Adaptive Coherence Information as an Approach to Facilitate the Comprehension of Online Learning Courses

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Overview

• Background
  – Aim of the study
  – Knowledge Acquisition & Text Comprehension

• Application
  – Hint Texts in NetCoach

• Empirical Studies
  – Exploration
  – Experimental Phase
  – Future Perspectives
Approach to Comprehension Facilitation

Central Goal: Provision of a better course comprehension by adapting the text presentation in online learning courses to the user

- Adding hint texts (coherence) when necessary (adaptively)
- Combination of the user’s goals and his/her proficiency may be relevant
Text Comprehension Model for Linear Text

Additional Coherence for Nonlinear Text

**Background/Prior Knowledge**
- linguistic proficiency
- topic proficiency

**mental model**

**Model Evaluation**
- text information (bottom-up)
- expectancies on information (top-down)

**Adaptive Text Coherence**
Sample Page without Hint Texts

Absolute Links on the Internet

Absolute links are addresses which do not depend on the context, i.e. for the referenced information it does not matter in which HTML file the link is integrated.

Examples:

http://hostname/
is the starting page on the computer "hostname".

http://hostname:8000/
is the starting page of a WWW Server which can be reached under port number 8000 on the computer "hostname".

http://hostname/directory/
is an overview of a directory the computer "hostname" or the index page, if one exists.

The slash after the directory name is necessary to be separable from file name. Some web browsers can detect a directory automatically but need for this detection a double access which means doubled net transfer. In many cases a missing slash leads to further problems with referencing links. Therefore, the slash should always be used after the directory name.

http://hostname/directory/filename
is a file on the computer "hostname" within a given directory.
Sample Page with Hint Texts

Background knowledge on not yet learned pages

- Publishing worldwide on the internet makes the author responsible for international law consideration (…more)
- The internet is suited for information the user searches on his own freewill (…more)
- You should have a concept of the content, the structure and the layout before publishing your information (…more)
- Tags should be used to organize the logic structure of a document and not for layout (…more)
- HTML Commands are pairwise expressions in brackets, which may contain parameters. (…more)

more

Absolute Links on the Internet

Absolute links are addresses which do not depend on the context, i.e. it does not matter in which HTML file the link is integrated.

Examples:

http://hostname/
is the starting page on the computer “hostname”.

http://hostname:8000/
is the starting name of a WWW server which can be reached at port number 8000 on the computer.
Hint Texts as Additional Adaptive Coherence Elements

Additional coherence…

• consists of
  – one short sentence
  – for each prerequisite page the user had not yet learned

• is not meant to substitute the reading of the background page but to facilitate the user’s decision to look up that page or not

• has to be generated manually by the course author
Why not Present Additional Coherence to Everyone?

<table>
<thead>
<tr>
<th>Prior Knowledge (Prerequisites)</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>High</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

- Higher text coherence should facilitate comprehension
- Higher (additional) coherence could reduce working accuracy

⇒ Adaptation of additional coherence presentation to the individual prior knowledge within the course seems more adequate (e.g., empirical evidence was found by Kintsch, 1994)
Course Subject

We used an already existing course about **HTML-programming**.

Advantages:

- **Many users** are working with the course

- HTML provides more *modularity* than a more sequential course of, e.g. a psychological domain

*Results of a study from Foltz showed that possibly the use of a course on a more social domain (i.e., economic market) would tempt the user to navigate through the text in a more linear way und thus just rarely producing hint texts.*
Exploration

User login*)

Group A

Random Assignment

Group B

Questionnaire

Hint Texts possible

Questionnaire

Hint Texts not possible

Goal: Assessment of navigation behavior and use of hint texts

*) http://art.ph-freiburg.de/HTML-Tutor
Sample Description

• Phase of Assessment: 4 Feb. – 16 May 2003

• 642 total new logins, of which just 603 used their access at all (resulting N=603)

• Age: M=30.3, SD=12.8

• Sex: 75.1% male, 24.9% female

• Working Duration: M=20:33, SD=45:26
Navigation Behavior and Use of Hint Texts

Random assignment (Hint Texts possible?)

- Yes: 50.9%
- No: 49.1%

Navigation behavior (Nonlinear Navigation?)

- Yes: 90.8%
- No: 9.2%

Hint text availability (Hint Texts Presented?)

- Yes: 74.6%
- No: 25.4%

Use of hint texts (Are the presented Hint Texts used?)

- Yes: 78.7%
- No: 21.3%
Distribution of Background Knowledge

Questionnaire Data

Level of Background Knowledge

Percent

low
high

69.5%
30.5%

theoretical
practical

(correlation theoretical/practical r=.83)
Navigation Behavior and Use of Hint Texts depending on the Background Knowledge

![Bar Chart]

- Nonlinear Navigation
  - Low Background Knowledge: 73.1%
  - High Background Knowledge: 83.0%

- Use of Hint Texts
  - Low Background Knowledge: 21.8%
  - High Background Knowledge: 22.8%
Correct Answers depending on the Use of Hint Texts

- Linear Navigation
- Nonlinear Navigation without Hint Texts
- Hint Texts not used
- Hint Texts used

Low Background Knowledge
High Background Knowledge
# Confounding of Background Knowledge

<table>
<thead>
<tr>
<th>Goal</th>
<th>Background Knowledge</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve a <strong>specific</strong> HTML Problem (%)</td>
<td>Low</td>
<td>14.1%</td>
<td>21.2%</td>
</tr>
<tr>
<td>Get a <strong>general</strong> Overview on HTML (%)</td>
<td>Low</td>
<td>57.1%</td>
<td>39.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Background Knowledge</th>
<th>Low</th>
<th>High</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M ± SD</strong></td>
<td>M</td>
<td>M</td>
<td>± SD</td>
<td>± SD</td>
</tr>
<tr>
<td>Working Duration (mm:ss)</td>
<td>22:22</td>
<td>±45:16</td>
<td>14:58</td>
<td>± 32:55</td>
</tr>
</tbody>
</table>
Effects of Confounding Variables on Exercise Performance

<table>
<thead>
<tr>
<th>Percent of correct Answers</th>
<th>M ±SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>A specific HTML Problem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>18.5%</td>
<td>± 30.4%</td>
</tr>
<tr>
<td>No</td>
<td>25.5%</td>
<td>± 31.5%</td>
</tr>
<tr>
<td>A general Overview on HTML</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>26.8%</td>
<td>± 32.6%</td>
</tr>
<tr>
<td>No</td>
<td>21.9%</td>
<td>± 30.7%</td>
</tr>
</tbody>
</table>

Correlation of Exercise Performance with Working Duration: 

\[ r = .35, p < .001 \]
Recent Approach of Outcome Centered Help Links

- **Situation**: Irrelevancy of the user’s actual comprehension (i.e., even users with no obvious comprehension problems get additional coherence)

- **Approach**: Adaptive help links are presented when the user answered an item incorrectly (and thus showed his/her malcomprehension)
Sample Description of Outcome Centered Help Links

- Data collection from Aug., 22\textsuperscript{nd} to Oct., 3\textsuperscript{rd}
- Requirements for sample inclusion:
  - First login within data collection phase
  - At least 1 false answer to exercise items
- Resulting Sample:
  - N=220 (just about 40\% of the 554 total logins)
  - 67.7\% male
  - Mean age = 30.7 years (± 14.6)
  - Mean working duration = 37:31 (± 61min)
  - 78.4\% no or little subjective background knowledge
Use of Help Links

• Overall 12.7% users used (followed) the presented help links (n=28)

• Differentiating between users‘ goals:

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
<th>sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific HTML problem</td>
<td>26.3%</td>
<td>11.4%</td>
<td>p&lt;.10</td>
</tr>
<tr>
<td>General overview</td>
<td>13.2%</td>
<td>12.3%</td>
<td>n.s.</td>
</tr>
<tr>
<td>Whole HTML in detail</td>
<td>17.3%</td>
<td>9.0%</td>
<td>p&lt;.10</td>
</tr>
</tbody>
</table>
Performance Differences due to the Use of Help Links

No significant performance difference:

<table>
<thead>
<tr>
<th>% correct answers</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Use of Help Links</td>
<td>40.8%</td>
<td>27.6</td>
</tr>
<tr>
<td>Use of Help Links</td>
<td>44.5%</td>
<td>26.8</td>
</tr>
</tbody>
</table>

Relevant confounding:

<table>
<thead>
<tr>
<th>Working duration</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Use of Help Links</td>
<td>30:12</td>
<td>48:31</td>
</tr>
<tr>
<td>Use of Help Links</td>
<td>87:42</td>
<td>106:13</td>
</tr>
</tbody>
</table>

n.s. \( p < .01 \)
Summary of the First Results on the Use of Help Links

- Quite a few users used the help links at all
- The influence of the background knowledge is not significant (sample size too small?)
- The user’s goal seems to influence his/her tendency to use the help links
- There are relevant confounding variables which have to be controlled in an experimental design
Planned Design for a Laboratory Experiment

Instruction / login

random assignment*

general (A1)  detail (A2)  general (B1)  detail (B2)

Quest.  Pretest  All Hint Texts
Quest.  Pretest  No Hint Texts
Quest.  Pretest  All Hint Texts
Quest.  Pretest  No Hint Texts

External Post Test, Questionnaire

*random assignment of goal (general vs. detail), and hint texts (all = A vs. none = B)
Future Perspectives

1. Usage of a pretest to determine the user’s background knowledge and to trigger the user model

2. The user may get the additional opportunity to mark the summarized concepts as already known

Example for 2.
Thank You