TABLE IV. Percentage of responses within each population towards Question 2 "Why do scientists do experiments for their research?"

Codes	Intro (%)	Upper (%)	Graduate (%)	p value
Theory testing	54	71	65	0.40
Theory development, modification	6	0	10	0.54
Empirical evidence	34	29	13	0.04
Scientific investigation	20	14	55	0.003
Technology advancement	0	14	16	0.01

B. Students' views of scientists doing experimental research

Question 2 asked, "Why scientists do experiments for their research?" Table IV shows the percentage of responses in each population expressing certain codes in response to Question 2. Table IV shows much more similarity among the three populations. Introductory students and graduate students are not all that different in how they perceive the goals of professional experimental research. This finding is consistent with previous CLASS results that showed students were good at identifying the expert response, but their personal beliefs were much more novice [2]. All three levels of students viewed doing physics experiments in a research lab as primarily to test or verify a theory. There are also a small portion of students in introductory and graduate levels mentioned the role of "theory testing" physics laboratory courses, however it is not as significant as it is in research labs. In addition, introductory students also describe doing experiments in research labs as providing evidence for a theory (i.e., empirical evidence). This code is similar to "theory testing" code but students often use terms such as "support", "back up" instead of "prove" or "test". About half of graduate students also mention the role of "scientific investigation" in doing experimental research.

IV. CONCLUSIONS

There are several important findings from our data. We developed a framework of epistemology that explicitly integrates experimentation. We also identified significant differences between introductory-level students and graduate students on their views about the pedagogical value of experiments, which could form the foundation of a developmental progression of epistemology of physics experiments. Ongoing work includes analyzing the remaining nine questions, identifying significant introductory to graduate level differences on those items, administering the survey to broader populations of students to see how repeatable the results are, and developing easier to score versions of the survey as long as it continues to provide helpful insights into students' epistemological development.

ACKNOWLEDGEMENTS

We thank Michael Rinkus for assisting in the interrater reliability. This work was funded by NSF DUE-1432301.

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