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Effects of Text Titles and the Timing of Keywording Tasks on Metacognitive Monitoring

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Abstract

Successful learning from text takes place when the cognitive demands of the learning task – i.e. the comprehension and retention of text material – and the metacognitive demands of the learning task – i.e. the accurate assessment of one’s own learning process—are met. The present study was designed to investigate text titles – a factor known to affect cognitive learning processes— as well as the timing of keywording tasks – a factor known to affect metacognitive processes – and their effects on metacognitive monitoring and learning outcomes. The results of the study showed that both factors affected learning on the cognitive as well as the metacognitive level.

Keywords: Text-based learning; metacognition.

Effects of Titles on Learning and Metacognitive Monitoring

Text titles, a common feature of written text, affect cognitive learning processes and outcomes by: (a) providing a context for an upcoming text (Ausubel, 1968), (b) activating relevant prior knowledge (Ausubel, 1968), and (c) guiding a reader’s attention towards certain information in the text (Lorch & Lorch, 1996). Titles also serve as retrieval cues for previously learned text information (Sadoski, Goetz & Rodriguez, 2000) and foster the recall of text information that is related to the title (Ritchey, Schuster & Allen, 2008). While the cognitive effects of titles are well-investigated, it is interesting to consider their potential influence on metacognitive monitoring, as well.

Metacognitive monitoring takes place when learners evaluate their own learning process with respect to a learning goal (Butler & Winne, 1995; Dinsmore, Alexander & Loughlin, 2008). In other words, learners engage in metacognitive monitoring whenever they judge their current state of learning relative to a desired state of learning (Thiede & Dunlosky, 1999). The quality of metacognitive

judgments is influenced by the cues that learners use to make their judgments. According to the Cue-Utilization-Framework (Koriat, 1997), metacognitive judgments are inferential in nature. ‘[Learners] do not monitor directly the strength of the memory trace of the [to-be-judged information], but use a variety of cues that are generally predictive of subsequent test performance’ (Koriat, 1997, p.2).

The authors believe that titles may function as such cues whenever they are used to prompt learners’ metacognitive judgments. Considering that a title related to a text provides a stronger link to relevant information from the text than an unrelated title, related titles should serve as more valid cues for metacognitive monitoring than unrelated titles.

Effects of Immediate vs. Delayed Keywording on Metacognitive Monitoring

Aside from cues that arise from the text material, such as titles, learning tasks provide further cues for metacognitive monitoring (Thiede, Anderson & Therriault, 2003). Keywording tasks are a type of learning task in which learners summarize a previously studied text using a set of keywords. The timing of when learners generate their keywords affects the quality of their metacognitive judgments with respect to recall test performance at a later point in time. Learners who generate keywords immediately after reading a text are less accurate in their metacognitive monitoring than learners who generate keywords after a delay (Thiede, Anderson & Therriault, 2003; Thiede, Dunlosky, Griffin & Wiley, 2005).

Current research relates these findings to Activation Theories of Text Understanding (Britton & Guelgoez, 1991)—theories that describe a spreading activation during reading. More text information is available shortly after reading a text than after a delay, when text information has

decayed in memory. That means learners who generate keywords immediately after reading a text experience a high ease of recall in every keywording task. The high ease of recall in each keywording task makes it hard for learners to distinguish between well and less-well learned texts. It is hard for learners to make that distinction because the performance on an immediate keywording task is not a valid indicator of performance on tests that occur at a later point in time when text information has decayed in memory.

Learners who generate keywords after a delay do not experience the same ease of recall in every keywording task, because the learners need to access text information that has been subject to memory decay to a much larger extent at the time of the keywording task. Hence, the learners may be able to generate only a few keywords for a text that they do not recall well, while they may generate more keywords for a text they recall better. Since delayed keywording requires learners to access text information that has been subject to memory decay to a larger extent than immediate keywording, delayed keywording is a more valid indicator of recall test performance with regard to tests taken at a later point in time. Hence, learners who generate keywords after a delay provide more accurate metacognitive judgments than learners who generate keywords immediately.

While most of the current research has focused on the effects of the timing of keywording tasks on relative monitoring accuracy – i.e. the ability of learners to distinguish between well-learned and less well-learned text, the present study aims to investigate the effects of the timing of keywording tasks on monitoring bias – i.e. the extent to which learners over- or underestimate how much they have learned from a text.

Purpose of the Present Study and Hypotheses

In order to develop learning materials that foster successful learning from text, learning materials should be constructed so that they foster learning on the cognitive, as well as on the metacognitive level. Thus, the present study was designed to investigate how related vs. unrelated text titles, and immediate vs. delayed keywording, affect metacognitive monitoring and learning outcomes.

The dependent measures of the study were comprised of a set of cognitive and metacognitive measures, namely a) performance on a keywording task as measured by the number of keywords correct, b) metacognitive judgments of learning for each text as measured by ratings on a 6-point Likert scale, and c) recall test performance as measured by the number of idea units recalled correctly in a free-recall essay task. Monitoring bias (d) was calculated by relating learners' metacognitive judgments to their recall test performance using the Self-Criterion-Residual-Strategy (Paulhus & John, 1998).

With regard to the objectives of the present study, the authors aimed to investigate the following hypotheses:

Hypotheses: Effects of Titles

1. Titles affect learning outcomes – titles related to a text serve as more valid retrieval cues than unrelated titles. Thus, the authors expect higher recall test performance for texts with related titles in both, the keywording task (Hypothesis 1.1) and an essay task (Hypothesis 1.2).
2. Titles affect metacognitive monitoring – titles related to a text serve as more valid cues for metacognitive monitoring than unrelated titles. Thus, the authors expect unrelated titles to evoke a stronger monitoring bias than titles related to the text.

Hypotheses: Effects of Immediate vs. Delayed Keywording

3. The timing of keywording tasks affects learning outcomes in the keywording task (Hypothesis 3.1), but not in the essay task (Hypothesis 3.2). Learners who generate keywords immediately after reading a text have access to text information that is presumed to still be rather active in their memory. They experience a high ease of recall in every keywording task and are able to generate many correct keywords. Learners who generate keywords after a delay need to access information in their memory that has been subject to decay to a much larger extent. They do not experience the same ease of recall as learners in the immediate keywording group and, thus, are expected to generate a smaller number of correct keywords. The authors do not expect to find the same effect in the essay task, because, in the essay task, learners in both keywording conditions have to rely on text information that has been subject to memory decay to the same extent (i.e. about the same amount of time has passed in between reading and essay writing).
4. The timing of the keywording task affects metacognitive monitoring – learners who generate keywords immediately after reading a text experience a high ease of recall in every keywording task, which may cue them to overestimate their ability to retrieve the same text information at a later point in time, when memory activation for text information has decayed. Thus, the authors expect learners in the immediate keywording group to show a stronger overestimation bias than learners in the delayed keywording group.

Hypotheses: Interactive Effects of Titles and Immediate vs. Delayed Keywording

5. Titles and the timing of keywording tasks interact with the learning outcomes in the keywording task (Hypothesis 5.1.), but not with the essay task (Hypothesis 5.2). While learners who generate keywords after a delay rely on titles as retrieval cues, learners in the immediate keywording group do not, because the text they just read is presumed to still be rather active within memory. Thus, the authors expect learners in the immediate keywording group to generate

more correct keywords for texts with unrelated titles than learners in the delayed keywording group. The authors do not expect to find the same effect in the essay task, in which learners in both keywording groups have to access text information that has been subject to memory decay to the same extent.

6. Titles and the timing of keywording tasks interact with metacognitive monitoring – learners who generate keywords immediately are expected to overestimate how much they learned from texts with unrelated titles. Learners who generate keywords after a delay are expected to show less of an overestimation bias with regard to texts with unrelated titles.

Methods

Participants. 213 undergraduate students of an American university – 56 males and 157 females – participated in the study. Participant's ages ranged from 18 – 57 years ($M = 22.2$).

Design. The study follows a 2-Keywording (Immediate vs. Delayed) x 3-Title (Related/Close vs. Related/Distant vs. Unrelated) - design with repeated measures on the factor 'Titles'. The order of topic and title appearance was balanced within a Latin Square.

Materials. The study was conducted online. Materials were comprised of 6 expository texts derived from online databases and modified to suit the purpose of the study. Each expository text consisted of 2 distinct subtopics of an overall related theme. Themes varied for each text and were chosen from topics which are neither part of the standard US high school curriculum, nor part of the standard undergraduate curriculum at the university from which participants were recruited. The text concerning the overall theme of 'Art', for example, was comprised of the subtopics 'Expressionist Painting' and 'Dualism in Art'. To control for confounding effects between a topic and its position in the text, the order of topic appearance was counterbalanced within a Latin Square, so that every participant experienced every title condition twice throughout the study. In order to control for confounding effects of text position, the order of text appearance was also balanced within the Latin Square. Each subtopic in a text consisted of 30 idea units. Idea Units were defined as "single, meaningful piece[s] of information conveyed by the passage, whether [they] consisted of a word, a definition, or a phrase in the passage" (Meyer, 1975). The subtopics were balanced for word count (range: 190 - 284 words) and readability (Flesh-Kincaid readability score; range: 11-13). The readability range was chosen to match the target participant group of undergraduate university students. Each text was accompanied by one of three titles - a title that was related to the first subtopic in the text (Related/Close), a title that was related to the second subtopic in the text (Related/Distant), or a title that was unrelated to either of the subtopics in the text (Unrelated). While the authors had explicit hypotheses on the effects of related versus unrelated titles on metacognitive monitoring and learning outcomes, the distinction between

Related/Close and Related/Distant titles was made in order to detect whether the position of the related information in the text would have distinct effects on metacognitive monitoring and learning outcomes.

Study procedure. Participants were randomly assigned to the immediate or delayed keywording condition. Each participant read 6 texts and was instructed to learn as much from them as possible. Each text was presented for 2.5 minutes. Participants were asked to generate a maximum of 6 keywords prompted by the title, in order to capture the main gist of each text. The immediate-keywording group generated keywords immediately after reading each text. The delayed-keywording group generated keywords only after reading all 6 texts. After reading and keywording, participants provided a metacognitive judgment of learning on a 6-point Likert scale (1 = learned very little to 6 = learned very much). Then, the text titles were presented one at a time, and participants were asked to write essays about what they remembered from the text. The time limit for each essay was 3 minutes. Reading and writing times were controlled in order to encourage participants to engage in each task thoroughly. Reading and writing times were allocated according to data derived from a pilot study conducted prior to the actual investigation.

Results

Keywording task. Keywords were scored using a 4-category scoring rubric. Keywords could be correct, incorrect, missing, or they could be derived from prior knowledge, rather than from the text. Only correct keywords were included in the keyword analyses. The results of the keywording task were analyzed using a 2-keyword (Immediate vs. Delayed) x 3-title (Related/Close vs. Related/Distant vs. Unrelated) Analysis of Variance (ANOVA) with repeated measures on the factor 'titles' and Bonferroni correction for multiple testing.

The ANOVA revealed a significant main effect for the timing of keywording tasks [$F(1, 211) = 132.64$; $MS_{\text{error}} = 2.71$; $p < 0.01$; partial $\eta^2 = 0.39$ (large effect)]. Learners who generated keywords immediately after reading a text were able to generate more correct keywords ($M = 3.97$; $SD = 0.09$) than learners who generated keywords after a delay ($M = 2.47$; $SD = 0.09$).

The ANOVA also revealed a significant main effect for titles [$F(2, 422) = 20.86$; $MS_{\text{error}} = 1.19$; $p < 0.01$; partial $\eta^2 = 0.09$ (moderate effect)]. Learners generated more correct keywords when the title was related to the text ($M \sim 3.41$; $SD = 0.09$), than when the title was unrelated ($M = 2.82$; $SD = 0.09$). The number of correctly generated keywords did not differ significantly depending on whether the title-related information was stated first in the text ($M_{\text{RC}} = 3.41$; $SD_{\text{RC}} = 0.09$), or second ($M_{\text{RD}} = 3.42$; $SD_{\text{RD}} = 0.09$). In other words, learners generated more correct keywords as long as the title was related to the text, no matter in which position the related information appeared.

The main effects of keywording and title conditions were further qualified by a significant two-way interaction

between the timing of keywording tasks and titles [$F(2, 422) = 11.95$; $MS_{\text{Error}} = 1.19$; $p < 0.01$; partial $\eta^2 = 0.05$ (small effect)]. Learners who generated keywords immediately after reading a text had no problem generating keywords for texts with unrelated titles ($M = 3.87$; $SD = 0.13$). Learners who generated keywords after a delay, on the other hand, generated a smaller number of correct keywords for texts with unrelated titles ($M = 1.78$; $SD = 0.13$).

Metacognitive judgments of learning. Metacognitive judgments of learning were analyzed using a 2-keyword (Immediate vs. Delayed) x 3-title (Related/Close vs. Related/Distant vs. Unrelated) ANOVA with repeated measures on the factor ‘titles’ and Bonferroni correction for multiple testing. The results of the ANOVA revealed a significant main effect for keywording conditions [$F(1, 211) = 7.47$; $MS_{\text{Error}} = 1.66$; $p < 0.01$; partial $\eta^2 = 0.03$ (small effect)]. Learners who generated keywords immediately after reading a text provided higher judgments of learning ($M = 3.14$; $SD = 0.07$) than learners who generated keywords after a delay ($M = 2.86$; $SD = 0.07$).

The ANOVA also revealed a significant main effect for titles [$F(2, 422) = 39.62$; $MS_{\text{Error}} = 0.68$; $p < 0.01$; partial $\eta^2 = 0.16$ (moderate effect)]. Learners provided higher judgments of learning for texts with related titles ($M \sim 3.2$; $SD = 0.07$) than for texts with unrelated titles ($M = 2.60$; $SD = 0.07$). The judgment magnitude did not vary significantly depending on whether the related information was stated close to the title ($M_{\text{RC}} = 3.25$; $SD_{\text{RD}} = 0.07$), or distant from it ($M_{\text{RD}} = 3.16$; $SD_{\text{RD}} = 0.07$).

Essay task performance. Essays were scored for idea units using a 5-category scoring rubric. Recalled idea units could be correct, incorrect, partially correct to 50% or 25%, or correct, but derived from prior knowledge rather than from the text. Only partially or fully recalled idea units derived from the texts were included in the essay analysis. The results of the essay task were analyzed with a 2-keyword (Immediate vs. Delayed) x 3-title (Related/Close vs. Related/Distant vs. Unrelated) ANOVA with repeated measures on the factor ‘titles’ and Bonferroni correction for multiple testing.

The ANOVA revealed a significant main effect for titles [$F(2, 422) = 21.14$; $MS_{\text{Error}} = 3.54$; $p < 0.01$; partial $\eta^2 = 0.09$ (moderate effect)]. Learners recalled more idea units from text with related titles ($M \sim 4.9$; $SD \sim 0.21$) than from texts with unrelated titles ($M = 3.89$; $SD = 0.21$). The number of idea units recalled did not vary significantly depending on whether title-related information was stated first in the text ($M_{\text{RC}} = 4.98$; $SD_{\text{RC}} = 0.22$), or second ($M_{\text{RD}} = 4.84$; $SD_{\text{RD}} = 0.21$).

Metacognitive monitoring bias. Metacognitive monitoring bias was computed using the Self-Criterion-Residual-Strategy (SCR-Strategy: Paulhus & John, 1998). For SCR-Analyses, self-reports (i.e. metacognitive judgments of learning) are regressed on an external criterion (i.e. essay task performance). The standardized residuals are used as indices for monitoring bias (i.e. the extent to which an

individual’s monitoring accuracy differs from the average monitoring accuracy observed in the participant sample). The closer the standardized residual is to 0, the more accurate the learner. Standardized residuals with negative values indicate underestimation, while standardized residuals above 0 indicate overestimation.

In a first step, the metacognitive judgment of learning for each text was regressed on the learner’s essay task performance on that text and the standardized residuals from these simple regressions were saved. In a second step, the mean standardized residual for each title condition was computed for each participant. In a third step, a 2-keyword (Immediate vs. Delayed) x 3-title (Related/Close vs. Related/Distant vs. Unrelated) ANOVA with repeated measures on the factor ‘titles’ and Bonferroni correction for multiple testing was computed on the mean standardized residuals for each title condition.

The ANOVA revealed a significant main effect for keywording conditions [$F(1, 211) = 5.72$; $MS_{\text{Error}} = 0.95$; $p = 0.02$; partial $\eta^2 = 0.03$ (small effect); see figure 1]. In general, learners showed virtually the same monitoring bias ($M = |0.09|$; $SD \sim 0.05$) in both keywording groups – except that learners who generated keywords immediately tended to overestimate how much they had learned ($M = 0.09$; $SD = 0.05$), while learners who generated keywords after a delay tended to underestimate how much they had learned ($M = -0.09$; $SD = 0.06$).

The ANOVA also revealed a significant main effect for titles [$F(2, 422) = 29.12$; $MS_{\text{Error}} = 0.39$; $p < 0.01$; partial $\eta^2 = 0.12$ (moderate effect); see figure 1]. Learners tended to overestimate how much they had learned when texts were related to the title, while it did not matter whether the title-related information appeared first in the text ($M_{\text{RC}} = 0.16$; $SD_{\text{RC}} = 0.05$), or second ($M_{\text{RD}} = 0.11$; $SD_{\text{RD}} = 0.05$). When texts were unrelated to the title, learners tended to underestimate themselves instead ($M_{\text{UR}} = -0.26$; $SD_{\text{UR}} = 0.05$).

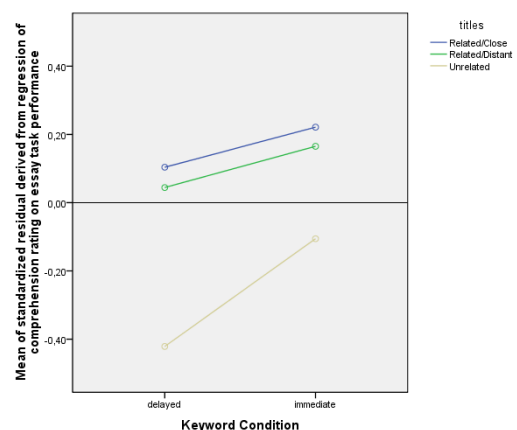


Figure 1: Metacognitive monitoring bias at timing of keywording task (Immediate vs. Delayed) x titles (Related/Close vs. Related/Distant vs. Unrelated).

Discussion

Effects of Titles and Qualifying Interactions

Hypothesis 1: The authors expected titles to influence learning outcomes in both – the keywording task (Hypothesis 1.1) and the essay task (Hypothesis 1.2). The results of the study are in line with the hypotheses – learners generated more correct keywords for texts with related titles, than for texts with unrelated titles. Learners also recalled more idea units from texts with related titles, than from texts with unrelated titles. These findings support the idea that related titles provide a stronger link to relevant text information than unrelated titles, and, thus, serve as more valid retrieval cues for recalling text information than unrelated titles.

It is important to note that the timing of the keywording task influenced how strongly learners relied on titles when generating keywords (Hypotheses 5.1). While learners in the immediate keywording group were able to generate almost as many correct keywords for texts with unrelated titles ($M = 3.87$; $SD = 0.13$) as for texts with related titles ($M = 4.01$; $SD = 0.13$), learners in the delayed keywording group generated less correct keywords for texts with unrelated titles ($M = 1.77$; $SD = 0.13$) than for texts with related titles ($M = 2.81$; $SD = 0.12$). This finding is in line with the assumptions of Activation Theories of Text Understanding (Britton & Guelgoez, 1991) suggesting a spread of activation during reading. Learners who generated keywords immediately after reading a text were able to access text information that was presumably still active within memory. That is, the learners did not have to rely on the title as a retrieval cue to the same extent as learners in the delayed keywording group. The delayed keywording learners needed to access text information from memory that had decayed to a much larger extent at the time of their keywording task. This interaction was not observable in the essay task (Hypothesis 5.2), because for the essay task, learners in both keywording groups had to access text information in their memory that had been subject to decay. About the same amount of time had passed in between reading and essay writing in both keywording groups. Thus, learners in the immediate keywording group could not rely on information that was presumably active within memory for the essay task, but needed to access information that had decayed.

Hypothesis 2: The authors expected titles to affect metacognitive monitoring. The authors specifically hypothesized that related titles would serve as more valid cues for making metacognitive judgments than unrelated titles, resulting in a smaller monitoring bias for texts with related, than for texts with unrelated titles. The results of the study showed that monitoring bias was indeed influenced by the title conditions. Learners tended to overestimate how much they had learned from texts with related titles, while they tended to underestimate how much they had learned from texts with unrelated titles. The strength of the monitoring bias differed between title conditions in the way

the authors hypothesized – while learners just slightly overestimated how much they had learned from texts with related titles (Mean standardized residual = 0.14), they underestimated how much they had learned from texts with unrelated titles to a much larger extent (Mean standardized residual = - 0.26). This finding supports the idea that related titles serve as more valid cues for making metacognitive judgments than unrelated titles.

Effects of Immediate vs. Delayed Keywording

Hypothesis 3: The authors expected the timing of the keywording task to influence the number of correctly generated keywords (Hypothesis 3.1), but not the number of correctly recalled idea units in the essay task (Hypothesis 3.2.) The results of the study provided evidence for these hypotheses. Learners in the immediate keywording group generated more correct keywords ($M = 3.97$; $SD = 0.09$) than learners in the delayed keywording group ($M = 2.47$; $SD = 0.09$). This finding again supports the assumptions of Activation Theories of Text Understanding (Britton & Guelgoez, 1991). Learners can easily access text information shortly after reading, while it is harder to access text information after a delay when memory activation has decayed. This effect was not observable in the essay task anymore, because for the essay task, learners in both keywording groups had to access text information in their memory that had been subject to decay to the same extent, i.e. about the same amount of time had passed in between reading and essay writing in both keywording groups.

Hypothesis 4: The authors expected the timing of the keywording task to influence metacognitive monitoring. The authors specifically hypothesized that learners in the immediate keywording group would show a stronger overestimation bias than learners in the delayed keywording group. The results of this study support this hypothesis. While learners in the immediate keywording group showed a slight overestimation bias ($M = 0.09$; $SD = 0.05$), learners in the delayed keywording group showed a slight underestimation bias ($M = - 0.09$; $SD = 0.06$). It is important to note that this result was influenced by the effects of the unrelated title condition, although the authors could not detect the hypothesized interaction (Hypothesis 6). That is, the general underestimation bias evoked by unrelated titles decreased the mean monitoring bias in both keywording conditions.

In order to detect whether the direction of monitoring bias was overall affected by the unrelated title condition, the authors removed the effects of the unrelated title condition from the analysis by conducting a separate analysis for texts with related titles only. That is, the authors compared the mean standardized residual for texts with related titles in the immediate keywording condition ($M = 0.2$; $SD = 0.08$) to the mean standardized residual for texts with related titles in the delayed condition ($M = 0.07$; $SD = 0.08$). The t-test revealed a significant difference between the keywording groups ($t(211) = -11.86$; $p < 0.01$). While learners in both keywording groups tended to generally overestimate how

much they learned from texts with related titles, as indicated by mean standardized residuals above 0, learners who generated keywords immediately showed a significantly stronger overestimation bias than learners who generated keywords after a delay. This finding is in line with former research investigating the delayed keywording effect (Thiede, Anderson & Theriault, 2003). The authors believe that this effect is due to the high ease of recall that learners experience in the immediate keywording task, as indicated by the large amount of keywords generated correctly. The ability to generate a large number of keywords may cue learners to believe that they have learned the text information well and that they will be able to recall it at a later point in time, as indicated by higher judgments of learning in the immediate keywording group. Yet, a learner's performance on an immediate keywording task is not a valid indicator of performance in the essay task, which takes place at a later point in time when text information has been subject to memory decay. Thus, learners who generate keywords immediately tend to show a strong overestimation bias due to the ease of recall they experience in their keywording task. Learners who generate keywords after a delay, on the other hand, need to access text information that has already been subject to memory decay to a larger extent and that is a much better indicator of performance in the essay task, which takes place after an even larger delay. That means that learners in the delayed keywording group do not experience an ease of recall that could cue them to overestimate themselves to the same extent as learners in the immediate keywording group, resulting in more accurate metacognitive monitoring in the delayed keywording group, as compared to the immediate keywording group.

Conclusions and Outlook

The present study contributes to the current literature in three ways. First, the authors could show that titles do not only affect cognitive learning processes and learning outcomes, but also metacognitive monitoring, with related titles functioning as more valid cues for making metacognitive judgments than unrelated titles. Second, the results of the study showed that delayed keywording does not only foster relative monitoring accuracy (i.e. the ability to distinguish between well and less-well learned texts), but also prevents overestimation bias (i.e. the tendency to overestimate oneself) to a larger extent than immediate keywording. Third, the results of the study showed that titles and the timing of keywording tasks interact with regard to certain learning tasks. This finding raises the question of how closely cognitive and metacognitive processes are related – a question that may be very interesting to investigate in further studies.

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