The Impact of Anomalous Information, Personality, and Motivation on Self-Regulatory Processes in a Multimedia Vicarious Learning Environment

Jeremiah Sullins¹ & Xiangen Hu²
¹Harding University, ²University of Memphis
Corresponding author: jsullins@harding.edu

Abstract
Regulating one’s learning involves analyzing the learning context, setting and managing meaningful learning goals, determining which learning strategies to use, assessing whether the strategies are effective in meeting the learning goals, evaluating emerging understanding of the topic, and determining whether there are aspects of the learning context which could be used to facilitate learning. The focus of this paper is on one specific self-regulatory process: self-questioning. Self-questioning specifically refers to a self-regulatory process in which a learner formulates a question, inquiry, or hypothesis about the material being studied. The current study was designed to assess the potential benefits of presenting anomalous information to the learner in order to produce a state of cognitive disequilibrium which in turn could potentially lead to an increase in the quantity and quality of questions. A significant difference in question asking quantity as a function of condition was discovered. Furthermore, certain individual differences were discovered to have an impact on who most benefited from the presentation of anomalous information.

Self-Regulation
According to Azevedo, Johnson, Chauncey, and Burkett (2011), regulating one’s learning involves analyzing the learning context, setting and managing meaningful learning goals, determining which learning strategies to use, assessing whether the strategies are effective in meeting the learning goals, evaluating emerging understanding of the topic, and determining whether there are aspects of the learning context which could be used to facilitate learning (p.225).

Self-Questioning
Not only has question generation received attention from proponents of self-regulation, it has received a great deal of attention in recent years from researchers in the fields of computer science (Heilman & Smith, 2010), psychology (Graesser, Ozuru, & Sullins, 2009; Rus & Graesser, 2009; Sullins & McNamara 2009) and education. Question generation is believed to play a crucial role in a variety of cognitive faculties, including comprehension (Collins, Brown, & Larkin, 1980;
Graesser, Singer, & Trabasso, 1994) and reasoning (Graesser, Baggett, & Williams, 1996; Sternberg, 1987). Asking good questions has been shown to lead to improved memory and comprehension of material in school children and adult populations (Rosenshine, Meister, & Chapman, 1996). Available research suggests that learning how to ask good questions should be taught at an early age but all ages benefit from question generation training (Wisher & Graesser, 2007).

Sadly, consistent with the research coming out of self-regulation, it is well documented that the ideal scenario of a curious question asker does not match reality. Students are unspectacular at monitoring their own knowledge deficits and their question generation is both infrequent and unsophisticated (Dillon, 1988; Graesser & Person, 1994; Van der Meij, 1988). Graesser and Person (1994) reported that an individual student asks approximately one question in seven hours of class time (around one question per day). Most of these questions are not good questions, so the quality is also disappointing.

**Individual Differences and Question Asking**

One area of research that has not received a great amount of attention in the area of self-regulation is the influence of individual differences. There is ample evidence to suggest that individual differences do play a role in other areas of cognition such as the teaching of reading comprehension strategies (Briner, Kurby, McNamara, 2007; O’Reilly, Best, McNamara, 2004; Best, Rowe, Ozuru, & McNamara, 2005). However, to date few researchers have explored how individual differences may impact student question generation (e.g., Sullins & Graesser, 2014).

**Current Study**

The current study was designed to assess the potential benefits of presenting anomalous information to the learner in order to produce a state of cognitive disequilibrium which in turn could potentially lead to an increase in the quantity and quality of questions.

**Procedure**

After completing the informed consent, the participants completed a demographics questionnaire. Following the demographics questionnaire, participants completed the Gates MacGinitie Reading Comprehension test. Participants were then randomly assigned to one of four different conditions.

The multimedia-learning environment used in the current study was AutoTutor Lite. For the purpose of the current study, AutoTutor Lite was used as an information delivery system (see Figure 1).

The four different conditions involving AutoTutor Lite were: 1) **Pro War Unedited**: participants listened to AutoTutor Lite deliver an opinionated article regarding why we should have started the Iraq war 2) **Anti War Unedited**: participants listened to AutoTutor Lite deliver an opinionated article regarding why we should not have started the Iraq war 3) **Pro War Cognitive Disequilibrium**: participants listened to AutoTutor Lite deliver the same opinionated article as in the **Pro War Unedited** condition, except in this condition, the article included erroneous information 4) **Anti War Cognitive Disequilibrium**: participants listened to AutoTutor Lite deliver the same opinionated article as in the **Anti War Unedited** condition, except in this condition, the article included erroneous information.

Following the completion of the AutoTutor Lite intervention, participants completed the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 2001) along with the Big Five Personality Test. Participants were given as much time as needed to complete these tests.

**Results**

A significant difference in question asking quantity as a function of condition was discovered, $F(3,69) = 4.63, p = .005$, $\eta^2 = .168$. Upon further exploration, it was revealed that participants in the **Pro War Cognitive Disequilibrium** condition ($M = 2.12$, $SD = 1.89$) asked significantly more questions than the participants in the **Anti War Cognitive Disequilibrium** condition ($M = .55$, $SD = .78$) and the **Anti War** condition ($M = .77$, $SD = \ldots$)
Furthermore, a marginally significant difference was discovered between the participants in the Pro War Cognitive Disequilibrium condition \( (M = 2.12) \) and the participants in the Pro War condition \( (M = 1.31, SD = 1.97) \).

Following the analysis exploring the differences in question asking among conditions, the participants were split into two different categories in order to determine if there were any differences in pro versus anti war. More specifically, participants were either in the Pro War conditions (both cognitive disequilibrium and unedited) or Anti War conditions (both cognitive disequilibrium and unedited).

Results revealed a significant difference between the two groups, \( F (1,71) = 10.41, p = .002 \). Participants that were in the Pro War conditions \( (M = 1.69, SD = 1.72) \) asked significantly more questions during their learning session than the participants in the Anti War conditions \( (M = .65, SD = .94) \).

Furthermore correlational analyses were conducted in order to determine if there were any relationships that existed between learners’ individual differences and the number of questions that were generated. A significant correlation was discovered between the MSLQ variable test anxiety and the number of questions asked during the learning session \( (r = .248, p = .035) \). Additionally, a marginal significant correlation was revealed between the number of questions that the participants asked during their learning session and their viewpoint on the most recent Iraq war (assessed in the demographics questionnaire) \( (r = .195, p = .09) \).

Discussion

It was predicted that learners who were placed in a state of cognitive disequilibrium (based on the presentation of erroneous information) would produce a significantly higher amount of raw questions than the learners in the non-cognitive disequilibrium conditions. However, our results were not in the predicted direction.

One potential explanation for these findings could be due in some degree to individual differences among participants. For example, as mentioned in the results, there was a significant correlation between the MSLQ variable test anxiety and the number of questions asked during the learning session. Analysis revealed that although there was not a significant difference among conditions regarding test anxiety, \( F (3,69) = 1.58, p = .203 \), there were some interesting trends that were revealed during the analysis. Results showed that participants in the Pro War Cognitive Disequilibrium condition on average had the highest test anxiety score \( (M = 4.68) \), compared to participants in the Anti War Cognitive Disequilibrium condition \( (M = 4.18) \), Pro War condition \( (M = 4.32) \), and Anti War condition \( (M = 3.64) \). Test anxiety, according to the MSLQ manual, refers in part with preoccupation and concern regarding task performance. It could be that the participants in the Pro War Cognitive Disequilibrium condition were more concerned with their task performance and therefore asked more questions to ensure they would perform well.

Another potential explanation for unexpected results could be a result of the reading comprehension as measured by the Gates MacGinitie reading comprehension test. Participants in the Pro War Cognitive Disequilibrium condition scored on average one percentage point lower than the participants in the Anti War Cognitive Disequilibrium condition, five percentage points lower than participants in the Anti War condition, and eight percentage points lower than the participants in the Pro War condition. As can be seen in the screenshot of AutoTutor Lite in Figure 1, AutoTutor Lite not only utilizes a text to speech engine but also has text bubbles present on the screen. It is possible that due to the difficulties in understanding, some learners relied heavily on the speech bubbles provided by AutoTutor Lite. If participants in the Pro War Cognitive Disequilibrium condition attempted to rely on the speech bubbles, due to lower reading comprehension scores, they may have not fully understood the material being covered and therefore asked a significantly higher proportion of questions during the learning session.

It also warrants mentioning that although the rate of question asking across all four conditions might look relatively low, this is actually a vast improvement from the previous findings. More specifically, as previously mentioned, Graesser and Person (1994) found that an average student in a typical classroom setting will only ask 1 question for every 7 hours in the classroom. However, in our Pro War Cognitive would result in approximately 148 questions every 7 hours!

References


Graesser, A. C., Ozuru, Y., & Sullins, J. (2009). What is a good question? In M. G. McKeown & L. Kucan (Eds.),
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