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# Completion strategy or emphasis manipulation? Task support for teaching information problem solving

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ABSTRACT

While most students seem to solve information problems effortlessly, research shows that the cognitive skills for effective information problem solving are often underdeveloped. Students manage to find information and formulate solutions, but the quality of their process and product is questionable. It is therefore important to develop instruction for fostering these skills. In this research, a 2-h online intervention was presented to first-year university students with the goal to improve their information problem solving skills while investigating effects of different types of built-in task support. A training design containing *completion tasks* was compared to a design using *emphasis manipulation*. A third variant of the training combined both approaches. In two experiments, these conditions were compared to a control condition receiving conventional tasks without built-in task support. Results of both experiments show that students' information problem solving skills are underdeveloped, which underlines the necessity for formal training. While the intervention improved students' skills, no differences were found between conditions. The authors hypothesize that the effective presentation of supportive information in the form of a modeling example at the start of the training caused a strong learning effect, which masked effects of task support. Limitations and directions for future research are presented.



## 1. Introduction

Searching the web for information seems effortless for students; they simply navigate to a popular search engine, type in a couple keywords, and select some of the sources that appear to be relevant (MaKinster, Beghetto, & Plucker, 2002). Most students easily find their way without any explicit instruction. They paraphrase, cite, or – in the worst case – copy and paste some of the text into their own document and the job is done (De Vries, van der Meij, & Lazonder, 2008). The abundance of information on the internet is a bliss. While this may be viewed as a successful process in the eyes of the student, from an educational perspective it can be a waste of time. If the student is not equipped with the necessary skills, such as advanced search strategies and the ability to critically scrutinize information sources to determine relevance and reliability, chances are that the search process and the product fall short of what the teacher intended. It may be true that younger generations of students appear to quickly master the skills needed to navigate online information sources, but it is premature to claim that they automatically develop the skills to find correct and reliable online sources and learn from them (Kennedy, Judd, Churchward, Gray, & Krause, 2008; Kirschner & van Merriënboer, 2013; Rosman, Mayer, & Krampen, 2016).

While most educational institutions acknowledge information problem solving (IPS) as an essential academic skill, they often struggle with implementation (Badke, 2010). To promote transfer of IPS to daily practice, it is advisable to practice these skills in different contexts and across different domains throughout the whole curriculum. This is problematic, and most schools experience great difficulty in finding a suitable place and time in the curriculum. Many, in turn, resort to providing nothing more than a short library training. To support teachers and faculty in embedding IPS skills in educational curricula, it is desirable to investigate which instructional approaches work well for IPS skills. This paper takes a first step in that direction, describing the development and empirical testing of instruction for IPS skills, based on a solid instructional design model for teaching complex skills. Implications are discussed for both the domain of instructional design and information problem solving.

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## 2. Theoretical framework

### 2.1. Information problem solving

In educational settings, teachers often use information problems, where the necessary information to solve the problem is lacking, as an educational approach. The student is required to gather the missing information from external sources and combine the findings to construct a solution. Simple information problems, such as looking up the average monthly temperature in a country, pose little challenge for most students. Complex information problems, such as writing an essay on the effects of global warming on biodiversity, are a far more difficult challenge, because students will need to find, evaluate, and process sources of information that can vary greatly in terms of their trustworthiness, bias, reliability, or can contain contradictory information. Teachers often expect that having students search for information will automatically lead to their learning (Kirschner, Sweller, & Clark, 2006). But correctly and efficiently solving an information problem is a complex higher-order cognitive competence requiring a broad range of different cognitive skills that these students might not possess. The range of skills has been summarized as a 5-step model (see Fig. 1) in which students iterate between the stages 'define the problem', 'search information', 'select information', 'process information', and 'present information', each step consisting of several constituent skills (Brand-Gruwel, Wopereis, & Vermetten, 2005; Brand-Gruwel, Wopereis, & Walraven, 2009).

To solve an information problem, the learner first needs to reach an understanding of the task and identify the needed information to define and delimit the task domain. In this step, formulating a clear and concise question is essential to stay focused and avoid unnecessary deviations while searching. Second, search terms need to be generated and tried out in a search engine. By identifying key concepts from the question and then systematically changing, adding, or removing terms while correctly using the available Boolean operators, the learner maximizes the chance to find relevant information sources. Third, it is important to maintain a critical attitude while evaluating the search results page, the subsequently visited information sources, and the information itself. Critical scrutiny avoids spending time on irrelevant websites or becoming occupied with information that is outdated, false, or which originates from unreliable or biased sources. Fourth, when relevant and reliable sources are found and stored, the learner needs to process their contents, deal with overlapping and conflicting information, and synthesize the different elements chosen from the separate sources. Finally, the solution can be presented in a product such as an essay or a presentation, depending on the task. It is important that the product clearly answers the question that was defined earlier in the task. Moreover, during all of these steps, the learner should regulate the search process, decide whether sufficient useful information has been found, and steer the process to avoid deviations or distractions.

Previous research indicates students may quickly develop the instrumental skills needed to operate digital devices and use software and internet browsers, but IPS skills are generally underdeveloped or absent. In a comparison of experts and novices, Brand-Gruwel et al. (2005) found that novices took less time for orientation, chose less effective keywords, judged and evaluated sources less often, and hardly regulated their process. In a literature review, Walraven, Brand-Gruwel, and Boshuizen (2008) discuss several studies that show execution of IPS skills leave much room for improvement for all age groups. Similarly, studies by Van Deursen and van Dijk (2009) and Van Deursen and van Diepen (2013) show users of all ages experience problems with query formulation, evaluation of search results and processing of information.

Two things become clear from these findings. First, IPS is a complex higher-order cognitive skill. Successful problem solving depends on the existence of knowledge, the mastery and coordination of a set of skills and the adoption of a critical attitude. Second, research shows clear deficiencies in students of almost all ages. In general, students' IPS skills are often overestimated or expected to develop naturally over time. These IPS skills may not be of the level that is often expected of the student problem solver, or from the so-called 'digital natives' (see also: Kirschner & van

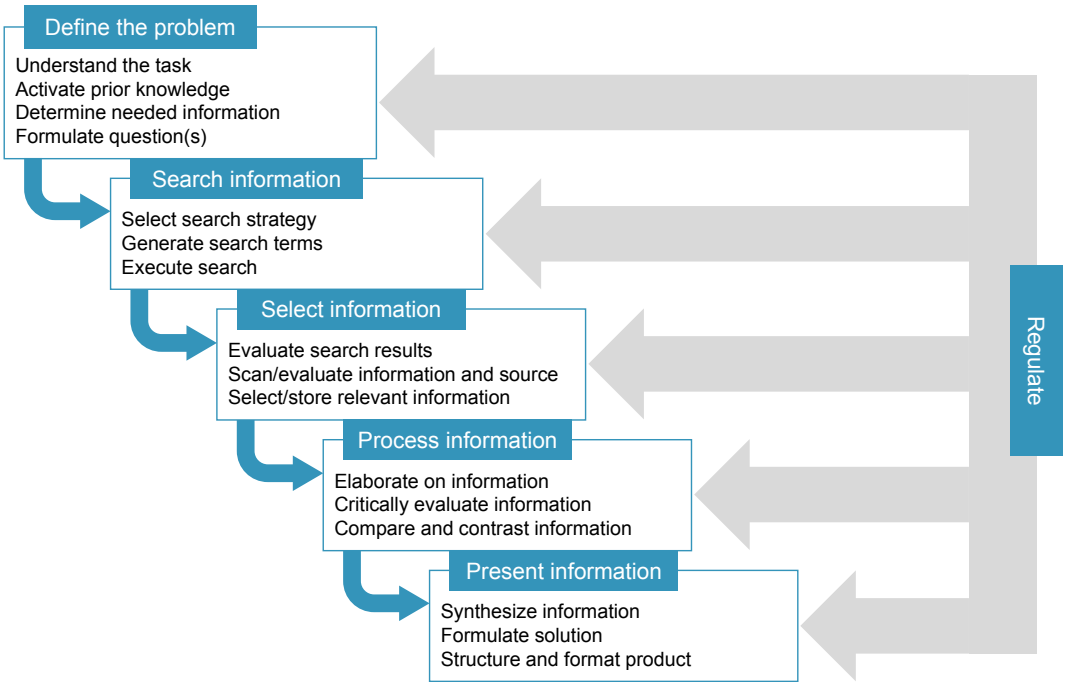


**Fig. 1.** Decomposition of the skill 'information problem solving' (based on Brand-Gruwel et al., 2005).