

Online lab simulations influence student perceptions of microbiology



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Introduction

Microbiology literacy is defined as understanding the relevance of microbes in everyday life, not just in disease (Timmis, 2023). It is as important to the understanding of human health as it is to the health of animals, agriculture, as well as the intersection of these, or One Health. Earlier in 2024, ASM published its revised Recommended Curriculum Guidelines for Undergraduate Microbiology, in which “impact of microbes” is included in the list of fundamental statements (Allen et al., 2024).

Many students who take microbiology come in with previous and often incorrect perceptions of microbes. These perceptions can change as the student engages with microbes during an in-person class, but there is little data to suggest that online labs can also change student perception of the significance of microbes in society. With the increase in online enrollment, it is important to examine attitudes and perceptions of microbiology’s role in the idea of One Health, particularly as many of these students are pre-nursing and pre-allied health. Though many studies assess student success using online virtual labs, as well as investigate how students feel about using online virtual labs, there are few that explore the differences in student understanding of the importance of microbes to the overall health of the planet (Brockman et al., 2020; Fidiastuti et al., 2024; Finne et al., 2022).

This study aims to elucidate to what extent online virtual labs impacted student perceptions of and attitudes toward microbiology. We conducted the study at a small rural community college that offers instruction in different modalities: online or in-person. Each modality of instruction had a different lab experience, online virtual or hands-on. We hypothesized that there would be a difference in perception of and attitudes toward microbiology.

Methods

Using the OECD Framework (attitudes, values, skills, and knowledge; Fidiastuti et al., 2024) as reference, we created a novel survey to measure student attitudes and values as they relate to microbiology and its impact on human, animal, and environmental health.

Data were analyzed using R.

Results

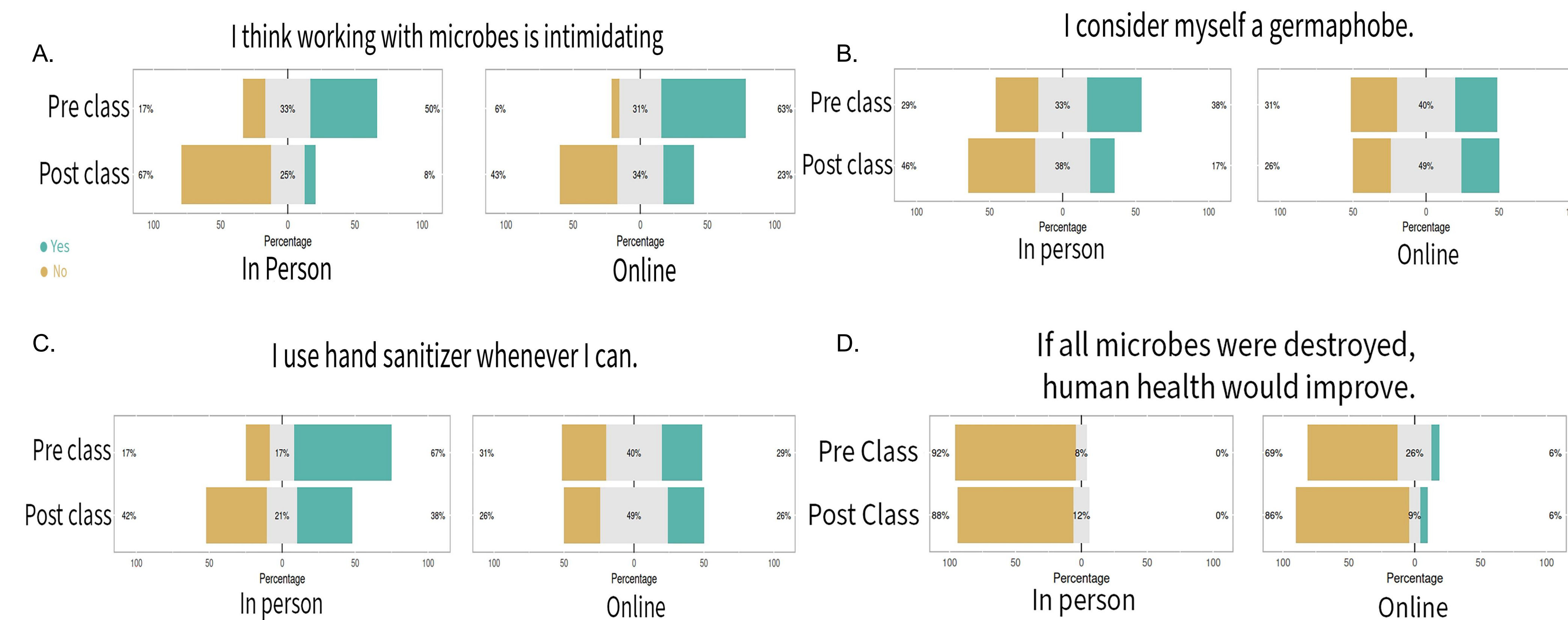


Figure 1. Select Likert results from the Impacts Survey. The survey was given pre- and post-class to determine if there is a change in student understanding/perception of microbes. The survey asked if the student agreed with the statement, did not agree, or was neutral about the statement. Data are separated by type of lab: in-person or online. Paired t-tests were performed between pre- and post-class data of each question. A) There was a significant decrease in students' intimidation of using microbes before and after lab, regardless of type of lab. B) There was a significant decrease in students identifying as a germaphobe in the in-person class; however, the online students' attitudes regarding this did not change. C) There was a significant decrease in the in-person students who claim they will use hand sanitizer; the online students did not show this same decrease. D) Online students showed a significant decrease in agreement with the statement that all microbes should be destroyed; however, there are still students who believe they should be destroyed. In-person students' attitudes on this question did not change; however, these students did not agree that microbes should be destroyed even pre-class.

Changes in overall perception of microbes pre- and post-class based on modality of labs

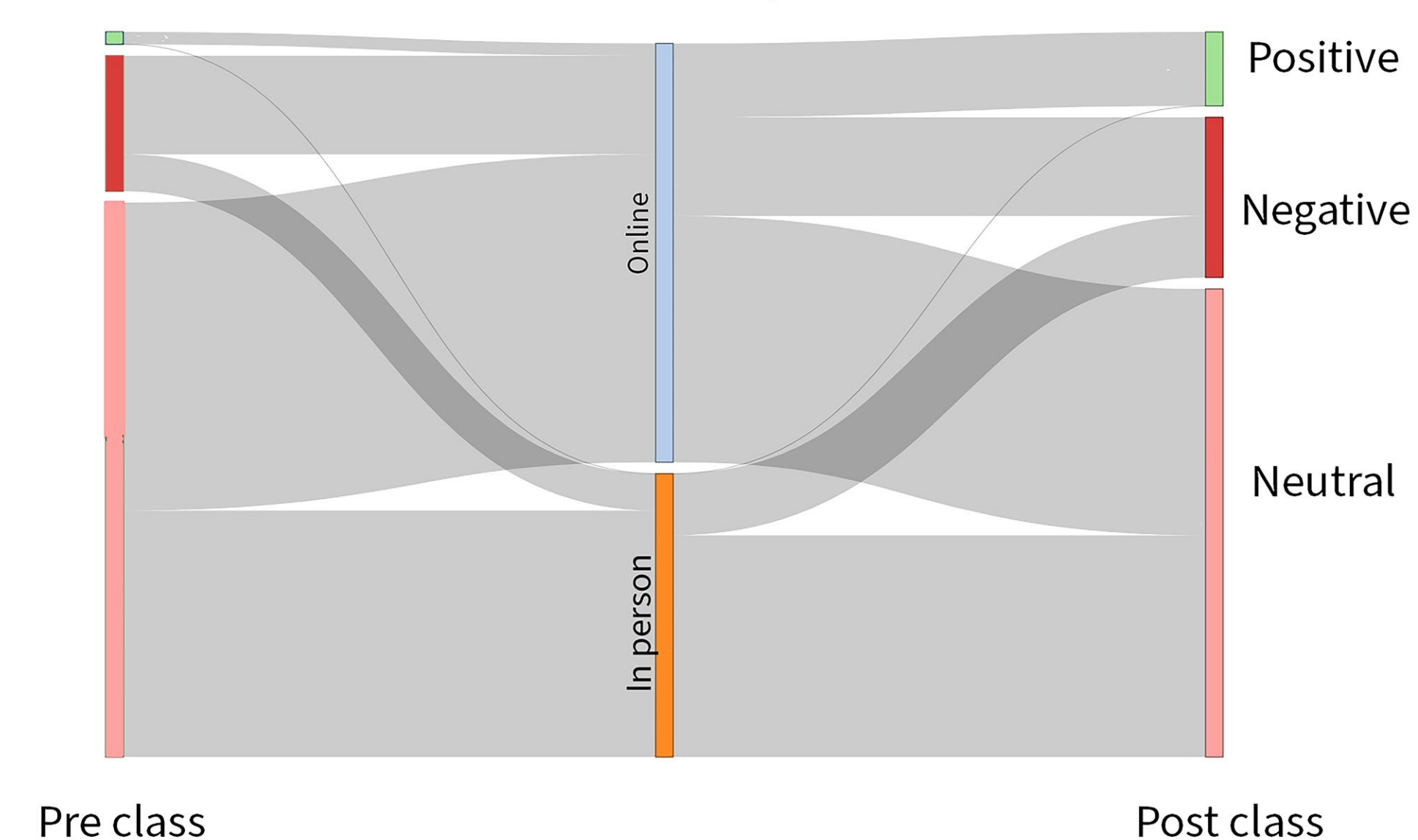


Figure 2. Overall, students start class with a neutral outlook of microbes, though online students tend to have more of a negative perspective at the beginning of the class. Online students change their perception of microbes from negative to positive more than in-person students.

Table 1. Demographics of participants (n = 58)

Category	Demographic	n	%
Gender	Female	47	81
	Male	11	19
Class standing	First year	21	36
	Non-first year	37	64
	18 - 24	32	57
Age	25 - 34	11	19
	35 +	15	26
	Yes	53	91
Employed ^a	No	5	9
	Yes	53	91
Previous biology ^b	0 - 2	42	72
	3 +	16	28
	Modality	Online	35
	In-person	24	40

Demographics were self-reported

^a Employed indicated any student who worked any amount
^b Previous biology meant any previous college-level biology

Conclusions

Overall, there is a change in perception of microbiology and microbes after taking a microbiology course.

There is a greater impact to the attitudes if the student is taking the class face-to-face rather than online; however, the online students do gain understanding of microbes by participating in the virtual labs

The decrease in students' intimidation factor with regard to using microbes is a positive result across all types of the sections, indicating that the virtual labs can create some positive impacts on student microbiology literacy.

Interestingly, the in-person students showed a much larger shift post-class when self-identifying as either a germaphobe or hand sanitizer user, indicating an investment in understanding microbiology rather than being intimidated by microbes.

Online students' decrease in their agreement with the statement that all microbes should be destroyed is a positive achievement in furthering literacy.

Taken together, these results show that both in-person and virtual labs can change perceptions of microbes, though the in-person component is a strong driver of this change.

Limitations of these data include small sample size.

Future Directions

- Student interviews to determine themes associated with microbiology hesitancy
- Expand to test the survey instrument with a larger sample size
- Comparing at-home hands-on labs to virtual labs
- Combining these data with the MCI and measuring skills to determine an overall understanding of how students' attitudes, knowledge, and skills vary based on the type of microbiology instruction

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