Using Minimalism to Support the Development of Self-Regulatory Knowledge and Skills

Ard W. Lazonder
Wageningen University
Department of Education
P.O. Box 8130
6700 EW Wageningen
The Netherlands
Email: Ard.Lazonder@ALG.AO.WAU.NL

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Minimalism in a nutshell
Carroll’s minimalism signaled a distinctly new approach to supporting the knowledge and skills development of computer users. Contrary to most approaches (that depart from a feature-oriented point of view), the key idea in the minimalist approach is to adapt as much as possible to the users’ desire for quick and hand-on experience. This notion is put into practice by combining concise instruction with ample opportunities for the users to engage in meaningful interactions with the software. More specifically, the minimalist approach consists of four design-principles: (a) allow for active learning, (b) anchor the instruction in the task domain, (c) support error-recovery, and (d) support reading to do, study and locate (Carroll, 1990; Lazonder, 1994; Van der Meij & Carroll, 1995). Each principle is specified into a set of heuristics: guides and grist for designing minimalist tutorials (Van der Meij & Carroll, 1995). The effectiveness of these principles and heuristics seems beyond questioning. In teaching novice users the basics of computer programs, minimalist tutorials have repeatedly been found to lead to faster training and better learning as compared to ‘traditional’ manuals (e.g., Carroll, Smith-Kerker, Ford, & Mazur-Rimetz, 1987; Lazonder & Van der Meij, 1993; Ramsay & Oatley, 1992).

Tailoring minimalism to contemporary software programs
Although the development of the minimalist approach was prompted by the bad press for the then-existing manuals, it can just as well be considered a response to the user-unfriendly software of the early 1980s. That is, minimal manuals compensated for confusing system prompts (“General EXEC failure”), output (“Your text may look different on screen than on paper”) and command names (the EXIT-command clears the screen). As software increasingly became user-friendly, the need to overcome these flaws was gradually reduced.

Notwithstanding these improvements, most of today’s software programs are still hard to handle, suffering from a new kind of user-unfriendlyliness. Internet’s WWW serves as a typical example of these programs and the problems they invoke. With relatively easy-to-use tools like browsers and search engines, WWW-users can retrieve so much information that specific skills to manage the information-flow are called for. More specifically, WWW-users risk information overload and thus need designated knowledge and skills to plan, monitor and evaluate (the results of) their actions.

There are at least two reasons why the minimalist approach holds considerable promise for developing self-regulatory knowledge and skills. Firstly, minimalism has repeatedly shown to be an effective and efficient approach to initial skill learning. And there are no obvious reasons why these
results should not transfer to metacognitive skill learning. The current view on teaching self-regulatory skills in fact resembles the minimalist approach in many ways. Both approaches advocate task-oriented instructions, ample opportunities to practice and cognitive scaffolding (i.e., gradually reducing external control in favour of self-directed learning activities). In addition, both approaches acknowledge personal variables such as intelligence, task value and self-efficacy to affect learning outcomes (Boekaerts, 1997; Gourgey, 1998; Schunk & Zimmerman, 1997). Secondly, the minimalist approach already has some elements that facilitate self-regulation. Error-information, for example, models problem solving behaviour by helping users to detect, diagnose and correct errors. Its presence also invites users to frequently monitor task progression. In similar fashion action statements like “Look on the screen to...” and “Check if the dialog window...opens” support monitoring by training users to keep track of their own actions.

The assumed functionality of self-regulatory skill instruction in minimal manuals is based mainly on logical thinking and inductive reasoning, however. The present research project therefore aimed to reveal if and how minimalist tutorials can support the development of self-regulatory knowledge and skills in information seeking on the WWW. Two research questions guide this research project: what should we teach students to search information on the WWW, and how should we teach it.

Study 1

What knowledge and skills should be taught to efficiently search the WWW? A classical yet fruitful way to answer this question is to identify differences between novice and experienced searchers. Some researchers studied the search performance of students with varying levels of WWW-experience (e.g., Fidel et al., 1999; Hill, 1999; Hill & Hannafin, 1997; Watson, 1998). Their work revealed many idiosyncrasies of Web searching and has unmistakably increased our understanding of the search process. However, as these studies did not treat the subjects’ level of expertise as an experimental variable, they are unsuited for identifying novice users’ training needs.

This observation gave rise to a systematic comparison of novice and expert search performance (Lazonder, Biemans & Wopereis, submitted). In this study, the search process was segmented into ‘locating a site’ and ‘locating information on a site’. The search performance of 25 fourth graders was compared on both parts of the search. Students were classified as novice (n=8) or expert (n=17) based on their level of WWW-experience. Novices had worked with Internet for less than 10 hours; the experts had over 50 hours of WWW-experience. Three search tasks were used to assess the subjects’ skills in locating sites and locating information. Search tasks dealt with Dutch literature; subjects had to locate a book review, answer a question on a collection of poems, and find the title of a biography.

The experts clearly outperformed their novice counterparts on the first phase of the search. Overall, they located sites about 3 minutes faster than novices did. Experts also had higher performance success (67% vs. 44%), indicating that they located more sites successfully than novice users did. The performance efficiency and effectiveness scores also differed in favour of the experts. No performance differences were found on tasks requiring subjects to locate information on a site. This finding is consistent with hypertext research. Locating information on a site requires a substantial amount of browsing (i.e., clicking hyperlinks), and novices and experts are equally proficient at browsing (e.g., Jones, 1989; Khan & Locatis, 1998; Wang, Liebscher & Marchionini, 1987).

In addition, the subjects’ level of domain expertise did not affect the outcomes at all. Domain expertise was defined by the subjects’ grade in Dutch literature. Subjects with high grades performed as good as subjects with low grades. In contrast, the subjects’ level of self-confidence did affect search outcomes. Subjects with high self-confidence scores produced higher performance scores. But, when the self-confidence scores were inserted into the analyses as a covariate, the effect of WWW-experience on search outcomes was eliminated. Apparently, self-confidence is closely related to WWW-experience. The more experienced a user gets, the higher his or her self-confidence in working with Internet becomes.

In conclusion, novices should be taught how to locate information on a site, because their performance on that part of the search already measures up to that
of experienced users. Still, the first study did not identify the knowledge and skills to be covered in the instruction. Prompted by this notion a second, more analytical study was performed.

**Study 2**

The second study investigated why novices are less proficient at locating sites and what kind of instructional support is needed to enhance their performance (Lazonder, submitted). Using the same tasks and the same operational definitions, this study compared the search performance of 7 novices and 7 experts. The subjects’ actions and comments were transcribed, and the transcripts were used to perform in-dept analyses of the subjects’ search performance.

*Figure 1* Process model of information searching on the WWW

Figure 1 shows the process model that was used in the analyses. To initiating a search, subjects must first sense a need for information. Information needs thus constitute the users’ search goal. In the study, the experimental task serves as the goal, designating what to look for – and sometimes even where to look for it. As users can identify the search goal by reading the task description, goal formation was not taken into account in the present study. By selecting a search strategy, the subjects decide on the approach to the search problem. Broadly speaking, the subjects may choose between entering a site’s URL, browsing subject categories, and content-based searching. Subjects then execute the strategy, and monitor the search outcomes. Monitoring generally occurs by judging the relevance of the sites included in the search engine’s hit list. Based on this evaluation, subjects may decide to examine the content of a site, thus entering the next phase of the search (i.e., locate information). Given the results from study 1, this part of the search was not included in the present study. Subjects may also choose to alter their search, or to start a new search. In both cases, the subjects return to a previous stage of the model.

Experts were expected to be faster and better at performing these steps than novices, but this prediction was not supported by the results. In general, this study showed minimal differences between experts and novices. On the simple task, experts tended to be more proficient in selecting and executing a search strategy. However, these differences decreased as the search task became more complex. On the one hand, experts needed more time to select a strategy and choose successful strategies just as often as the novices did. On the other hand, the novices became more skilled in operating the search engine, which reduced the initial differences in strategy execution. In addition, the novices’ way of monitoring resembled that of the experts on all tasks.
Still, some results reveal interesting insights into how the search performance of novices can be enhanced. For example, several findings suggest that the basic operation of the search engine should not be elaborated on in the instruction (cf. Marchionini, 1989). Initially the novices executed their search strategies somewhat inefficiently. They made errors, explored the function of task buttons and menu commands and consulted the on-line help. However, their hands-on skills improved rapidly during the course of the experiment (cf. Khan & Locatis, 1998) even though they received no instructional support at all. In spite of these performance gains, novices never took full advantage of the search engine’s potentials. For example, they were unaware that they could change the search engine’s default from ‘any word’ to ‘all words’ in order to search for multiple keywords. They also overlooked the ‘refine’ and ‘broaden’ commands, and failed to use Boolean operators. Teaching novices the meaning and use of these advanced features might yield a further increase in performance efficiency.

Novices should also be taught to identify and interpret the information that appears on screen. Even experienced subjects made little use of system cues such as relevance ratings and ‘keywords found’ to monitor search outcomes. The consequences of this neglect were most apparent on the complex task. Subjects frequently overlooked relevant sites, examined the content of irrelevant ones instead and failed to notice that their attempt to refine a search had an adverse effect. Because the complex task closely resembles the information-seeking problems students encounter in real practice (i.e., open-ended search tasks without reference to a particular site), their monitoring skills need improving in order to search the WWW-efficiently.

Finally, the results are indecisive as to whether novices should be taught to select search strategies. The subjects’ initial approach to the search tasks showed great similarity, although the novices tended to be less proficient at strategy selection on tasks designating which sites to visit. Their choice of strategies on subsequent attempts depends, at least to some extent, on their ability to monitor search outcomes. For example, subjects decide to refine a search only if they are convinced the intermediate outcomes are relevant to their information needs. Given the subjects’ weak monitoring skills, their true capability to select search strategies cannot be assessed.

**Looking back and looking ahead**

At the outset of this paper, I postulated that novice WWW-users should be taught self-regulatory knowledge and skills to manage their search process. The results of the studies support this notion. To become proficient information searchers, novice WWW-users should be taught how to locate sites. That is, they have to acquire the knowledge and skills to monitor search outcomes. Novices might also benefit from instruction in selecting search strategies, but more research is needed to corroborate this tentative conclusion. Furthermore, novices should learn to use the advanced options of the search engine, but these skills are cognitive instead of metacognitive by nature.

The next part of this research project aims to reveal how minimalist tutorials can support the development of these self-regulatory knowledge and skills. Consistent with earlier work on minimalism (e.g., Lazonder, 1994; Lazonder & Van der Meij, 1993; Van der Meij & Carroll, 1995), this part of the research will be directed at identifying design principles regarding the content of self-regulatory skill instruction as well as heuristics that relate to the presentation of the instruction (e.g., sequencing, cognitive scaffolding).
References


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