What is an educational website?

- Educational vs informational
- Alur et al, 2002
  - 17% of websites had all components of a “learning paradigm”
  - critical thinking, independent learning, evidence-based learning, feedback
  - <50% met any criteria
- Conclusion: Most “educational” websites just provide information

Core principles of learning
Kaufman (BMJ 2003)
1. Learner an active contributor
2. Context of real-life problem (“situated”)
3. Activate prior knowledge
4. Self-direction (metacognition)
5. Practice and feedback
6. Reflection

Learning = Active process (construction of knowledge)

- Interaction with guide
- Elaboration (meaning)
- Prior knowledge and experience
- New information and experience
- Environment
- Personality, learning style, motivation

Key issues in designing educational Websites

Input (senses) evanescent
Elaboration (working memory) seconds 7 items
Storage (long-term) permanent no limit

Core principles of learning
Kaufman (BMJ 2003)
1. Learner an active contributor
2. Context of real-life problem (“situated”)
3. Activate prior knowledge
4. Self-direction (metacognition)
5. Practice and feedback
6. Reflection

Learning = Active process (construction of knowledge)

- Interaction with guide
- Elaboration (meaning)
- Prior knowledge and experience
- New information and experience
- Environment
- Personality, learning style, motivation

Copyright 2016 Mayo Foundation
e-learning: The role of the instructor

Active learning on the Web: How to facilitate?

- Activity vs active learning
- Clicking and typing ≠ active learning
- "Butterfly defect" – hover/flit
- Cognitive activity, not physical activity
- Online lectures?
- Online small groups?

First Principles of Instruction
Merrill, Educational Technology Research and Development (2002)

Activation (of prior knowledge)

- Analyze problem (group > alone)
- Respond to thoughtful questions
- Generate questions on topic
- Study advance organizer
- Engage in experience (case, interactive model, experimental data …)

Demonstration

- Don’t just “talk” – demonstrate
  - Example and non-example of concept
  - Picture or video of procedure
  - Diagram or animation of process
- More than one example
  - Multiple representations, points of view
- Multimedia may be helpful
  - Images, video, text emphasis

Demonstration (cont’d)

- Build mental models
  - Use analogies
  - Teach process knowledge (how, why)
  - Promote elaborative rehearsal
    - Ask questions
    - Facilitate concept maps
    - Encourage learners to self-question
    - Provide for online collaboration

Copyright 2016 Mayo Foundation
Application

- Learners should **solve problems**
  - More than one – multiple perspectives
  - Represent real life
  - Complexity consistent with objectives
  - Group or individual
  - Simulation (low/high fidelity), written case
  - Coaching should fade over time
  - Feedback (automated or from instructor)
  - Reflection (questions, portfolio)

Integration

- **Do** something with knowledge
  - Demonstrate ("go public")
  - Reflect upon
  - Defend
  - Share (e.g. teach)

Problem-centered

- Context of **representative** problem
  - Activation
  - Demonstration
  - Application
  - Integration
  - Whole task (not just components)
  - Progression of complexity & guidance
  - Compare problems

Expertise Reversal Effect

- What works for beginners doesn’t work for intermediate/advanced

4-component instructional design (4C/ID) – van Merriënboer

- Whole learning tasks
  - High task-task variability within cluster of equivalent tasks; scaffolding fades
  - Complexity varies between clusters

Essential Skills in Computer-Enhanced Learning

**Principles of online instructional design**

Part 2. Effective multimedia design
Cognitive Load

• 7 ± 2
  • Letters … words … sentences … paragraphs … concepts …
• Limiting factor in learning
• How to manage cognitive load
  • Minimize “extraneous” ➔ effective instructional design

1. Multimedia Principle

People learn more from graphics + words than words alone

<table>
<thead>
<tr>
<th>Types of graphics and appropriate applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction</td>
</tr>
<tr>
<td>Representative</td>
</tr>
<tr>
<td>Relational</td>
</tr>
<tr>
<td>Organization</td>
</tr>
<tr>
<td>Transformational</td>
</tr>
<tr>
<td>Interpretive</td>
</tr>
</tbody>
</table>

• With multimedia, keep in mind
  • Graphics “can add value, but won’t improve a bad learning program”
  • Graphics appropriate to content
  • Less is often more
  • Copyright

2. Contiguity Principle

Place words near (or within) corresponding graphics

• Helps learners to see the relationships
• Limits the amount of cognitive effort
• Synchronize spoken words with graphics

[Brain diagram with labels: A. Frontal, B. Temporal, C. Parietal, D. Occipital, E. Cerebellum]
3. Modality Principle

*When there are graphics, present words as speech rather than on screen text*

- "Dual channel" input
  - Phonetic processing
  - Visual processing

---

3. Modality Principle

---

3. Modality Principle

---

3. Modality Principle

---

4. Redundancy Principle

*Explain graphics with words in audio or text – NOT BOTH*

- Learners read the words rather than focus on graphics
- ("Don't read your slides")
3. Redundancy Principle
Conflict

Information \rightarrow\text{Input} \rightarrow\text{Working Memory}

Printed Words \rightarrow\text{Eyes} \rightarrow\text{Visual}

Spoken Words \rightarrow\text{Ears} \rightarrow\text{Phonetic}

4. Redundancy Principle

*Explain graphics with words in audio or text – NOT BOTH*

- Learners read the words rather than focus on graphics
- Exceptions
  - No graphics
  - Unfamiliar or complex material
  - Learner disability

5. Coherence Principle

*Less is More – Avoid the extraneous*

- Interesting but *irrelevant* details *detract*
  - Sounds
  - Graphics
  - Words
- Why? Inhibits effective elaboration:
  - Distraction (irrelevant)
  - Disruption (interfere)
  - Seduction (incorrect)

6. Personalization Principle

*Use a conversational style*

- Activates social response
- Increases active cognitive processing
- Human voice
- Important not to be too informal
- On screen coaches (pedagogical agents)
- Visible author
- May help maintain interest

7. Segmenting and Pretraining Principles

*Manage intrinsic cognitive load by chunking information*

- Segmenting – breaking the lesson into smaller parts
- Pre-training – teach names and key concepts up front

---

**Does it Matter?**

<table>
<thead>
<tr>
<th>Multimedia Principle</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimedia</td>
<td>1.5</td>
</tr>
<tr>
<td>Contiguity</td>
<td>1.11</td>
</tr>
<tr>
<td>Coherence</td>
<td>1.32</td>
</tr>
<tr>
<td>Modality</td>
<td>.97</td>
</tr>
<tr>
<td>Redundancy</td>
<td>.69</td>
</tr>
<tr>
<td>Personalization</td>
<td>1.30</td>
</tr>
<tr>
<td>Segmenting</td>
<td>.98</td>
</tr>
<tr>
<td>Pretraining</td>
<td>1.3</td>
</tr>
</tbody>
</table>

From Clark & Mayer 2007.