Title: Multiple-Text Processing In Text-Based Scientific Inquiry.
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Strand of work: Design and Design-Based Research on Interventions

Abstract

This study examined multiple-text processing in the context of text-based scientific inquiry for purposes of generating causal models. We used a series of rubrics to examine students' use of the texts, the quality of the causal models they created, and the impact of text use on model quality. Results indicate that multiple text users engaged with the texts in qualitatively different ways and created significantly higher quality models than single text users.

Purpose and Questions Investigated, Assessments or Tools developed

This study examined how students used an intentionally designed text set to generate causal models of the carbon cycle prior to and following an instructional intervention. Using a series of rubrics, we analyzed the pre/post models to determine the extent to which students made use of the texts and the quality of the models that they created. We then examined the relationship between text use and model quality, focusing on the role of multiple-text processes.

Methodology

This work was developed in the context of a three-week implementation of a text-based inquiry module on the water cycle in a 6th grade science classroom at an urban public school in the Midwest. Prior to, and at the conclusion of, the module, an assessment was administered that engaged students in the same reading and inquiry practices taught during the implementation but for a different topic. The four texts included several different types of information including running text and illustrations. The pre/post text set was designed to facilitate an investigation of students' text use and multiple-text processing in that it required the selective use of information from multiple texts and cross-text synthesis to produce a complete causal model. During the pre/post assessment, students were asked to read and annotate the texts. They were then asked to use information from the texts to create a model that explains how and why the scientific phenomenon occurs.

This study used an analytic approach that was developed to capture the range of performances on the pre/post multiple-text modeling task across students and changes in performance post instructional intervention. The performances of interest were students' use of the texts and the causal models that they constructed. The pre/post assessment was administered individually to each student in the class one day prior to and two days

following the conclusion of the instructional module. Pre/post test data was available for 22 consented students.

The models constructed during the pre and post assessment constitute the data source for this work. These models were coded for text use and model quality using two rubrics that were developed by two of the authors through an iterative refinement process of generating criteria, applying them to student work, and revising the scoring criteria to effectively capture the variation present in student work.

Rubric for text use. This rubric allowed us to trace the information in each model to the texts that each student used to create their models. We identified the type of information that was used including 1) running text, 2) illustration. Overall text use was evaluated based on how many texts were used (1) no texts, 2) single text, 3) multiple texts).

Rubric for model quality. Model quality was scored against an "expert" model of the elements and causal links in the model, as reflected across the text set that students were provided with. Models were scored for how many of the elements (max = 3) and links (max = 2) in the expert model were reflected in the student's model.

General statement of findings
The findings suggest that many students only used information from a single text to construct their models. Some students included information from multiple texts in their models and a few students did not make use of information from any of the texts. Those students who included information from a single text tended to use one of the two visual texts in the text set. In contrast, most of the multiple text users included information from both verbal texts and visual texts. This suggests that single text users largely relied on visual texts to create their models whereas multiple text users engaged with both verbal and visual texts.

The findings also indicate that variation in text use was related to important differences in the quality of the explanatory models that students constructed. Multiple text users produced significantly higher quality models than single text users with respect to the number of elements that they included in their models. We also found that only multiple text users included causal links in their models. This indicates that only multiple text users were making connections within and across texts. Thus, students varied in the ways they used the texts to construct their explanatory models and these differences in text use were related to important differences in the quality of the models that they constructed.

Implications
This work provides insight into the challenges associated with multiple-text processing and highlights the impact of this practice on scientific understanding. The findings from this work will be used to inform the development of curricular materials to support these critical scientific literacy practices.