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How Does Students' Perception Of The Main Point Of A Unit Relate To The Quality Of The Final Argument?

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Abstract: Learning about science from an inquiry question across a unit is challenging. We examined whether students with more appropriate goals and plans for a science investigation (i.e., task models) wrote more complete culminating arguments. Students who perceived the unit was about reasoning had less evidence in their essays than those that did not. This suggests that some students need supports to understand the role of reasoning to guide inclusion of evidence in their final arguments.
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Introduction

U.S. students are increasingly engaging in inquiry tasks to learn about disciplinary core ideas, science and engineering practices, and crosscutting concepts (Achieve, 2013). By interweaving these three dimensions to answer a question about an authentic anchoring phenomenon (e.g., why were Mesosaurus fossils found in both South America and Africa and how did they get so far apart?), students should begin to develop scientific thinking by engaging in both the construction of explanatory models and argumentation (Achieve, 2013). Argumentation in science entails the development of claims, the collection of supporting evidence, and the use of key scientific principles and core ideas to reason from evidence to claims (Berland & Reiser, 2009; McNeil & Krajcik, 2012; Osborne & Patterson, 2011). Inquiry learning in 7th grade often involves engaging in argumentation and reasoning across multi-week units. In this situation, it would benefit students to understand how all the individual investigation subtasks contribute to the overarching goal of the unit. Students must know what they are being asked to do for each subtask (i.e., goal state) and how they can do this (i.e., strategies), in order to then assign value to each goal (i.e., interest and motivation for doing the work). We define this regulatory structure as a task model (Britt, Rouet, & Durik, 2018), which is the students' representation of the task during learning. In the current study, we explored students' task models about the point of the unit and the important content they gained from the unit. Then we examined whether students' task model content predicted what they included in their final arguments. In general, we expected students' task models would help explain what was included and not included in their final essay.

Methods

Fifty-seven students participated from three 7th grade science classes taught by the same teacher in Chicago Public Schools (n_s = 25,15,17). After obtaining consent, researchers collected data in March of the 2019-2020 school year. The school district used a science curriculum centered around the Next Generation Science Standards (Achieve, 2013). Each unit presented a hypothetical or real-world scenario with a unit investigation question and built toward a culminating argument essay. During instruction, the teacher used several supportive tools including an *Investigation Steps Chart*, that included five questions to help students monitor and guide inquiry activity (e.g., "How will we use the materials like a scientist to answer the investigation question?" "What have we figured out that helps us to answer the investigation question?" "What do we still need to figure out?"). Towards the end of their second unit of the year, students completed an eight-minute Task Model survey about that unit. We provided two prompts to try to capture the goals in the forefront of the students' minds ("What is the main point of this unit?", "Describe the three most important ideas you learned from this unit."). Then two days later, students wrote their unit argument essay in class. The instructions prompted students to use evidence to support their claim and to explain their reasoning (i.e., the unit's key reasoning concepts). Students had three resources available to them while writing their essay: a word bank, their completed Investigation Steps Chart, and notes from a reasoning tool activity that guided students to connect claim-evidence-reasoning.

Results

The publisher's ideal essay was parsed to identify the key idea units: 15 evidence units (e.g., Earthquakes occur between the South American and African plates), 10 reasoning units (e.g., The plates of Earth's outer layer move), and seven possible pairings of evidence and reasoning. Then the student essays were scored for these units. The Task Model surveys were scored for the same idea units. Scores were computed as proportions since the number of possible idea units varied between the task model survey and the final essay. Interrater reliability revealed high agreement between two of the authors' judgements (Kappa = .84).

In the argument essays, many students included evidence-reasoning pairs (25%), unpaired evidence (30%), and unpaired reasoning (5%). In the Task Model, students included unpaired evidence (26%), and unpaired reasoning (17%). Evidence-reasoning pairs were uncommon (1%). The majority of students' essays (88%) included some of the items that they listed as important in the survey. The 12% that did not, included only background facts and details of specific activities. There was a .34 correlation between the overall number of idea units mentioned in the Task Model survey and the number of evidence-reasoning pairs in their essay ($p < .05$). A multivariate regression was conducted with evidence and reasoning from the Task Model survey predicting the evidence, reasoning, and pairings in the final essay. Reasoning in the Task Model significantly negatively predicted the evidence in the essay $F(2,52) = 2.79$, $p = .05$, $\eta_p^2 = .139$. As students included more reasoning in the Task Model survey, the amount of evidence in the final essay decreased by -.327, $p = .005$. The Task Model Survey also included one question on student interest. While students indicated that the unit was interesting, student interest did not account for variance in any aspect of essay performance ($p > .05$, $M = 4.21$, $SD = 1.56$).

Discussion

This study presents an exploratory investigation of students' task model and how it predicts the elements that they include in their unit-culminating argument essay. Students who mentioned that the unit was about key scientific principles and core ideas (i.e., reasoning idea units) included less supporting evidence in their essays. Focusing on curriculum-provided reasoning did not help the students include evidence or make evidence-reasoning pairings in their essays. This finding points to the need to emphasize the need to provide evidence that supports reasoning as an important scientific practice. Otherwise, students may not benefit from learning these practices and other important concepts intended in inquiry learning. Of course, all these observations are tentative as we only have three classes taught by one teacher. Yet, there was variability in the extent to which students saw evidence as the main point of the unit. Future work will include examining these relationships with a larger sample of classes and different units in the curriculum. This is an exciting first step in connecting Task Models to learning outcomes in this age group.

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