

# Design and Effects of Metacognitive Support for Hypermedia Learning

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**Abstract:** The aim of this research was to find appropriate scaffolding for metacognitive reflection when learning with modern computer-based learning environments. It was assumed that prompting students for metacognitive reflection will affect the learning process by engaging students in more metacognitive behaviour leading to better learning performance. Results from three experiments where students of the experimental groups were supported by different metacognitive prompting measure are described. In sum, results of learning process and learning outcome confirm the positive effects of all three metacognitive prompting measures. However, their specific influence varied significantly in size. Implications for the design of metacognitive support to improve self-regulated learning with CBLEs are discussed.

**Keywords:** Metacognitive Support, Hypermedia Learning

## 1. Metacognitive Support and Prompting

Research in the field of self-regulated learning points to the crucial role of learners' strategic and metacognitive behaviour (e.g. [1]). Thus, successful learning is not a matter of trial and error, but depends on the nature and sequencing of metacognitive activities that need to be enacted, such as analysing, planning, monitoring, and evaluating. However, research also reveals that many learners have difficulties in performing these metacognitive activities spontaneously, in effect resulting in lower learning outcomes [2]. The key purpose of this research project is to develop effective metacognitive instructions.

One promising instructional strategy prompting students to carry out specific metacognitive activities while engaged in task performance. Such metacognitive prompts should focus learners' attention on their own thoughts and on understanding the activities they are engaged in during the course of learning [3]. Hence it is hypothesized that prompting students to reflect upon their own way of learning will allow them to activate their repertoire of metacognitive knowledge and skills which will further enhance hypermedia learning and transfer.

## 2. Experimental Studies

By means of three experimental studies, effects of different metacognitive support measures were analysed experimentally, using similar designs, procedures and materials. In all three studies, the metacognitive prompts stimulated students to engage in certain activities before, during and at the end of the learning session. No metacognitive prompts were offered in the control groups.

In this presentation only the main idea, procedures and results of the different studies will be sketched in order to discuss the main findings with regard to the design and evaluation of effective metacognitive tools supporting self-regulated learning.

Table 1: Experimental Studies

Experiment	Experimental Manipulation
Study 1: see [2]	EG = Reflection Prompts (n=24), CG = without (n=22)
Study 2: see [4]	EG = Metacognitive Prompts (n=20), CG = without (n=20)
Study 3: see [5]	EG = Training + Metacognitive Prompts (n=20), CG = without (n=20)

### 3. Results and Discussion

Hypotheses were partly confirmed by the data. Participants of the experimental groups performed more metacognitive activities and showed better transfer performance ( $.42 < d < .59$ ), especially when they complied with the offered support in the intended way.

By means of a comprehensive video analysis it could be shown that only half of the students receiving prompts has used these in an optimal manner. Thus, offering metacognitive support is not sufficient; care has to be taken, that these instructional prompts are utilized in the intended manner in order to increase learning outcomes. Maybe this is one major reason why metacognitive instruction often has no positive effects on learning outcome. In future research one should ascertain that students who were instructed and trained to apply metacognitive strategies indeed apply them in the transfer session. Furthermore, it has to be investigated why students do not comply with the metacognitive support. Recent research is right at the beginning to start discussions why support devices are often ignored or inadequately used by students, e.g. [6].

This research focused on instructional measures with very short intervention. In further studies we will investigate whether an extension of the training time will improve help compliance with the metacognitive support. In addition, other kinds of metacognitive support, such as adaptive metacognitive prompting by means of pedagogical agents will be developed and evaluated experimentally.

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