We also see some differences between resources used in the two conditions, especially in the 'rebuttal' stage of the argumentative response. For instance, videos and experiments were more prevalent in the 'evaluate' while 'force is not transferred' was more prevalent in the 'construct' condition. We believe that a reason for this difference is that the 'evaluate' condition relied on counter positions from the hypothetical responses provided in the question, while the 'construct' condition tended to create hypothetical counter positions based on elementary children's alternative conceptions discussed in class.

We were also interested in finding out the extent to which students applied their resources in productive and scientifically appropriate ways. To do so, we coded each response twice. First, only the claim and reasoning (i.e. response to "What reasons and evidence support your answer?") were coded as "justified", "adequate" or "problematic". Second, the entire response, including the rebuttal (i.e. response to "How would you help the elementary kid understand that their position is incorrect, and your position is correct?") was coded using the same scheme. The intent was to measure whether the additional resources that were invoked by the students in their rebuttals were being used appropriately. We found that approximately 30% of the responses changed in the quality of their justification provided. Unfortunately, we also found that the justification quality of a vast majority of these responses (about 20-25% out of 30%) declined with the use of additional resources. This means that although students were using additional resources while writing their rebuttals, they were not necessarily doing so appropriately. This trend was similar across both conditions. Future work will expand this investigation to other topics and other audiences.

V. CONCLUSIONS

Prior research has shown connections between argumentation quality and scientific conceptual quality of students' responses. Yet, argumentation as process for learning is seldom emphasized in physics classrooms [18].

We find that use of argumentative prompts can help students activate a wider repertoire of reasoning resources than merely asking them to provide an answer and explain their reasoning. Prompts that ask students to consider counter positions and rebuttals to these counter positions can be a useful tool to facilitating students to activate a wider range of resources. For a about a quarter of these students, the task of constructing these rebuttals to hypothetical counter positions, results in the inappropriate use of these additional resources.

The main limitation of this study is that it is confined to a single task in a single class for future elementary teachers. In spite of this limitation, there are two important broader impacts of this research. First, the study demonstrates that the use of argumentative prompts can be a useful tool to facilitate students to bring to bear previously inert experiential knowledge in the form of new resources and ways of thinking about the problem. This shift in framing can be especially useful for future teachers who need to develop appropriate epistemological framing to facilitate future students in their learning of science. Second, the study demonstrates, that argumentative prompts may also have value as a diagnostic tool in that they in many cases reveal that students may not necessarily use resources in scientifically appropriate ways. Therefore this study demonstrates that the use of argumentative prompts may reveal alternative student conceptions about a topic.

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