Fostering Information Problem Solving Skills: Effects of Worked Examples and Learner Support

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Introduction

An information problem occurs when a person lacks the knowledge needed to solve a problem and must undertake a search to find it. This process of *information problem solving* is generally divided into five steps which encompass the required skills: 1) defining the problem, 2) searching for information, 3) selecting information based on relevance, reliability and correctness, 4) presenting the information, and 5) evaluating and regulating the process itself (Brand-Gruwel, Wopereis, & Vermetten, 2005). Research has shown that teenagers and adults encounter significant problems when solving complex information problems online (Brand-Gruwel et al., 2005; Walraven, Brand-Gruwel, & Boshuizen, 2008). These findings make it evident that there is a need for carefully designed formal training to develop information problem solving skills.

This study aims to develop a theoretically sound instructional approach to foster the acquisition of information problem solving skills based on the guidelines presented in the Four-Component Instructional Design model (van Merriënboer & Kirschner, 2007).

In the beginning of the learning process, learners have restricted and incomplete schema of solution procedures, and most often fall back on naive strategies such as means-ends analysis or a trial-and-error approach. This can be avoided by integrating sufficient support for learners into the learning tasks. One method of support is to provide learners with a task in which all steps of the solution procedure are worked out. Demonstrating an expert's solution procedure reinforces the correct strategies and domain-principles while reducing the strain on working memory. This can be very effective to help learners form correct problem solving schemas, especially when they are stimulated to actively process the examples by prompted self-explanations (Atkinson & Renkl, 2007).

When the learning process progresses, knowledge is constructed and problem solving strategies are incorporated into schemas. Some of the support that was necessary in the beginning now becomes redundant and detrimental to learning, since it is already present in the learner's memory. At that stage, worked-out examples can be replaced by completion tasks, in which the solution is partially worked-out and the learner is asked to solve the remaining steps. This fading of worked steps can then gradually continue until the learner can solve all the steps.

Another way to guide learners through the problem solving process is to provide them with a process worksheet. Filling out these worksheets automatically forces the learner to follow the correct procedure, which might be particularly useful when procedural knowledge is essential, as is the case with information problem solving skills. This research aims to find out how learning is affected when worked examples are combined with learner support provided by completion problems and process worksheets.

Method

A total of 99 first-year university level students participated in the computer-based training at the Katholieke Universiteit Leuven/Kortrijk (Belgium). The training session consisted of: taking a prior

knowledge test, watching a 15 min. instructional video, watching a worked-out example video while answering several explanation prompts in between, completing three learning tasks (in which students are required to search the web) and a performance task (another search but without any support), and taking a post-test. The provided learner support in the three learning tasks differed between the conditions, and each learning task ended with a reflection and a subjective rating of mental effort.

In the first condition, after viewing the worked example, students completed partially worked-out problems (completion problems). Two steps were worked out in the first learning task, the first step was worked out in the second task, and no steps were worked out in the third. Worked-out steps were presented as video fragments. Students in the second condition received conventional learning tasks after the worked example, but were guided through the process step-by-step, comparable to a digital process worksheet. In the third condition, students received the same conventional learning tasks (after the worked example) but without any support or guidance. Finally, students in the control condition worked on a practice problem instead of watching the worked-out example, and then received the same conventional tasks without support.

Results and Discussion

A repeated measures ANOVA showed that in all conditions scores on the posttest were significantly higher than on the pretest: $F(1, 76) = 315.61$, $p = .000$, indicating that instruction was effective. Furthermore, scores between the four conditions differed significantly: $F(3, 76) = 2.80$, $p < .05$. Students in the control condition improved the least ($M = 13.19\%$, $SD = 7.7$), followed by students in the condition without support ($M = 19.08\%$, $SD = 9{,}19$) and students in the completion condition ($M = 20.24\%$, $SD = 10.25$). Students who received a process worksheet improved the most: 21,02% ($SD = 9.36$).

These results show that the form of learner support incorporated into the learning tasks had no significant effect on scores in this study. However, the presence of a worked example proved to be very powerful, and was effective for teaching skills in a less structured domain like information problem solving. When designing instruction in this domain, teachers would benefit from integrating worked examples into their material. In this study, completion problems or process worksheets seemed of no added value, but whether that holds for longer or more difficult instructional sessions remains an open question.

References

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