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Abstract

The Predict-Observe-Explain (POE) learning cycle improves understanding of the connection between empirical results and theoretical concepts when students engage in hands-on experimentation. This study explored whether training students to use a POE strategy when learning from social science texts that describe theories and experimental results might be more beneficial than an explanation strategy. The study found that students trained to use an explanation strategy displayed better comprehension on a new set of topics.

Keywords: Learning from text; Explanation; Comprehension

How Do Predictions Change Learning from Science Texts?

The Predict-Observe-Explain (POE) learning cycle has been shown to improve students' ability to understand the connection between empirical results and theoretical concepts when students engage in hands-on experimentation (Lehrer & Schauble, 1998; White & Frederiksen, 1998). In contrast to instructional approaches where students read or are lectured to about scientific concepts, this learning cycle engages students more actively in the inquiry process. They are prompted to make predictions, followed by observations of phenomenon under various conditions, and finally explanations of how the results support theories. By directing students' attention to the design and results of experiments, students develop a better understanding of theory-evidence relations.

Beyond its benefits in inquiry settings, a POE study strategy might also improve understanding from texts that emphasize theories and evidence, which is a common style for textbooks in the social sciences. There is already some evidence that engaging in POE activities can lead to better learning of social psychology topics from textbook excerpts that used descriptions of experimental results to provide evidence for theories (Carvalho et al., 2018). These beneficial effects on learning from expository texts may be similar to those that have been seen with other constructive activities such as generating arguments, sketches, questions, or explanations (Ainsworth & Th Loizou, 2003; Butcher, 2006; Chi, 2000; Davey & McBride, 1986; Hinze, Wiley, & Pellegrino, 2013; King, 1994; McNamara, 2004; Wiley & Voss, 1999).

Generative activities also provide the conditions that have been found to most robustly support the accurate comprehension monitoring skills that students need to engage in effective self-regulated learning (SRL). Although students' tend to be poor at monitoring their understanding from expository science texts (Griffin, Mielicki, & Wiley, 2019; Maki, 1998;

Thiede, Griffin, Wiley, & Redford, 2009), multiple studies have shown that engaging in generative activities such as attempting to explain how and why a scientific phenomenon occurs after reading can improve students' ability to monitor their understanding (Griffin, Wiley, & Thiede, 2008, 2019; Jaeger & Wiley, 2014; Wiley et al., 2016). Prompting students to make predictions prior to learning the results of empirical studies may help students to reflect more deeply on relations between hypotheses, designs, and results of studies. If engaging in a prediction activity as part of a study strategy for social science texts helps to direct the student's attention to the key relations between theories and evidence, then this strategy could also be expected to offer benefits beyond those of explanation. The main goal of the current experiment was to test whether training students to use the POE study strategy would support better comprehension when students engaged in future learning attempts.

Method

Participants

Students (N = 358) completed online homework activities as a part of their Introduction to Psychology course. They received course credit for completing the activities. To minimize contamination from discussion of activities, students were randomly assigned to POE (n = 173) or explanation only (n = 185) training conditions based on the section of the course they were enrolled in.

Materials

Domain-Specific Comprehension Skill (DSCS) Assessment

Students were given a test which served as a measure of individual differences in domain-specific prior knowledge and reading skill in psychology. They read six psychology textbook excerpts (Sampling Bias, Placebo Effect, Self-Control, Fundamental Attribution Error,

Conformity and Obedience, and Cognitive Dissonance). All texts were structured in a similar manner in which they first described a real-life example of the theory or phenomenon, followed by the presentation of two empirical studies that provided support for the concept.

They then completed a test which included five inference test questions based on each text. Test questions were designed to measure students understanding of the concepts in the text, not their verbatim memory (Guerrero & Wiley, 2018). Questions asked students to identify implicit connections between ideas within the text, compare or contrast results from empirical research studies, and apply their understanding of theories to new situations.

Study Strategy Training

Students were trained to use either a POE or explanation study strategy using the texts from the DSCS assessment. All students were prompted to write short responses at two points in the text. In the POE condition, after the method and design of the second empirical study was described (and before the results were revealed), students were tasked with making a prediction about the results of the second empirical study from three multiple-choice options, after which they were asked to explain why they chose their prediction. Then, at the end of the text, they were asked to explain how the results of the studies provided support for the theory.

In the explanation-only condition, students were instead asked to write explanations at both points in the text. Feedback on the written responses was not provided to students in either condition.

Future Learning Activity

Similar to the DSCS assessment, students read 6 textbook excerpts, however, these were on new psychology topics (Classical Conditioning, Operant Conditioning, Observational

Learning, False Memories, Twin Studies, and Aphasias). After reading, they completed a comprehension test containing 5 inference questions for each new topic.

Procedure

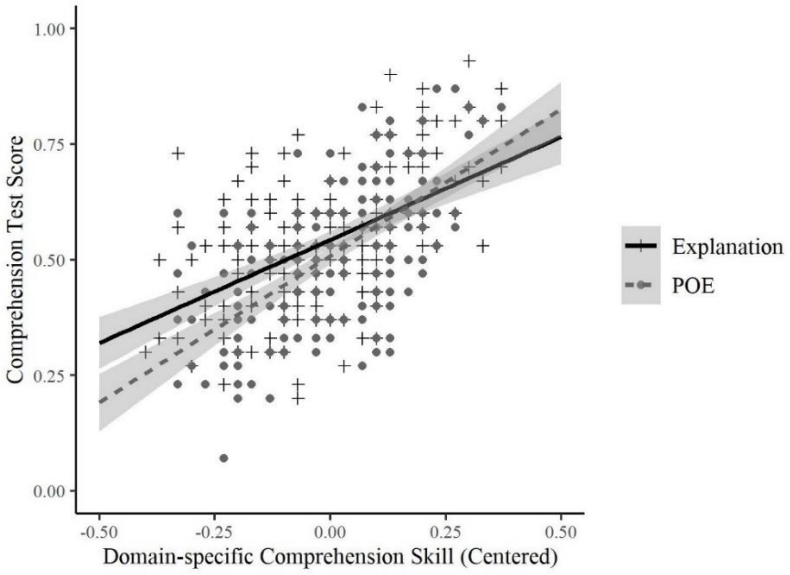
During the first week of the class, prior to any content instruction, all students completed the DSCS assessment. The following week, students completed the study strategy training activity either using POE or explanation. During the next week, all students completed the future learning activity.

Results

The tests given as part of the future learning activity served as a measure of how the training to use POE or explanation strategies while studying might support better comprehension on future reading assignments. As shown in Figure 1, contrary to the hypothesis that engaging in prediction might support better understanding than explanation alone, an analysis of covariance entering individual differences in DSCS as a covariate showed that students in the explanation condition had better performance on the comprehension tests for the new topics than students in the POE condition. The covariate was also significant, as was the interaction. The interaction was due to students with lower DSCS performing more poorly in the POE condition than the explanation condition.

Figure 1

Comprehension Test Score by Condition as Predicted by Domain-specific Comprehension Skill



Exploratory analyses were conducted to understand why the POE condition did not benefit from the strategy training activity. Review of the final explanations given in both conditions for one topic showed that semantic overlap from the written responses to the reference text was greater for those in the explanation-only condition than POE. This suggests that those in the POE condition might have been focusing on information outside of the text. Further, using LIWC (Pennebaker, Francis, & Booth, 2001) the responses were examined for words signifying positive or negative affect as well as first-person pronouns indicating that they might be referencing the accuracy of their prediction. The written responses from the POE group contained more words signifying affect, and more first-person pronouns, than the explanation-only group.

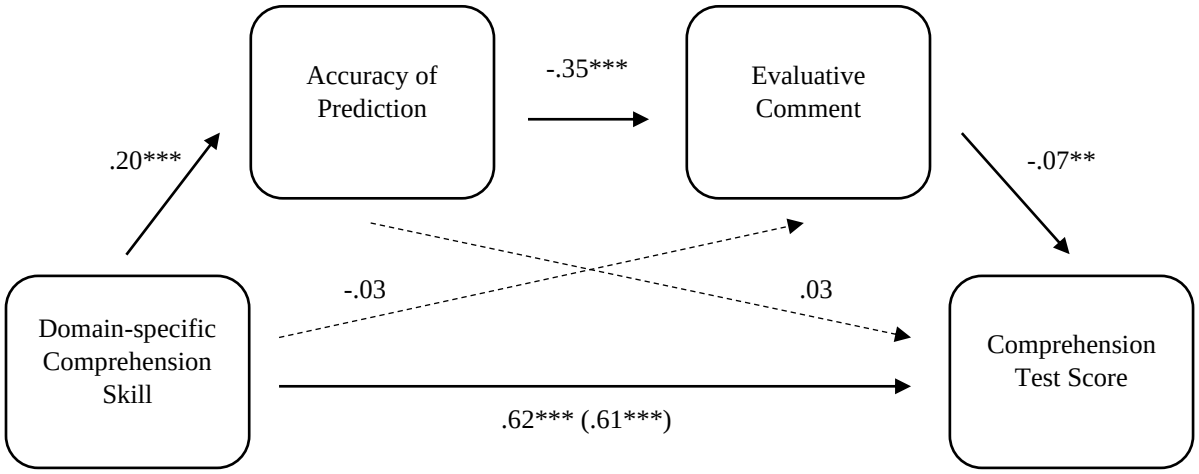
Additional coding analyses were subsequently performed for all topics. The best student responses were determined by human scoring using a rubric that gave points for discussion of theories and evidence. An ideal student response was compiled from the best student responses.

These analyses indicated that responses in the explanation condition were coded as being of higher quality by human scoring, and also scored higher in semantic overlap with the ideal student responses.

One possible reason for the ineffectiveness of the POE strategy could be that during the final explanation phase, instead of focusing on explaining the text as was intended, the POE group was more focused on the accuracy of the prediction made earlier. When the responses were coded for the presence of evaluative statements, this indicated that the POE group was more likely to include these. The relationship between these factors was explored in a sequential mediation analysis. The relationship between DSCS and future comprehension test score was partially mediated by the accuracy of the predictions and the presence of evaluative comments.

Figure 2

Sequential Mediation Model



Note. Standard regression coefficient for the relationship between domain-specific comprehension skill and comprehension test score as mediated by accuracy of the prediction and inclusion of evaluative statements. The standardized regression coefficient between domain-specific comprehension skill and comprehension test score, controlling for accuracy of the prediction and evaluative comments, is in parentheses.
*** $p < .001$.
** $p < .01$.

Discussion

Overall, these findings did not indicate any benefit from training students to use the POE cycle as a comprehension strategy for social science texts. Making predictions before explaining failed to improve comprehension on a new set of psychology textbook excerpts, and in fact, harmed comprehension for lower-skilled readers. Based on the exploratory analyses of the student responses obtained during the training activity, it seemed that the prediction activities changed the way students engaged in explanation. That is, during an explanation task they became more concerned with whether they were correct or incorrect, and less focused on understanding how the empirical results described in the text supported the theory. Although in this instance prompting students to use a POE study strategy did not improve comprehension on future learning attempts, it is still possible that a POE study strategy could be better than an explanation-only strategy if students actually engaged in each stage of the POE cycle as intended. Nevertheless, the results extend prior work showing the benefits of explanation activities for helping students to engage in effective self-regulated learning from expository science texts (Griffin et al, 2008; 2019; Jaeger & Wiley, 2014; Wiley et al. 2016).

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