

Effect of Presentation on Reading Behaviour

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Outline

- Motivation
- Background
- User Study
- Results
 - Effect on Overall Performance
 - Effect on Eye Movements and Reading Behaviour
- Conclusion

Can we promote learning?

- eText & eLearning are ubiquitous
- Does presentation of text and evaluation resources have an effect on:
 1. Performance outcomes
 2. Eye movements
 3. Reading behaviour
- How to present learning material to optimise learning?

How Do People Read?

When a person is reading a sentence silently, the eye movements show that not every word is fixated. Every once in a while a regression (an eye movement that goes back in the text) is made to re-examine a word that may have not been fully understood the first time. This only happens with about 10% of the fixations, depending on how difficult the text is. The more difficult the higher the likelihood that regressions are made.

Regression

Fixation

Saccade

Image taken from: <http://www.scholarpedia.org/article/File:Reading.jpg>

Eye Tracking in eLearning

- Reading assistance
 - iDict – foreign language readers (Hyrskykari et al., 2000)
 - The Reading Assistant – text-to-speech (Sibert et al., 2000)
- How multiple choice questions are answered (Nugrahaningsih et al., 2013; Tsai et al., 2012)
- Predict performance of physics concepts when presented as text or images (Chen et al., 2014)

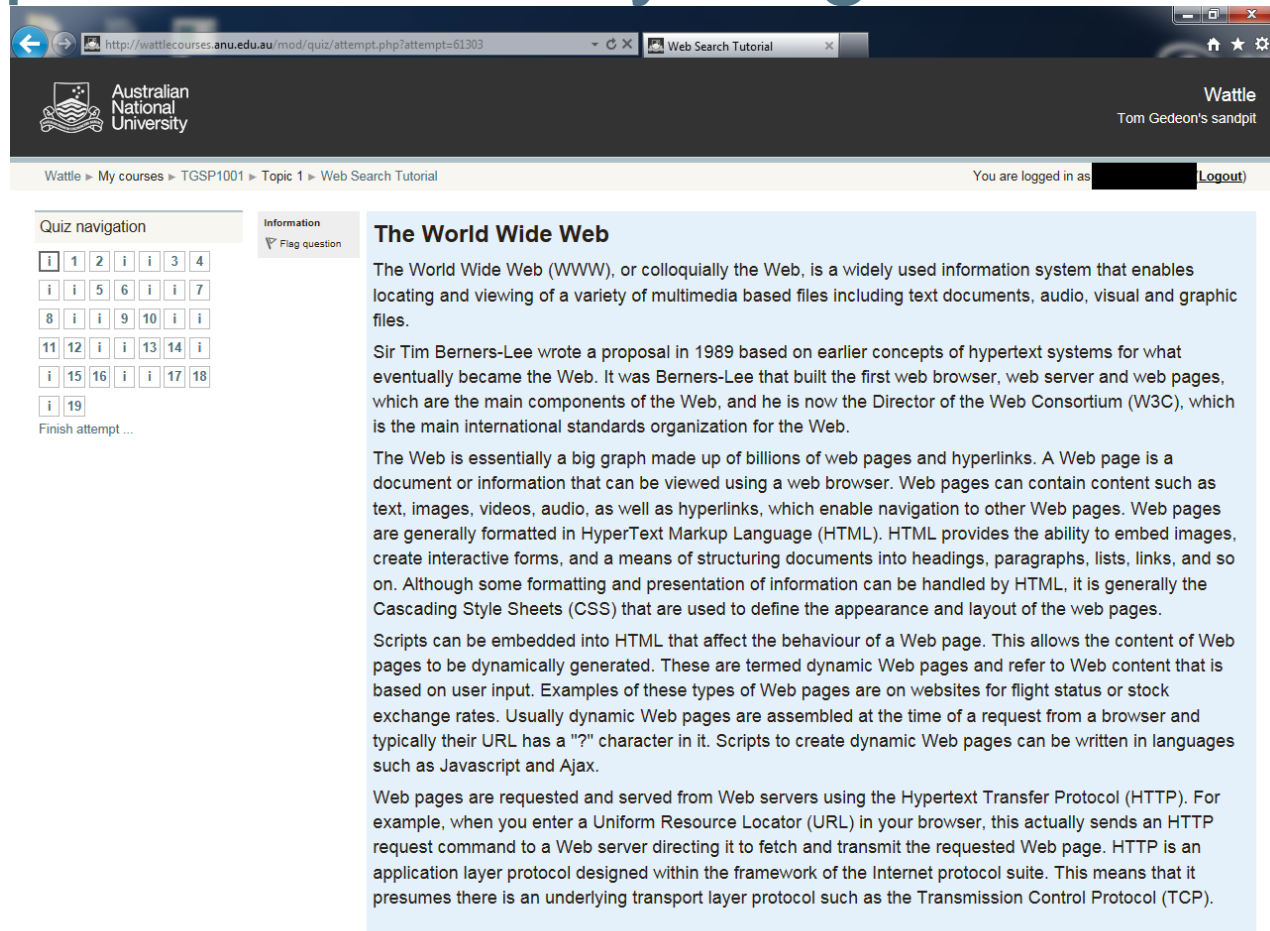
Hypotheses

- 4 presentation formats of educational material
 - manipulations of the order of which text and quiz questions are shown to a student.
- Hypotheses - presentation format will:
 1. have an effect on students' performance, in terms of time and quiz score, and perceived understanding of the text;
 2. Cause differences in eye movements and reading behaviour

User Study

- Between-subjects design
- 2 presentation sequences:
 - Format A: text only slide then questions & text slide
 - Format B: questions & text slide

Example of Text Only Page



Wattle
Tom Gedeon's sandpit

Wattle » My courses » TGSP1001 » Topic 1 » Web Search Tutorial

You are logged in as [redacted] (Logout)

Quiz navigation

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Finish attempt ...

Information
Flag question

The World Wide Web

The World Wide Web (WWW), or colloquially the Web, is a widely used information system that enables locating and viewing of a variety of multimedia based files including text documents, audio, visual and graphic files.

Sir Tim Berners-Lee wrote a proposal in 1989 based on earlier concepts of hypertext systems for what eventually became the Web. It was Berners-Lee that built the first web browser, web server and web pages, which are the main components of the Web, and he is now the Director of the Web Consortium (W3C), which is the main international standards organization for the Web.

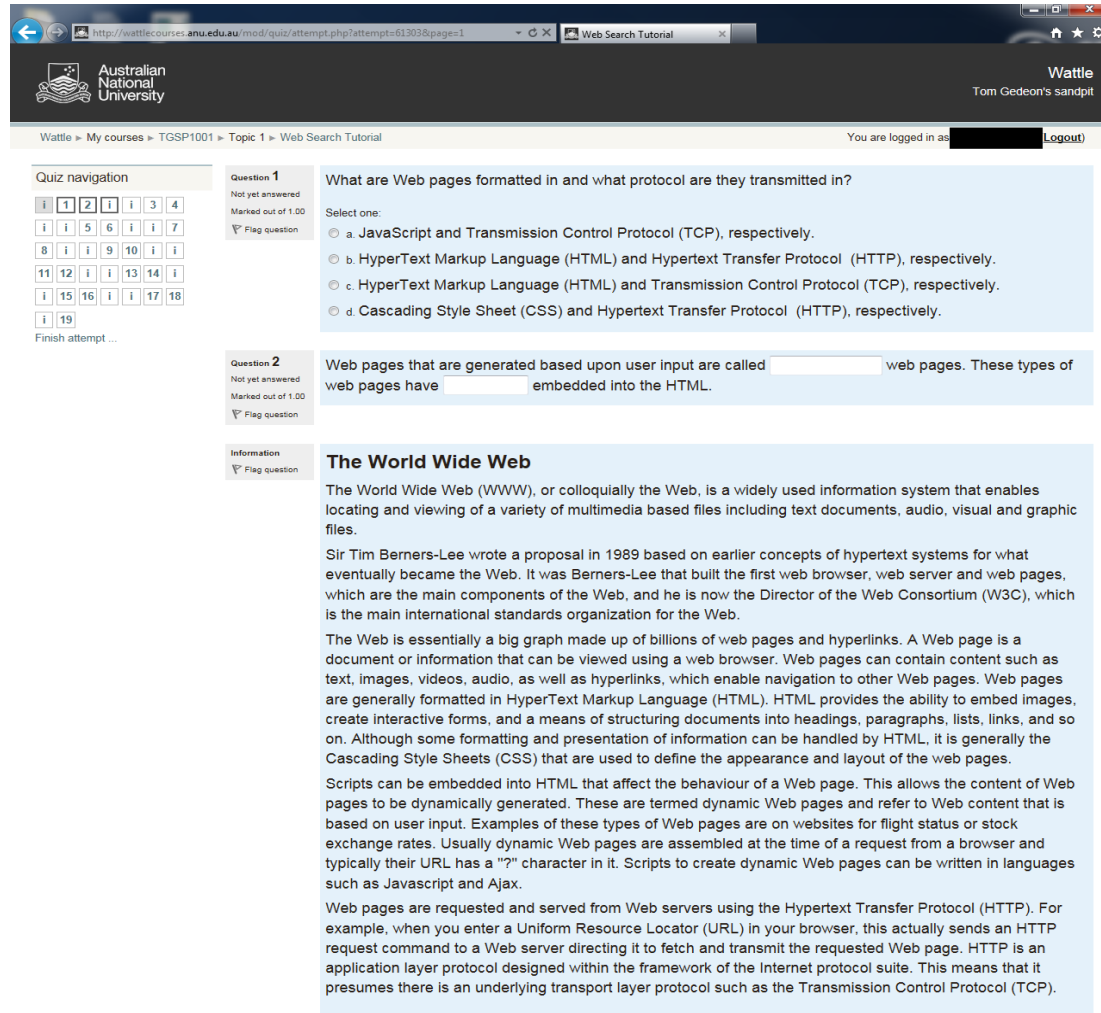
The Web is essentially a big graph made up of billions of web pages and hyperlinks. A Web page is a document or information that can be viewed using a web browser. Web pages can contain content such as text, images, videos, audio, as well as hyperlinks, which enable navigation to other Web pages. Web pages are generally formatted in HyperText Markup Language (HTML). HTML provides the ability to embed images, create interactive forms, and a means of structuring documents into headings, paragraphs, lists, links, and so on. Although some formatting and presentation of information can be handled by HTML, it is generally the Cascading Style Sheets (CSS) that are used to define the appearance and layout of the web pages.

Scripts can be embedded into HTML that affect the behaviour of a Web page. This allows the content of Web pages to be dynamically generated. These are termed dynamic Web pages and refer to Web content that is based on user input. Examples of these types of Web pages are on websites for flight status or stock exchange rates. Usually dynamic Web pages are assembled at the time of a request from a browser and typically their URL has a "?" character in it. Scripts to create dynamic Web pages can be written in languages such as Javascript and Ajax.

Web pages are requested and served from Web servers using the Hypertext Transfer Protocol (HTTP). For example, when you enter a Uniform Resource Locator (URL) in your browser, this actually sends an HTTP request command to a Web server directing it to fetch and transmit the requested Web page. HTTP is an application layer protocol designed within the framework of the Internet protocol suite. This means that it presumes there is an underlying transport layer protocol such as the Transmission Control Protocol (TCP).

Next

Example of Questions & Text Page



The screenshot shows a web browser window with the URL `http://wattlecourses.anu.edu.au/mod/quiz/attempt.php?attempt=61303&page=1`. The page header includes the Australian National University logo and the name 'Wattle Tom Gedeon's sandpit'. The user is logged in as 'Tom Gedeon'.

Quiz navigation: A grid of question numbers from 1 to 19. Question 1 is highlighted in blue, indicating it is the current question. Questions 2 through 19 are marked with a small 'i' icon, indicating they are not yet answered.

Question 1: Not yet answered. Marked out of 1.00. The question is: "What are Web pages formatted in and what protocol are they transmitted in?". The options are:

- a. JavaScript and Transmission Control Protocol (TCP), respectively.
- b. HyperText Markup Language (HTML) and Hypertext Transfer Protocol (HTTP), respectively.
- c. HyperText Markup Language (HTML) and Transmission Control Protocol (TCP), respectively.
- d. Cascading Style Sheet (CSS) and Hypertext Transfer Protocol (HTTP), respectively.

Question 2: Not yet answered. Marked out of 1.00. The question is: "Web pages that are generated based upon user input are called _____ web pages. These types of web pages have _____ embedded into the HTML.".

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User Study (Cont.)

- Presented in Wattle
- 33 COMP1710 students
 - Format A: 9 participants (2 female, 7 male)
 - Format B: 8 participants (1 female, 7 male)
- Eye gaze collected with infrared tracking system
- Gaze converted into eye movement measures; number fixations, fixation time, etc.

Effect on Overall Performance

- Format A took significantly longer to complete
- The same quiz score for both formats
 - Format A & B: highest ave. quiz scores
- Format A: positive correlation ($r=0.6$) between quiz score & subjective understanding score
- Format B: unable to interpret comprehension ($r=-0.2$)
- Manipulation of format can be use to optimise learning outcomes

Effect on Eye Movements & Reading Behaviour

- Consider the text only page and questions & text pages separately
- Only looking at the questions & text pages
- Hypothesis:
 - first read through in format A will aid in answering questions; less answer seeking needed compared to format B

Questions & Text

- Eye movements

Format	Num fixations	Total fixation dur (s)	Num regressions
A	224.4 ± 171.2	40.4 ± 35.8	95.7 ± 66.9
B	374.2 ± 167.8	77.2 ± 43.7	157.5 ± 66.4

- Reading Behaviour
 - significantly higher ratio of skimming behaviour observed for format B

Questions & Text (Cont.)

- Answer Seeking behaviour

Format	Multiple Choice Question		Cloze Question	
	Jumps between question and content	Saccades classified as Reading after jump	Jumps between question and content	Saccades classified as Reading after jump
A	7 ± 6	58 ± 69	10 ± 8	89 ± 102
B	11 ± 9	132 ± 96	17 ± 10	134 ± 92

Far more answer seeking observed for format B; reading the text first is beneficial!

Conclusion

- The presentation of text and evaluation resources can have a great impact on the learning process and outcomes
 - Quiz score, time taken and perceived understanding
 - To promote thorough reading behaviour
- Optimal presentation format is format A
- Further work:
 - Different types of questions
 - Mobile devices
 - Explore engagement

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Questions?