METACOGNITIVE PROMPTS WITHIN AN ONLINE COURSE

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Abstract: *This study attempted to answer whether strategically designed and placed metacognitive prompts within an online prerequisite teacher education course can make a difference in the amount and quality of student self-reported use of metacognitive strategies. The study found significant metacognitive results for students in an online introductory education course. Three themes about metacognitive use emerged from student online postings: the importance of transforming online material into more useable formats, the need to structure the learning environment to increase student attention, and the importance for students to make personal connections to the content.*

Keywords: metacognition, online learning, metacognitive strategies

Introduction

Metacognition, a construct first proposed by Flavell in 1976, is often referred to as thinking about thinking. A more formal definition is "knowledge and beliefs about one's own cognitive processes, as well as conscious attempts to engage in behaviors and thought processes that increase learning and memory" (Ormrod, 2012, p. 100). Researchers originally believed metacognition starts to develop around age five and continues to develop throughout the school years. It is now recognized that metacognition continues to develop through adulthood (Stewart, Cooper, & Moulding, 2007).

An abundance of research exists about the importance of metacognition in educational settings (Hattie, 2009; Joseph, 2009; Nietfeld, Cao, & Osborne, 2006; Preston, Stewart, & Moulding, 2014). It is known to improve student performance in academics as metacognition has been found to be a strong predictor of academic success (Hattie, 2009). When students are encouraged to be more metacognitive, they frequently outperform students who are not taught to use metacognitive skills (Joseph, 2009). The ability for a teacher to encourage and model metacognition is an important but often underdeveloped skill of practicing teachers.

Metacognition is often separated into two components: knowledge and regulation. Metacognitive knowledge is knowledge about oneself as a learner and the factors that influence learning. Metacognitive regulation includes planning, monitoring, and evaluating. Planning includes the ability to think about and select appropriate strategies and resources to achieve a task. Monitoring is awareness of understanding and progress in learning. Evaluation is appraising the end results and efficiency of one's learning (Shraw & Dennison, 1994). Metacognitive regulation can be considered a subset of the broader construct of self-regulation. Self-regulation is usually defined as the ability to control and sustain behavior, emotions, and thoughts (Woolfolk, 2013), while metacognitive regulation focuses only on the ability to control and direct one's own thoughts.

Metacognitive strategies can be taught (Halpern, 1996) and are associated with successful learning (Borkowski, Carr, & Pressley, 1987). Successful learners usually have a repertoire of metacognitive strategies to select from and can

transfer them to new settings (Pressley, Borkowski, & Schneider, 1987). However, not all learners have developed these strategies; therefore, instructors need to prompt learners to become more metacognitive and think about what they are doing as they complete learning tasks (Biemiller & Meichenbaum, 1992). Instructors should take care not to do the thinking for learners or tell them what to do because this runs the risk of making students experts at seeking help rather than experts at thinking about and directing their own learning.

Unfortunately, McKeachie (1988) found that few college instructors explicitly teach metacognitive strategies for monitoring learning. They assume that students have already learned these strategies in high school, but many students have not developed and are unaware of the metacognitive process and its importance to learning. Rote memorization is the usual—and often the only—learning strategy employed by high school students when they enter college (Nist, 1993). Simpson and Nist (2000), in a review of the literature on strategic learning, emphasized that for effective student learning to occur, instructors need to go beyond teaching reading strategies to helping students develop the cognitive and metacognitive skills that underlie these traditional reading strategies.

The last decade has seen an increase in the number of online courses and the number of students taking online courses (National Center for Education Statistics [NCES], 2016). With increasing numbers of students taking online courses, has come a new challenge of helping students develop metacognition. Garrison (2003) suggested metacognition can be achieved in online courses by providing opportunities for students to reflect and collaborate. More recently researchers reemphasized the need for reflection to build metacognition in online courses (de Bruin, Kok, Lobbestael, & de Grip, 2017; Watkins, 2016).

Further, Watkins (2016) found that in order for students to have metacognitive levels of reflection in online courses, students needed open-ended prompts. These prompts request students to reflect but are open in the ways in which they can formulate their reflections. Even more powerful are providing opportunities for students to share their reflections with other students and being able to discuss their reflections with others (Watkins, 2016).

Despite the abundance of literature on the importance and benefits of metacognition in face to face and online courses, many educators struggle to implement metacognitive strategies within the limitations of time constraints during live class sessions or pedagogical constraints of an online courses. While the research on promoting metacognition in online courses does identify the types of experiences students need to have, it does not thoroughly explain how to implement them. This study examined the effectiveness of inserting metacognitive prompts within an online course. Specifically, the study examined whether student metacognition can be enhanced with minimal online intervention.

The present study sought to answer the following research question: What effect does a minimal level of metacognitive intervention in an online course have on student reported use of metacognitive strategies?

Method

This study intended to discover whether strategically designed and placed metacognitive prompts in an online course would help students develop metacognitive use. *Education (EDUC) 1010 – Exploring Teaching* is an introductory, prerequisite course for entrance into this American university's teacher education program. All students applying for acceptance into the undergraduate teaching major must successfully take and pass this course. The

participants in this study were primarily freshman and sophomore students (N=111). The data collected in this study were the number of metacognitive practices students reported to use during each module of the online course. All 111 students responded to the discussion modules.

The online section of the course included ten different modules for students to complete. Each module has selected readings and assignments which demonstrate student understanding of the readings. Additionally, there are three exams. The first exam covers information from modules 1-3, the second modules 4-6, and the third exam covers modules 7-10.

This study had two different interventions. Intervention 1 was used in online course sections 1 and 2. For intervention 1, prior to the first module, the instructor created an informational page containing the syllabus and directions on how to progress through the course using the "next" button. The very first "next" button takes the student to a page about metacognition. On this page, there is text describing metacognition and its importance. Additionally, a couple of informative short videos were available that go into more depth on the importance of metacognition in helping students become higher achieving students and the three metacognitive areas of planning, monitoring, and evaluating.

The "next" button from the introduction to metacognition took the students to an Overview page of what the first module covered. Next, they were taken to a page that read:

> *Metacognitive Planning Questions*:
> Before beginning the module, take a minute and ask yourself the following questions. Questions I need to ask myself before I do the module.
> - What do I already know about this topic?
> - How much time will I need to complete the module?
> - How can I motivate myself to do the assignments to the best of my ability?

Then students advanced to the next page and began working through the module. Part way through each module, students advanced to a page that read:

> Now would be a good time to stop and ask yourself some *Metacognitive Monitoring Questions*. Questions I need to ask myself *while* doing the module.
> - Am I using the best strategies to learn this material? If not, what should I do differently?
> - Am I trying to go too fast? Am I going too slowly?
> - Am I understanding the information in this module? If not, what can I do?

Finally, at the end of the module after all other assignments were submitted, students were shown a page that read:

> *Metacognitive Evaluation Questions*:
> Now that you have completed the module, it would be helpful to stop a minute and ask yourself the following metacognitive evaluation questions.
> Questions I need to ask myself *after* I am finished with the module.
> - How well did I do on this module?
> - Did I use the best strategies for each assignment in the module?
> - What are the main things I learned doing this module?

The same questions were repeated in each module.

The next page after each module asked the students to reflect on their use of metacognition in the module. The instructions on this page read, "1. Please post a paragraph describing some of the metacognitive processes you used in this module. 2. Comment on at least one other person's posting about the metacognitive processes they used. You can compare your experience, ask or give advice." The learning

management system used by this university (Canvas is its name) provides an optional setting requiring students to make their own initial posting prior to being able to view their peers' postings. This Canvas option was not utilized. Students could view peer posts before and/or after their own posts. Allowing students to read other's postings before their own was hoped to provide them stimulus to be more metacognitive.

Intervention 2 was used in online course sections 3 and 4. All four course sections had the same "before", "during", and "after" metacognitive prompts. However, in intervention 2, the assignment beginning with "Please post a paragraph describing some of the metacognitive processes you used in this module" was followed up with an additional sentence, "Do not discuss the topic of the readings, rather talk about your thought processes, what practices you used to learn and remember the content, and what you would do differently in the future to help you focus and learn." The statement was preceded by ******** and followed up with **** to draw attention to the clarification to the original instruction.

The final four questions of each exam were questions about whether or not they had done the metacognitive prompts in each module. Students were asked to indicate "True" or "False" "I completed the metacognitive planning questions; I completed the metacognitive monitoring questions; I completed the metacognitive evaluation questions after each module".

A follow-up email was sent to 18 participants receiving the first intervention after the course was finished. Only three students responded to the following questions,

- Did the instructional videos about metacognition and its importance provided at the beginning of the course make any difference in your life on either increasing your then current level of metacognition or making you want to become metacognitive? Why or why not?
- Did you feel like the metacognitive prompts in each module of the 10 Utah Effective Teaching Standards (UETS) helped you become more metacognitive? In what ways? If not, why?
- Have you continued to use any of the metacognitive strategies you wrote about in the *Metacognition Discussion* board? Which ones?
- How has your use of metacognition changed from before you took EDU 1010?

Analysis

The data in this study underwent varied analysis. The first analysis conducted was of the number of metacognitive responses each student wrote in their Canvas discussion board. This analysis was strictly a count of the number of different strategies the students reported using during the course modules. Included in accepted metacognitive strategies was their comments about strategies they planned to use in the future. The second analysis was conducted using the chi square. This analysis allowed us to compare the number of responses with an expected number of responses.

After each module, students posted their reflection on their use of metacognition in the Canvas discussion board. Analysis of each student reflection was performed by two researchers. Each student response was coded either 0 – no metacognitive statements, 1 – one or two metacognitive statements, or 2 – three or more metacognitive statements. All participants were identified by a number. One researcher coded all of the odd numbered participants while the other researcher coded the even numbered participants. To ensure rater reliability, the researchers coded the first ten participants together. After the initial coding of participant responses, a second reading of ten random

responses was performed by the opposite researcher to check for reliability of coding.

Data were analyzed using chi square test of independence with an alpha of .05 as criterion for significance. This test of goodness of fit was used to determine if there was a difference the number of actual responses and the statistical anticipated number of responses.

In addition to coding the number of metacognitive strategies, all student posts were read a second time by both researchers for content analysis. Specific strategies were organized and grouped into broad categories. Next, the researchers performed a thematic analysis in an attempt to identify emerging themes (Fraenkel, Wallen, & Hyun, 2015).

Results

This study examined the amount of student metacognitive processing in an online course containing minimal levels of metacognitive intervention. Table 1 displays the total number of metacognitive statements made by students during the course. Statements are grouped by either no metacognitive responses, 1-2 metacognitive responses, or by 3 or more metacognitive responses. Section 1 had 39 students. Section 2 had 18 students. Section 3 had 25 students. Section 4 had 29 students (see Table 1). Responses were tabulated from all ten course modules.

Table 1
Number of metacognitive responses by section

	Zero Metacognitive Responses		1-2 Metacognitive Responses		3 or more Metacognitive Responses		Total Metacognitive Responses
Course	n	%	n	%	n	%	N
Section 1	305	78	67	17	18	5	390
Section 2	174	97	6	3	0	0	180
Section 3	23	9	90	36	137	55	250
Section 4	52	19	101	36	127	45	280

We sampled 1100 responses from section 1 (n = 390), section 2 (n = 180), section 3 (n = 250), and section 4 (n = 280) to test whether the number of metacognitive responses in each section was significant. Data were analyzed using chi square test of independence with an alpha of .05 as criterion for significance.

According to the test of independence, the difference in number of metacognitive responses was statistically significant (x^2 (4, n = 1100) = 472.77, $p \leq .000$). To follow up the findings, Phi was calculated to determine effect size of the different sections. The finding of Phi = .629 provides evidence of a moderate correlation between each section and the number of metacognitive responses. See Table 2 for counts of observed and expected responses by course section.

Table 2
Observed compared to expected number of metacognitive responses by section

	Zero Metacognitive Responses		1-2 Metacognitive Responses		3 or more Metacognitive Responses	
	n_o	n_e	n_o	n_e	n_o	n_e
Section 1	299	225	73	127	18	37
Section 2	180	103	0	59	0	17
Section 3	132	144	96	82	22	24
Section 4	24	162	191	92	65	27

Note: n_o = number observed, n_e = number expected

As shown in Table 1, students in sections 1 and 2 did not make very many metacognitive statements. The follow up email sent to students asking them about their perceived benefits of the metacognitive videos and assignments reveal that several students felt the metacognitive reflection assignments were a waste of time. One student responded to the email question "Did you feel like the metacognitive prompts in each module of the 10 UETS helped you become more metacognitive? In what ways? If not, why?" by writing,

> "No, not at all. I thought they were silly. No one even addressed them appropriately. I am honestly the only person who EVER addressed metacognition in any way in our posts. Everyone else just talked about what they liked or didn't like about the module."

Student comments from intervention 1 primarily focused on the content of the modules and not the metacognitive processes used during learning. A typical comment was:

> "This module was so interesting to me. In my own experience, I have seen how many teachers can lose control of their classrooms. I was excited to learn some tips and strategies on how to bring the classroom's attention back."

From student statements, it appears that most students were not aware of their metacognition.

In intervention 2, the metacognitive intervention was adjusted slightly. An additional prompt was added to each module reminding students to focus on their thinking, what they were doing to increase their learning, and what they could do differently to learn more effectively. The number of students with one or more metacognitive statements increased by 70% (see Table 3). Only 16% of statements in the first intervention sections had more than one metacognitive statement, while in the second intervention, 86% of response had more than one metacognitive statement.

Table 3
Number of metacognitive responses by intervention

	Zero Metacognitive Responses		1-2 Metacognitive Responses		3 or more Metacognitive Responses		Total Metacognitive Responses
Course	n	%	n	%	n	%	N
Intervention 1	479	84	73	13	18	3	570
Intervention 2	75	14	191	36	264	50	530

We sampled 1100 responses from intervention 1 (n = 570) and intervention 2 (n = 530) to test whether the number of metacognitive responses in each intervention was significant. Data were analyzed using chi square test of independence with an alpha of .05 as criterion for significance.

According to the test of independence, the difference in number of metacognitive responses was statistically significant (x^2 (2, n = 1100) = 514.60, $p \leq .000$). To follow up the findings, Phi was calculated to determine effect size of the different sections. The finding of Phi = .629 provides evidence of a moderate correlation between each intervention and the number of metacognitive responses. See Table 4 for counts of observed and expected responses by intervention.

Table 4
Observed compared to expected number of metacognitive responses by intervention

	Zero Metacognitive Responses		1-2 Metacognitive Responses		3 or more Metacognitive Responses	
	n_o	n_e	n_o	n_e	n_o	n_e
Intervention 1	479	279	73	158	18	133
Intervention 2	157	357	287	202	286	171

Note: n_o = number observed, n_e = number expected

Additionally, there was a change in the quality of student statements. The following is an example of a typical comment from students in Sections 3 and 4 who received the modified intervention. "I didn't take notes this time as I should have, but I was thinking I would make myself some flash cards next time, those are quite useful. I read the articles aloud and then read them more than once. I told what I had learned to my dog, pretending I was teaching these concepts to someone else."

In intervention 2, students made comments in which they reflected on the effectiveness of the metacognitive strategies they were using. For example, one student wrote,

> During this module, I found it helpful to research some of the topics I was less familiar with. I also found it helpful to make sure I had a dedicated time to study and played soft music, which helped me stay focused. I was a lot less distracted this time, as I scheduled my study times during times when my children were in classes. I also found that reading the articles a second or even third time, really helped me gain a better understanding as well as remember the information better.

Not only were students in these sections identifying more metacognitive approaches, but they were reflecting on their effectiveness and frequency of use. The process of self-regulation was becoming more explicit and more frequent.

From review of all student posts, three themes emerged from student statements in intervention 2. The first theme is the importance of transforming online material into more useable formats. The second theme is the need to structure the learning environment to increase student attention. The final theme identified is the importance for students to make personal connections to the content.

Several students wrote about changing the online material into formats better suited to their learning needs. For example, some students printed the readings. Others mentioned the importance of taking notes on the online articles, particularly handwritten notes. Yet, others mentioned the importance of accessing the readings on devices with screens larger than

their smart phones such as Kindles, iPads, and computers.

The second theme was structuring the learning environment to increase student attention. Students wrote about scheduling quiet time to work on their assignments. Some discussed doing their homework without the distractions of other people. Another strategy was playing classical music to drown out distractions. Finally, some students mentioned their phone being a distraction and thus placed it in a different room.

The third theme was the importance of making personal connections with course content. Many students mentioned thinking about how the content related to their previous relevant life experiences. Still other students discussed making connections of the content to what they are currently doing. Additionally, others processed and made deeper connections with the content by discussing their thoughts with other people.

Discussion

The results of this research suggest that a minimal intervention in an online course can encourage student metacognitive thought. The positive impact of open-ended prompts in this study are similar to the findings by Watkins (2016) that open-ended prompts are necessary to promote metacognitive reflection in an online course. This study further clarified the nature of effective prompts. The results of this study showed that not all open-ended prompts foster metacognitive reflection. Instead, the prompts need to be very specific otherwise students discuss the content of their learning, but not the process they use to achieve their learning. Students need specific support to make the jump from thinking about content to thinking about their own learning. Both Garrison (2003) and Watkins (2016) emphasized the importance of students sharing their metacognitive reflections with other students in online discussion forums. It appears that this process may encourage students to be more aware of their metacognitive use and to try metacognitive strategies modeled by their peers. Numerous studies in face to face classrooms (Borkowski et al., 1987; Hattie, 2009; Joseph, 2009; Pressley et al., 1987) described the positive impact of metacognition on academic achievement. Further research is needed to determine if students' increased metacognition also impacts student achievement in the online environment.

The first theme is the importance of transforming online material into more useable formats. It is somewhat surprising that students in an online course often reported printing out the readings in order to process the information more deeply. It may be that as students become more metacognitive, they are better able to monitor their learning effectiveness. The students seemed to intuitively realize what researchers are beginning to document. Singer and Alexander (2017b) reviewed research completed since 1992 examining student comprehension in print versus digital text. They found that when the text was more than one page, comprehension was higher when students read a printed text. When Singer and Alexander (2017a) further explored this relationship, they found no difference in comprehension when students were identifying the main idea, but if college students were asked to recall key details and other relevant information, students performed better when reading print. It appears that when the task requires deeper level of processing there is something about the digital text that hinders learning. One possible explanation suggests the process of scrolling for longer texts increases the cognitive demand on the reader and thus negatively impacts comprehension of digital versus print mediums (Kerr & Symons, 2006; Wästlund, Reinikka, Norlander & Archer, 2005). Another possible explanation centers on the speed with which readers read text. Lenhard, Schroeders, and

Lenhard (2017) reported participants read digital medium more quickly than print, which led to decreased depth of processing of the text.

The second theme is the need to manage distractions so students could focus attention on the learning task. Many strategies focused on reducing distracting environmental "noise" by either removing themselves from the situation or masking it with classical music. The other type of distraction was technology. Winter, Cotton, Gavin & Yorke (2010) found graduate students pursuing a Ph.D. struggled with minimizing distractions, particularly electronic distractions during online learning. It is no wonder that students in our study, who are just beginning their college career, would also struggle with this same issue. Rosen, Carrier, and Cheever (2013) observed high school and university students studying in their homes. They found on average, students studied less than 6 minutes before becoming distracted by technology.

The third theme identified in this study is that students reported trying to make personal connections with the course content. This result supports the findings of Nilsson (2008) where science pre-service teachers had to connect with the content in order to make use of it. In addition, Hume and Berry (2011) reported that many students struggle in their understanding of course content and naturally look for ways to personally connect the content to their current understanding.

One limitation of this study is that the data collected were based on student self-reporting. Another limitation is that it is not clear if students actually increased their use of metacognitive strategies or just the number and type of strategies reported because they were able to read other students' postings about their use of metacognition. Additional research is required to identify the influence of students reading other students' metacognitive strategies.

Conclusion

The number of metacognitive strategies students reported in an online course was increased by the insertion of carefully crafted prompts within the course. It is important to remind students of the difference between sharing what they learned and sharing the strategies they used to learn. Three themes emerged from student posts about their metacognitive strategy use: the importance of transforming online material into more useable formats; the need to structure the learning environment to increase student attention; and the importance for students to make personal connections to the content. A minimal level of metacognitive intervention in an online course can increase student reported use of metacognitive strategies.

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