Competent Information Search in the World Wide Web

- Development and Evaluation of a Training for Pupils -

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ABSTRACT
In this paper I present the training program for pupils CIS-WEB that supports **C**ompetent **I**nformation **S**earches in the World Wide **WEB** (WWW). CIS-WEB relies on an idealized processing model specified for search tasks of varying complexity. Its development is based on a first empirical study that analyzed pupils' typical errors when searching information in the web. CIS-WEB led to a significant reduction concerning those errors as demonstrated in study 2.

Keywords
Information search, internet, education, training, evaluation

INTRODUCTION
With increasing importance of the WWW, the ability to use various information sources autonomously becomes more and more important. At the same time, an information user is confronted with an increase in control requirements concerning to the selection and evaluation of information. My research project aims at reducing this gap by fostering pupils' ability for competent information searches in the web.

TASK ANALYSIS
In order to describe competent information search in the web a cognitive task analysis was conducted that resulted in an idealized processing model (Figure 1).

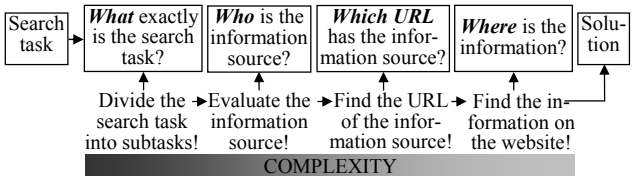

Figure 1: Idealized processing model

This model relies on two basic ideas: First, search tasks can be distinguished according to their complexity that is determined by the amount of information given for task accomplishment. The latter also influences the way a task should optimally be processed.

Consider the following search task: *Since when is the burger Whopper offered by Burger King (www.burgerking.de)?* In this example, the URL of a website is given as information source for the information asked. This task has the lowest possible stage of complexity that can be solved by simply retrieving the website and finding the information. However, in the case of more complex search tasks additional processing steps are needed in order to find a task's solution (cf. Figure 1). The model assumes that information search is adaptive in nature. This is in line with empirical studies which found that experts show top-down planning and flexibly select their processing strategies depending on a search task (e.g., [1, 3]).

STUDY 1: PERFORMANCE ANALYSIS

Method
In this study, pupils' performance in solving search tasks in the web was examined whereby higher error rates were expected with increasing complexity of search tasks. Additionally, it has been investigated whether the opportunity to browse the web freely or to accomplish a conventional, i.e., technically oriented internet training could improve performance. Accordingly, two independent variables were introduced: (1) *Simple training* (between-subjects): free browsing vs. conventional training and (2) *task complexity* (within-subjects): 1 to 4 (cf. Figure 1). As dependent variables *declarative knowledge* about the web (Pre-/ Posttest) and *performance* when solving search tasks were measured. Participants were 28 pupils (6^{th} grade) with average age of 11.9 years. The study was realized as a group experiment (3x2 lessons) with each pupil working autonomously at a PC. The procedure is illustrated in Figure 2.

	Pretest	Search tasks	Simple training	Search tasks	Posttest
A	X	Complexity 1-4	Free browsing	Complexity 1-4	X
B	X	Complexity 1-4	Conventional training	Complexity 1-4	X

Figure 2: Procedure of study 1

Results and Discussion
Pupils' preknowledge was quite good as indicated by low error rates in the pretest (29.5 %). However, this preknowledge was obviously not sufficient for solving the search tasks as the overall error rate of 85.5 % strongly demonstrated.

The manipulation of *simple training* had neither an effect, neither on declarative knowledge ($t(24) = -.60$; $p > .50$; two-tailed**)** nor on performance ($t(26) = -.24$; $p > .80$; two-tailed; Figure 3, next page**)**. This can be seen as an indicator that complex skills are necessary to search information in the web competently. Thus, a more comprehensive kind of training is required. Contrary to the prediction performance was also not influenced by the variation of *task complexity* **(**$F(3, 81) = 4.11$; $MS_e = 568.51$; $p > .50$), which may be explained by the high overall error rates (Figure 4, next page).

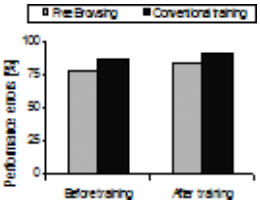

Figure 3: Mean error rates [%] by simple training

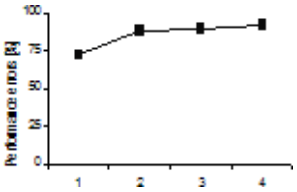

Figure 4: Mean error rates [%] by task complexity

However, qualitative error analyses identified typical errors in pupils' processing depending on task complexity as can be seen in the following examples:

- *Complexity 1. Where is the information?*: Selecting irrelevant information even if this is highly improbable.
- *Complexity 2. Which URL has the information source?*: Using complete interrogations as search queries.
- *Complexity 3. Who is the information source?*: Trusting any information source without evaluating it.
- *Complexity 4. What exactly is the search task?*: Answering search tasks with the first information found even if this is incomplete.

In sum, pupils face serious problems while searching the web with different errors depending on task complexity. Thus, in order to support competent information searches in the web, a comprehensive training program is necessary.

TRAINING DESIGN

The in-class training CIS-WEB is made up of six subsequent modules and teaches system expertise as well as information-seeking expertise (cf. [2]). The training modules are realized either as whole class-lessons or as pairs of pupils-lessons with multimedia modules. All modules are constructed case-based, i.e., a question-answer dialogue is simulated by using concrete examples. Furthermore, the modules are combined with work sheets that include problem-solving tasks. Thus, CIS-WEB entails different learning methods in order to maximize learning results.

The modules' topics are described in the following:

- *Module 1. Search environment*: Features of internet, WWW, and search systems (cf. conventional trainings).
- *Module 2. Search tasks*: Idealized processing model of information searches in the web (cf. Figure 1).

Each of the remaining modules addresses the processing of a search task depending on its complexity in a simple-to-complex sequence.

- *Module 3. Find the information on the website!*: Help functions on websites and search strategies.
- *Module 4. Find the URL of the information source!*: Syntax of URLs and handling of search systems.
- *Module 5. Evaluate the information source!*: Identification and evaluation of information sources with regard to credibility and actuality.
- *Module 6. Divide the search task into subtasks!*: Identification and processing of subtasks.

STUDY 2: TRAINING EVALUATION

Method

The effectiveness of CIS-WEB was investigated in study 2. 61 pupils (7th and 8th grade) with an average age of 12.7 years were trained with *CIS-WEB* that comprised 18 lessons. As in study 1 *declarative knowledge* about the web and *performance* when solving search tasks were measured. Figure 5 shows the procedure of study 2.

	Pretest	ST	M1	ST	M2-4	ST	M5-6	ST	Posttest
A	X	X	X	X	X	X	X	X	X

Figure 5: Procedure of study 2 (ST=Search tasks, M=Module)

Results and Discussion

Pupils had a rather good preknowledge (mean error rate: 34.4 %). However, they had severe problems solving search tasks in the web demonstrated by an error rate of 83.4 % before the training. CIS-WEB was able to improve both declarative knowledge and performance. Mean error rates after the training dropped to 21.7 % in the declarative knowledge posttest ($t(58) = 5.27$; $p < .00$; two-tailed) and to 72.5 % in case of the search tasks in the web ($t(55) = 5.53$; $p < .00$; two-tailed).

Because study 2 has been finished just recently, only these overall results can be presented at the moment. More detailed analyses, also with regard to the concrete impact of CIS-WEB on pupils' search strategies will be conducted next. However, CIS-WEB has already proven effective as a comprehensive training program to foster pupils' ability for competent information searches in the WWW.

ACKNOWLEDGMENTS

I thank Peter Gerjets and my supervisors Friedrich Hesse and Werner Tack for their support as well as Albrecht Schmitt and Hans-Jürgen Hofmann for their cooperation.

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