimedia within course designs
- do visuals make a difference in helping a learner's understanding, retention, and recall of skills and knowledge
- how do they differ in their value compared to words, both written and spoken
- value of graphics and texts in e-Learning courses compared to text alone
- graphics can be static (photos, drawings...) or dynamic (animations, video...)

## 'e-Learning' and multimedia

a unity of words and graphics

- closer integration of words and graphics in e-Learning courses
- learners more likely to understand material when engaged in active learning
  - attending to relevant material in a given lesson
  - mentally organising the material
  - mentally integrating the material with existing knowledge
- multimedia presentations encourage learners to engage in active learning
  - mentally representing material in words and in pictures
  - mentally making connections between the verbal and pictorial
- words alone may encourage learners to engage in shallow learning
- graphics need to be targeted and relevant, complementary to the text

## 'e-Learning' and multimedia

choosing graphics for learning

- not all graphics are created equal, they need to complement and help learning

when we use graphics in instructional design we can consider:

- decorative graphics (decorate a page without enhancing the text in a lesson)
- representational graphics (portray a single element)
- relational graphics (portray a quantitative relation among two or more variables)
- organisational graphics (depict the relations among elements)
- transformational graphics (depict changes in an object over time)
- interpretive graphics (illustrate invisible relationships)

## 'e-Learning' and multimedia

using graphics effectively

organisation

- graphics can help organise information visually (topics, interactive menu graphics...)

relationships

- graphs, comparisons...can show one point relative to another, easier to visualise change (animations to show transitions, maps...)

lesson interfaces

- guided discovery often employs graphical representations of examples, scenarios...

## 'e-Learning' and multimedia

supporting evidence

- simple instructional situations benefit most from words and pictures

  - Mayer, R.E. 'Multimedia Learning'. Cambridge University Press, 2001

  - Moreno, R. & Mayer, R.E. 'Learning science in virtual reality multimedia environments: Role of methods and media'. Journal of Educational Psychology, PP. 598-610

- 11 different studies compared test performance of students

  - animation and narration vs narration alone

  - illustrations and text vs text alone

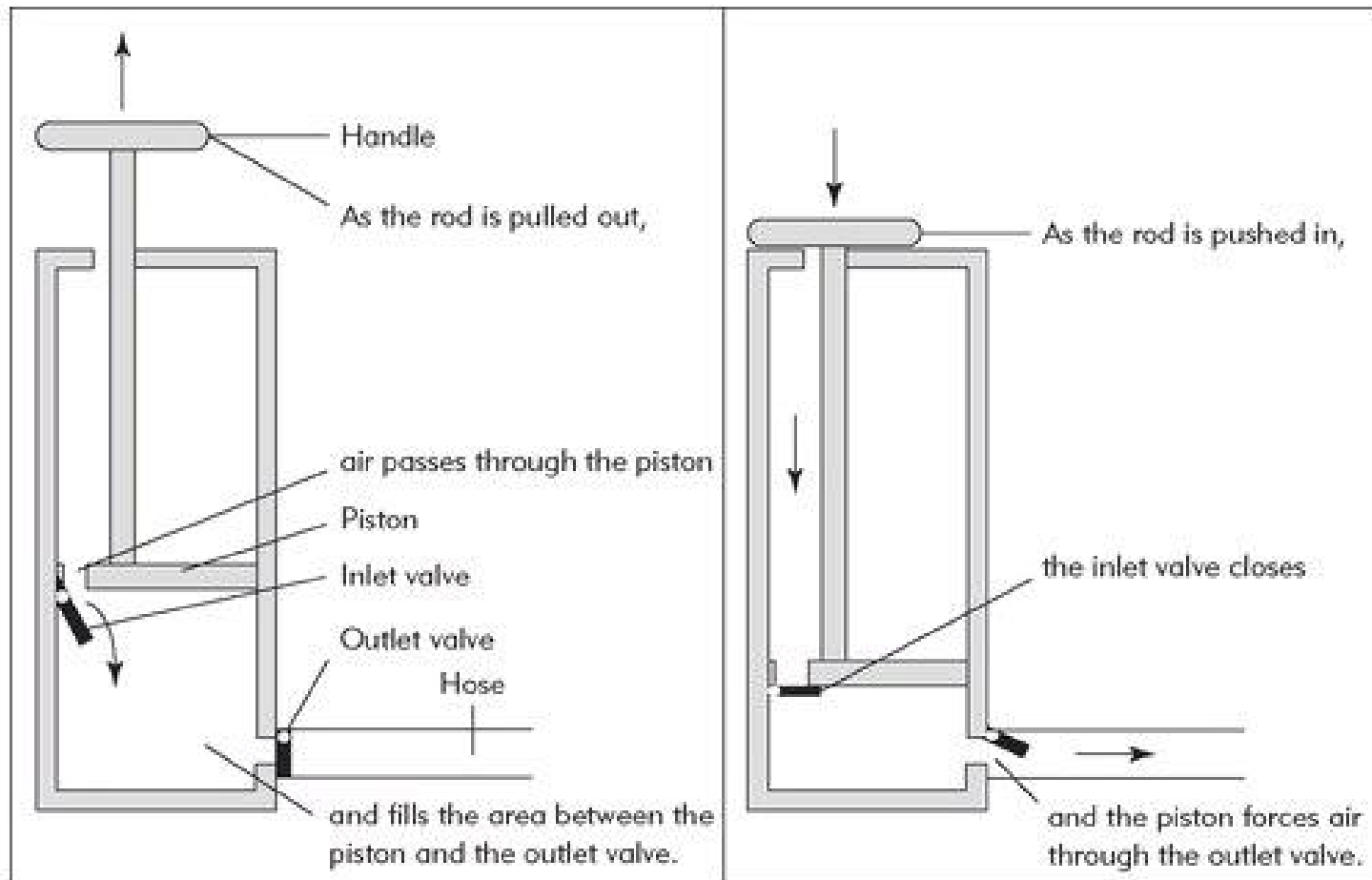
- lessons taught on scientific and mechanical processes

- students who received multimedia lesson performed better in testing

  - between 55 and 121% more correct solutions

## 'e-Learning' and multimedia

testing sample



## 'e-Learning' and multimedia

### multimedia effect

- our example evidential finding is referred to as the multimedia effect
  - people learn more deeply from words and graphics than words alone

"The multimedia principle, which suggests that learning and understanding are enhanced by adding pictures to text rather than presenting text alone, appears to be well supported by findings from empirical research."

Fletcher, J.D., & Tobias, S. 'The multimedia principle.' in 'The Cambridge handbook of multimedia learning'. Cambridge University Press, 2005.



## visuals and text in e-Learning - cont'd

### contiguity principle - intro

- need to coordinate printed words and graphics
- on-screen words placed near the parts of the referring on-screen graphics
  - words and graphics contiguous in space
- consider how on-screen text is integrated with on-screen graphics
  - ensure proximity of printed words to appropriate part of graphic
- violations of this principle are all too common

## visuals and text in e-Learning - cont'd

### contiguity principle - violations (part 1)

- scrolling window separation of graphics and text
- feedback displayed on a separate screen from exercise or question
- related text appears in a separate window, covering graphic...
- directions for practice exercise placed on separate screen from the application
- all text is placed at the foot of the screen creating a division from the graphics
- key for a graphic is placed at the foot of the page

## visuals and text in e-Learning - cont'd

contiguity principle - synchronisation of narration and graphics

- necessary to coordinate narration and graphics
- narration describes event depicted by graphics, such as animation or video
- narration and graphics contiguous in time
- consider how narration is integrated with the on-screen graphics
  - ensure corresponding narration and graphic are presented at the same time

### video

contiguity principle - violations (part 2)

- separation of the links and actions for the narration and on-screen video
- narrated introduction followed by an animation or video

## visuals and text in e-Learning - cont'd

contiguity principle - psychological reasons (part 1)

- poor design consideration may lead to physical separation of text and graphics
- temporal separation may occur as well
- designers may have failed to consider effective way to present information
- designers may reason that greater choice is preferable and not detrimental to learning
- separation of words and graphics not based on an accurate understanding of how people learn
- are you a copy machine or recorder?
- people are 'sense-makers'
- seeing meaningful relations between words and pictures
- separation of words and graphics requires people to use scarce cognitive resources to match them up
- 'extraneous processing'

## visuals and text in e-Learning - cont'd

contiguity principle - psychological reasons (part 2)

- effective combination of text and graphics helps retention in working memories
  - easier to make meaningful connections
- sense-making process that leads to meaningful learning
- working memory organises incoming information for integration with existing knowledge in long-term memory
- taxed limited capacity of working memory leads to cognitive overload
- 'split-attention' forces the learner to use limited working memory capacity
  - Ayres, P. and Sweller, J. 2005. "The split attention principle in multimedia learning." In "Cambridge handbook of multimedia learning". Cambridge University Press, PP. 135-146.

## visuals and text in e-Learning - cont'd

printed words and graphics - evidence to consider

- based on cognitive theory and some relevant research studies

- Mayer, R.E. 1989. "Systematic thinking fostered by illustration in scientific text." Journal of Educational Psychology 81. PP.240-246.

- Mayer, R.E., Steinhoff, K., Bower, G. and Mars, R. 1995. "A generative theory of textbook design: Using annotated illustrations to foster meaningful learning of science text." Educational Technology Research and Development 43. PP.31-43.

- Moreno, R. and Mayer, R.E. 1999. "Cognitive principles of multimedia learning: The role of modality and contiguity." Journal of Educational Psychology 91. PP.358-368.

- training programs for technical tasks

- Chandler, P. and Sweller, J. 1991. "Cognitive load theory and the format of instruction." Cognition and Instruction. 1991. PP.293-332.

- Paas, F. and van Merriënboer, J. 1994. "Instructional control of cognitive load in the training of complex cognitive tasks." Educational Psychology Review 6. PP.351-371

## visuals and text in e-Learning - cont'd



1. collision with a moving particle excites the atom
2. electron jumps to a higher energy level
3. electron falls back to its original energy level, releasing the extra energy in the form of a light photon

## visuals and text in e-Learning - cont'd

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## visuals and text in e-Learning - cont'd

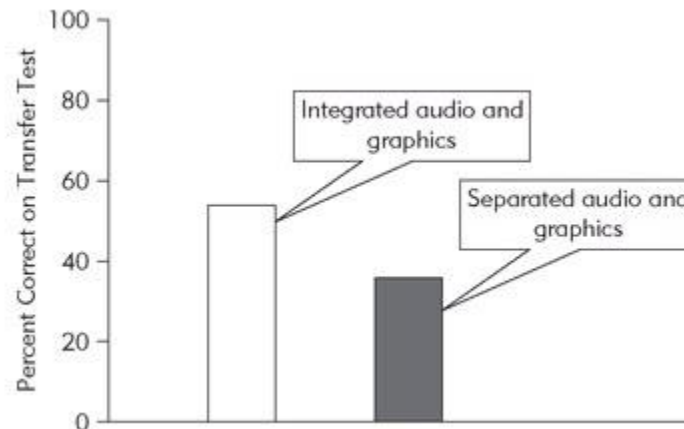
### narration and graphics - evidence to consider

#### - some sample research based evidence

- Mayer, R.E., Moreno, R., Boire, M., and Vagge, S. 1999. "Maximising constructivist learning from multimedia communications by minimizing cognitive load." *Journal of Educational Psychology* 91. PP. 638-643.

- Mayer, R.E., and Sims, V. 1994. "For whom is a picture worth a thousand words? Extensions of a dual-coding theory of multimedia learning." *Journal of Educational Psychology* 86. PP.389-401.

- Mayer, R.E. and Anderson, R.B. 1991. "Animations need narrations: An experimental test of a dual-coding hypothesis." *Journal of Educational Psychology* 83. PP.484-490.



## visuals and text in e-Learning - cont'd

narration and graphics - thoughts?



## visuals and text in e-Learning - cont'd

narration and graphics - thoughts?



## visuals and text in e-Learning - cont'd

contiguity - a few considerations

- useful techniques considered include
  - presentation of words near the appropriate part of the graphic
  - presentation of narration relative to appropriate part of the graphic
- a few unresolved issues to consider include:
  - how much detail should be included in both the text and graphics?
  - when is it preferable to use printed text instead of narration, and vice versa?
  - how does the style of writing affect the efficacy of actual learning?
  - how does the narrator's accent or other vocal characteristics affect learning?

## audio and text in e-Learning

### modality principle - intro

- benefits of presenting words as narration rather than on-screen text
- a lot of research to support this principle
- considerable evidence that narration, instead of on-screen text, provides significant learning gains
- empirical evidence to support this position
- memory limitations may require text over audio
- psychological advantage to using audio
  - incoming information split across two separate cognitive channels
  - words in the auditory channel and pictures in the visual channel

## audio and text in e-Learning

modality principle - words as speech

- cognitive theory and research evidence supports narration for simultaneous graphic presentation and viewing
- overload of visual channel due to simultaneous processing of graphics and printed words
- eyes attending to printed words cannot fully attend to graphics
  - especially when the words and graphics are presented concurrently and rapidly
- e-Learning should be designed to minimise overloading the visual channel
- using audio allows a learner to focus on the visual while listening to the narration

## audio and text in e-Learning

### modality principle - limitations

- narration useful in combination with graphics to reduce demands on visual processing
- technical demands may limit successful implementation of narration
  - network constraints, hardware access and facilities, sound quality...
  - additional cost for narration and editing, regular updates, amendments...
- carefully consider the use of narration relative to learning material
  - words and graphics simultaneously presented
- words might remain available to the learner for memory support or direction
  - mathematical formulae, directions...

## audio and text in e-Learning

modality principle





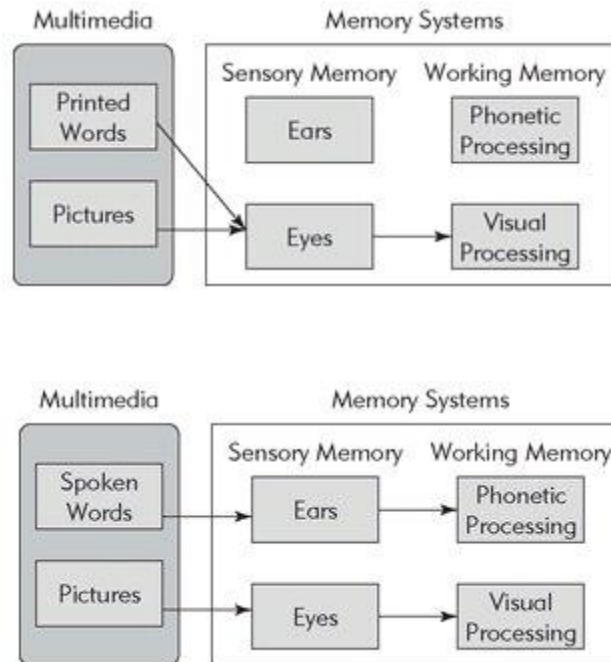
## audio and text in e-Learning

modality principle - psychological reasons (part 1)

- concern with the 'information acquisition view of learning'
  - conflicts with research evidence concerning how we know people actually learn
- multimedia lessons that present words as on-screen text can conflict with learning
- cognitive theory of learning
  - separate channels for visual and auditory processing
- issue of initial processing in the visual channel
- competition for limited visual attention
- attention deficit due to overloaded visual channels
- reduce load on visual channel with narrated explanation

## audio and text in e-Learning

modality principle - psychological reasons (part 2)



## audio and text in e-Learning

modality principle - evidence in support of narration

- multimedia lessons presenting explanations on the working of lightning, a car's braking system, an electric motor...

- Craig, S.D., Gholson, B., and Driscoll, D.M. 2002. "Animated pedagogical agents in multimedia learning environments: Effects of agent properties, picture features, and redundancy." *Journal of Educational Psychology* 94. PP. 428-434.

- Moreno, R. and Mayer, R.E. 1999. "Cognitive principles of multimedia learning: The role of modality and contiguity." *Journal of Educational Psychology* 91. PP.358-368.

- Mayer, R.E., and Moreno, R. 1998. "A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory." *Journal of Educational Psychology* 90. PP.312-320.

- interactive game to teach botany

- Moreno, R., Mayer, R.E., Spires, H., and Lester, J. 2001. "The case for social agency in computer-based teaching: Do students learn more deeply when they interact with animated pedagogical agents?" *Cognition and Instruction* 19. PP.177-214.

## audio and text in e-Learning

modality principle - applicability

- not meant as a recommendation for each and every scenario
- applies in situations where you present graphics and their verbal commentary at the same time
- in particular when the material is complex and presented at a rapid, continuous pace
- familiar material or learner has control over pacing of material, modality becomes less important
- in certain cases words should remain available to the learner over a given sequence
  - technical terms, list key steps, give directions to a practice exercise...
- consider native language and language ability
- only printed words on the screen, without associated graphic, modality principle does not apply
- 'redundancy principle' needs to be considered