Inquiry-Based Laboratory Course: Current Status and Future Improvement

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Introduction

Recently, science lab courses have deviated from traditional lab instruction to more inquiry-based approaches. This change prompts new questions such as:
- What defines an authentic research experience?
- Do students feel more engaged in inquiry-based courses?
- How can undergraduate students be taught lab skills while contributing to meaningful, current research?

Pre and post surveys were implemented in the General Biology B lab course to better understand:
1. How students' confidence in lab and research skills changed over the duration of the course
2. How relevant students think this course is to their careers and to the scientific community at-large

Methods

- The pre and post survey questions were grouped in three categories: (1) lab skills and scientific thinking, (2) relevance of course to career goals and future research, and (3) demographics
- Two additional questions were asked in the post survey relating to student contributions to current research
- 202 pre-survey and 176 post survey results were analyzed using R (version 3.4.2)
- An ordinal regression was fit to confidence scores using gender (i.e. male or female), time (i.e. pre or post), and question (e.g. confidence in reading literature or forming hypotheses) and all possible interactions. We included a random effect of survey ID to account for non-independence of student responses. Likelihood ratio tests were used to evaluate the significance of model terms
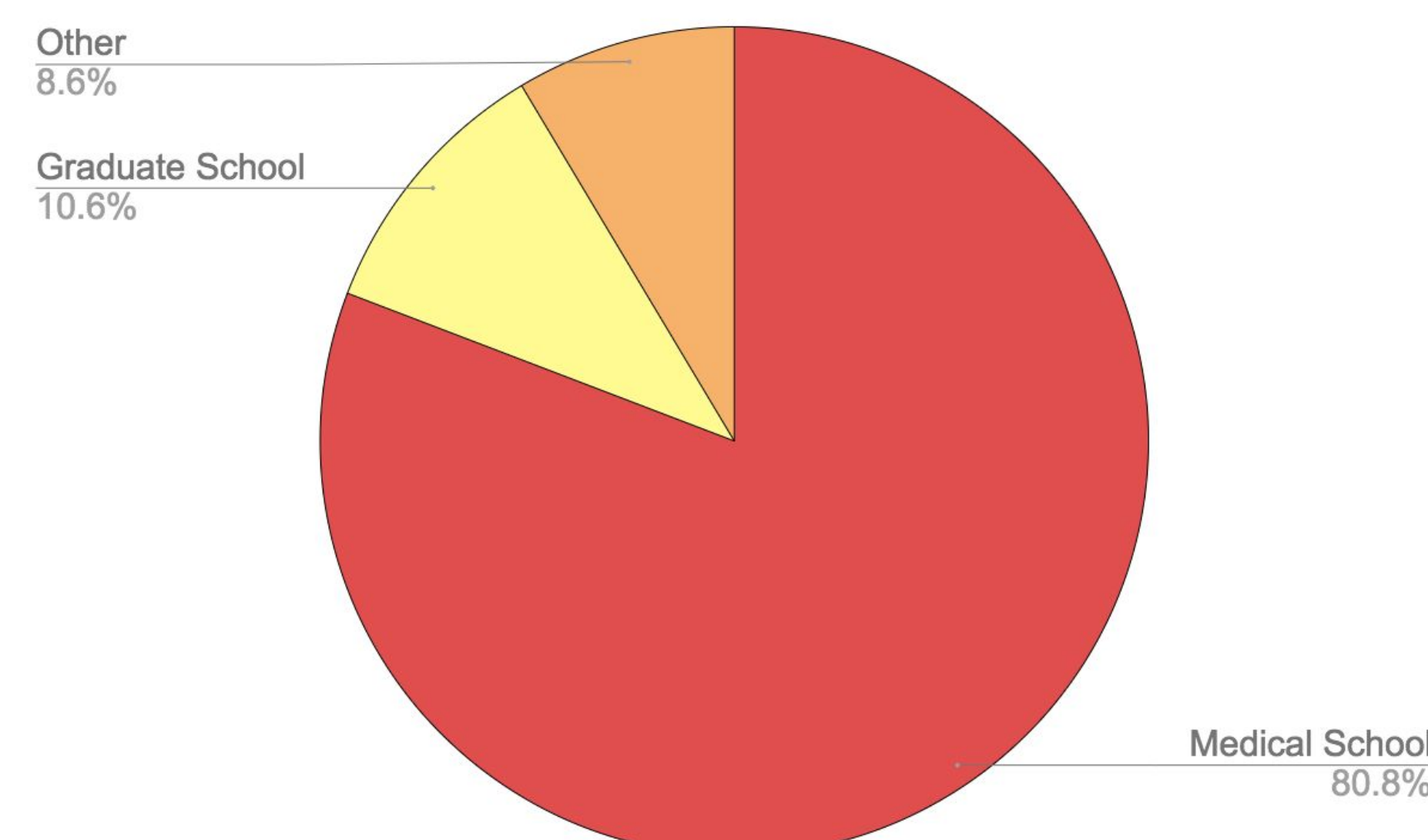
Figure 1. Pre-survey. Future career paths of students in course. 81% intend to go to medical school, 11% intend to go to graduate school, and 9% have other career plans.
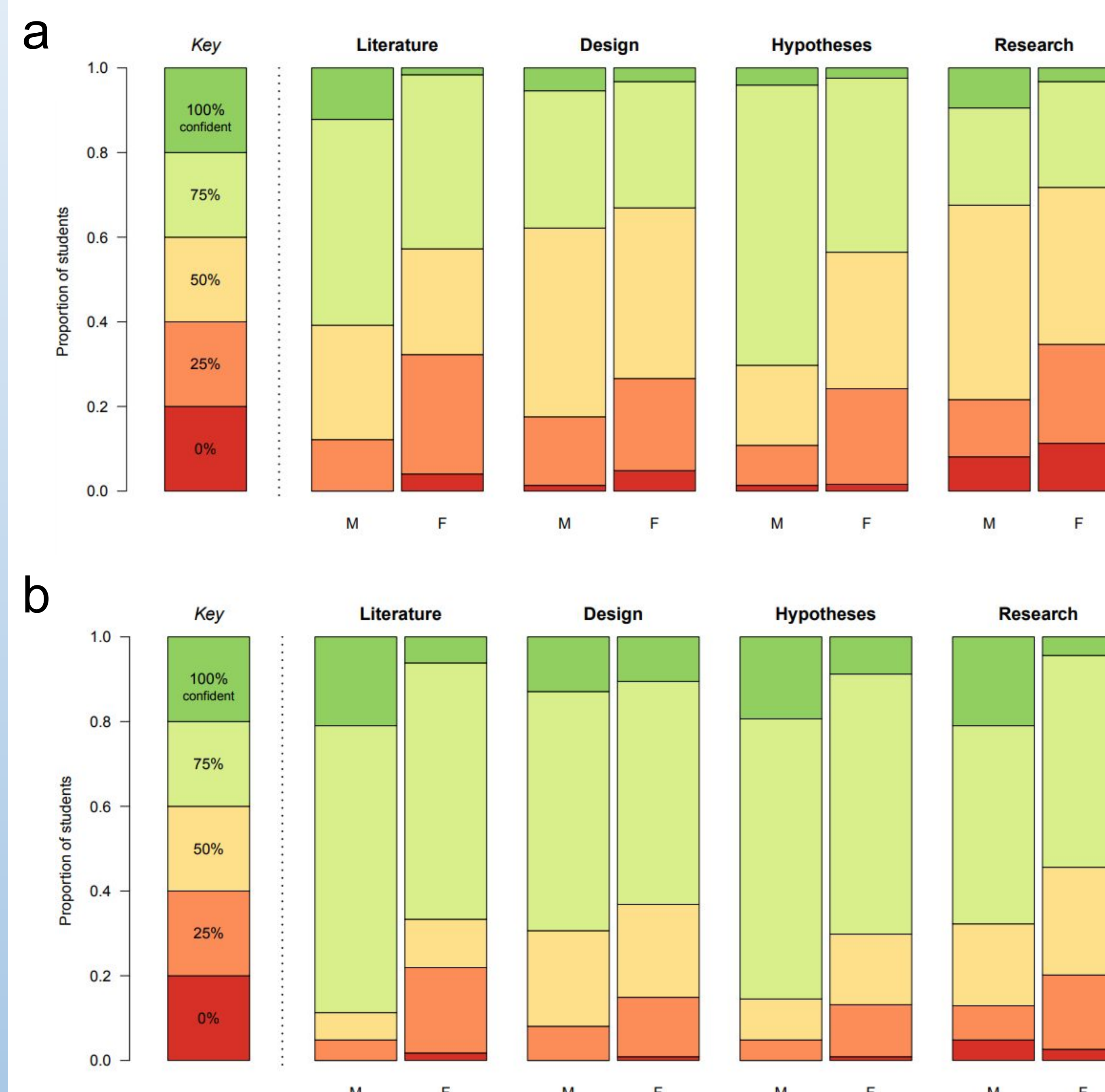
Figure 2. (a) Pre and (b) post-survey. Male (M) and female (F) confidence levels in reading scientific literature, designing experiments, creating hypotheses, and conducting their own research. There was a significant gender by question interaction ($p=0.001$), meaning that the size of the gender disparity varies depending on the question. Males have higher confidence overall, averaged across questions ($p<0.001$).
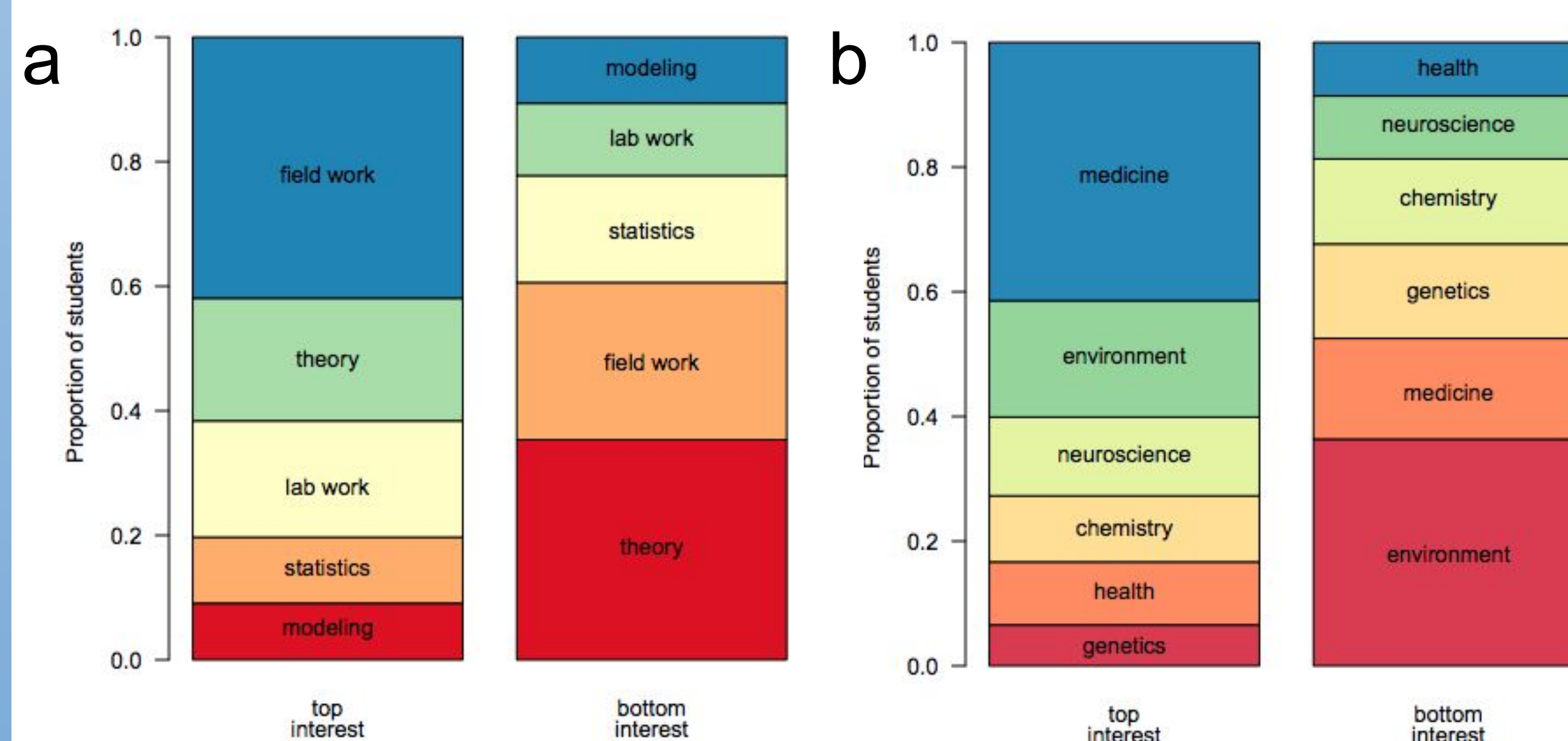
Figure 3. Pre-survey. (a) Top and bottom scientific *approaches* students are interested in. Field work was the top approach and theory the bottom. (b) Top and bottom scientific *applications* students are interested in. Medicine is the highest interest, and environment is the lowest.
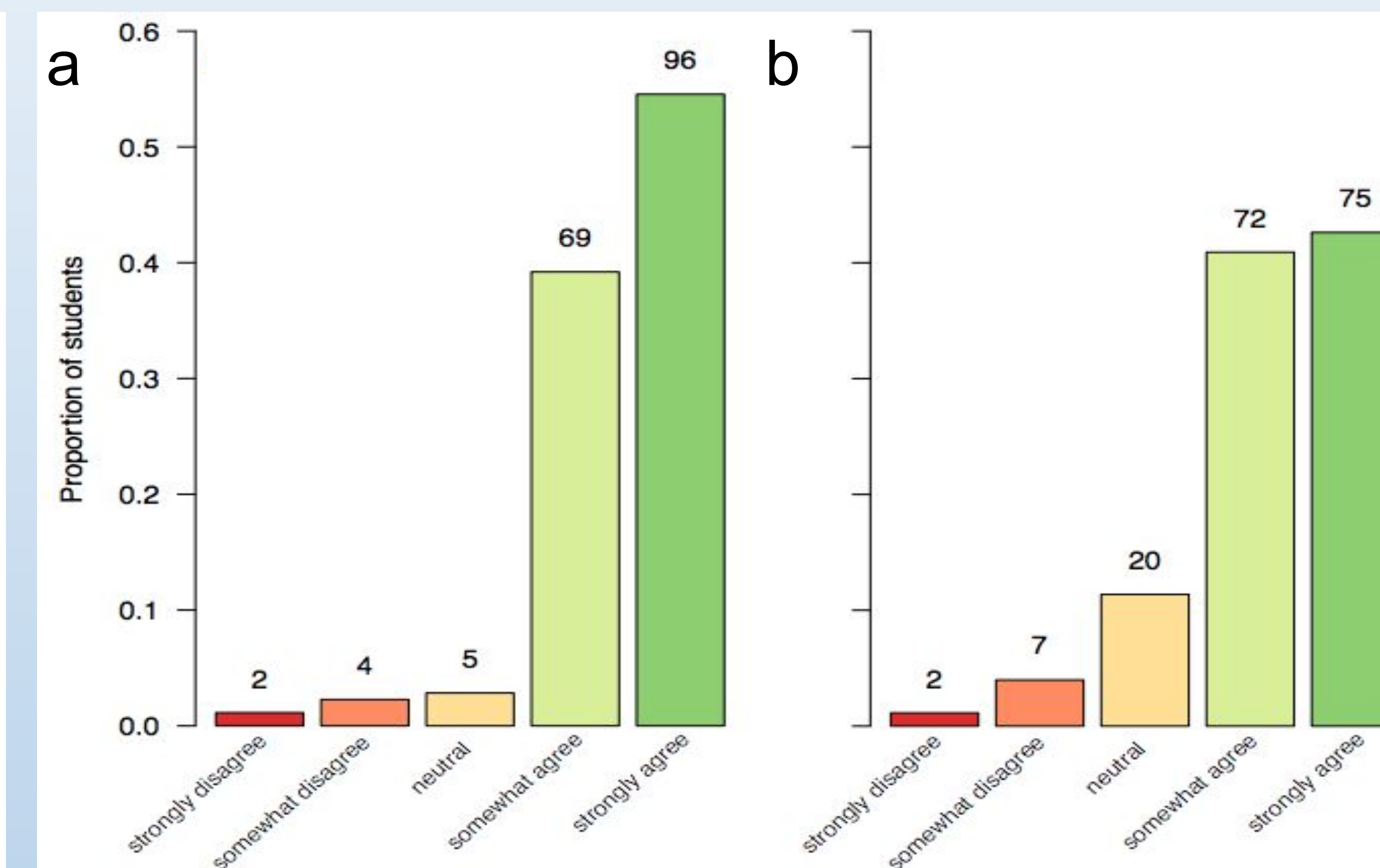
Figure 4. (a) Students' sentiments on whether the course is relevant to current research. (b) Students' sentiments on whether they felt they had contributed to advancing current research.

Discussion

Confidence in Skills
- Males have significantly higher confidence than females in reading literature, forming hypotheses, and conducting independent research.
- Students were more confident in their research skills post-survey than pre-survey ($p<0.001$).

Relevance and Contribution
- 93.8% of students felt that the lab course was relevant and up-to-date with current research
- 83.5% of students felt that the they had contributed to advancing current research through their own experiments

Future Directions
- Learning outcomes will be assessed in conjunction with student self-assessments

Acknowledgments