Call on me! Undergraduates' perceptions of voluntarily asking questions in front of large-enrollment science classes

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Background

Eliciting student participation by giving students the chance to voluntarily ask questions is a common way for instructors to engage students in the college science classroom. While this method is primarily used in small-enrollment classes, it is also used in upwards of 15% of large-enrollment classes (Lund, et al., 2015). While some studies have linked voluntarily asking questions to student engagement and enhanced learning (e.g. Crone, 1997; Junn, 1994), we know of no studies that have documented students' perceptions of the benefits and drawbacks of this teaching practice, particularly in the context of large-enrollment science courses.

Which students ask questions? One study in biology has demonstrated that women are less likely to ask questions than men (Aguillon, et al., 2020), although another study found that men and women ask questions at equal rates (Eddy & Hogan, 2014). Additionally, the literature suggests that non-native English speakers, underrepresented minority students, and first-generation students may be less likely to speak up in class (Loftin, et al., 2010; White, 2011; Eddy and Hogan, 2017). Further, students who have greater fear of negative evaluation (FNE), or who are worried about being judged by others, are likely asking fewer questions than their peers with lower FNE (Cooper, Downing, et al., 2018; Downing, et al., 2020).

To our knowledge, no studies have specifically explored student perceptions of the benefits of asking questions and what discourages students from asking questions in front of the whole class in large-enrollment college science courses. Further, no studies have examined whether student demographics predict their perceptions.

To fill this gap in the literature we asked the following research questions:

1. To what extent and why do undergraduates perceive other students voluntarily asking questions is helpful in large-enrollment science classes?

2. How frequently do undergraduates report asking questions in large-enrollment science classes during a semester and what discourages students from asking questions?

Methods

This study was conducted as part of a course-based undergraduate research experience (CURE) in spring 2020. In the CURE, 19 UCF students worked collectively to develop the research questions and create the survey, as well as collect and analyze the data.

In fall 2019, we conducted exploratory interviews with 50 science undergraduates to understand what motivates them to and discourages them from asking questions in front of large-enrollment science classes. These data served as pilot data for the survey.

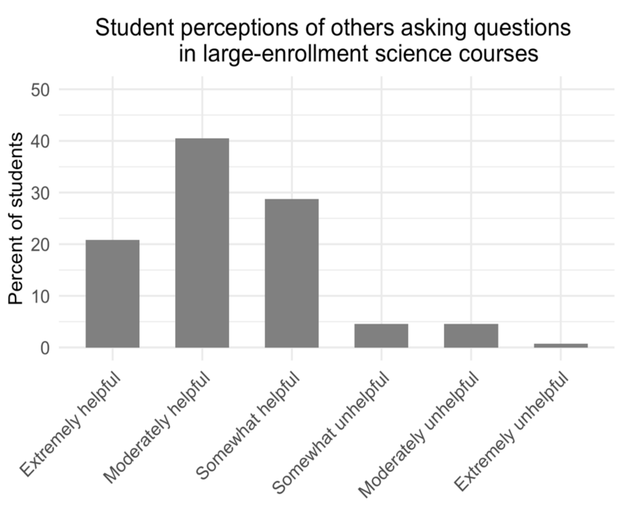
In spring 2020, the CURE class surveyed 417 students from 11 science classes at an R1 institution.

On the survey, students answered a 6-point Likert-scale question about the extent they feel it is helpful when others ask questions (extremely unhelpful to extremely helpful). Students were presented with reasons why they might perceive asking questions to be helpful, which were developed from the pilot interview. They were asked to select all reasons that applied to them. Students were then asked a Likert-scale question about, on average, how often they volunteer to ask questions in large-enrollment college science classes during a semester (never, not often (1-2 times), somewhat often (2-3 times), fairly often (4 times or more)). After, students were presented with a list of factors that might discourage them from asking questions in class that were developed from the pilot interviews. Students were asked to select all factors that applied to them. Finally, students answered a series of questions about their demographics and about their fear of negative evaluation (how much they worry about what others think of them).

Using binomial logistic regression we tested whether student demographics predicted the extent to which they perceived asking questions as helpful (vs unhelpful), whether they were more likely to select a particular reason why they perceived asking questions as helpful, how frequently they reported asking questions (never asked a question vs asked a question), and whether they were more likely to select a particular factor that discouraged them from asking questions. In the model, we included demographics that we predicted might influence student experiences (e.g. model: reported reason yes/no ~ gender + race/ethnicity + college.generation + year.in.college + comfort.speaking.english + FNE + GPA).

Results

To what extent and why do undergraduates perceive other students voluntarily asking questions is helpful in large-enrollment science courses?



Over 90% of students reported that they felt it was helpful when others ask questions to their instructor in front of others in their large-enrollment college science courses, while only 9.8% said It was unhelpful.

First-generation college students were 5.1x more likely to perceive that others asking questions to their instructor in front of others in their large-enrollment college science courses is helpful compared to continuing generation college students. We did not identify any other significant demographic differences.

Table 1. Of students who reported that they perceive asking questions to be helpful, percent and demographic differences in who selected each reason that they perceive asking questions to be helpful.

Reasons students perceive other students asking questions is helpful to them	% (n)	Summary of demographic differences of which students selected each reason
I sometimes have the same question	96.0% (361)	Students with high fear of negative evaluation (FNE) were more likely to select this reason.
Other students' questions sometimes help me clarify my thinking	83.2% (313)	No significant differences
I sometimes feel uncomfortable asking questions myself	77.7% (292)	Women and students with high FNE were more likely to select this reason.
Other students' questions sometimes give me a different way of thinking about the material	73.1% (275)	URM students and students with higher GPAs were more likely to select this reason.
Other students' questions sometimes break up the lecture, which keeps me engaged in class	42.0% (158)	No significant differences

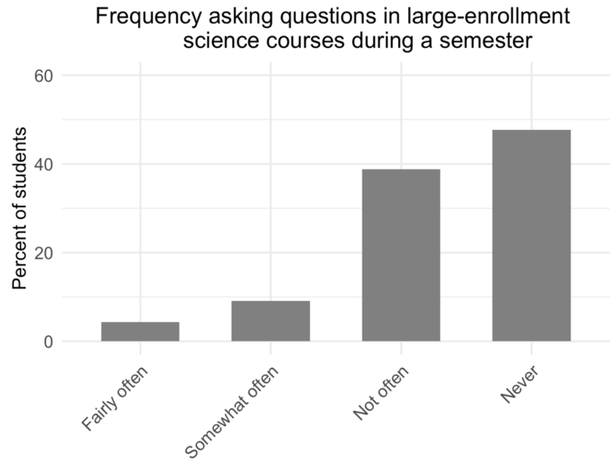
Logistic regression was used to test to what extent student demographics predict whether a student would select a particular reason for why they perceived other students asking questions in large-enrollment classes is helpful. All significant findings are summarized in the last column of the table. We only included students in these analyses who reported that they felt other students asking questions is helpful (n = 376). No student reported that none of the factors applied to them.

Demographics

Gender identity		**Comfort speaking English**		**Year in college**	
Woman	68.3%	Extremely comfortable	88.2%	First year	23.7%
Man	30.7%	Moderately comfortable	7.4%	Second year	36.5%
Declined to state	1.0%	Slightly comfortable	3.1%	Third year	22.3%
Race/ethnicity		Slightly uncomfortable	1.0%	Fourth year +	17.5%
URM*	29.0%	Moderately uncomfortable	0.0%	**Frequency of fear of negative evaluation (FNE)**	
White	46.5%	Extremely uncomfortable	0.2%	All the time	12.2%
Asian	15.3%	**College generation status**		Most of the time	21.1%
Other	6.7%	First-generation	39.1%	Sometimes	36.7%
Declined to state	2.4%	Continuing generation	57.8%	Rarely	23.0%
Average GPA	3.6	Declined to state	3.1%	Never	7.0%

*We collapsed students who identify as Black or African American, Hispanic, Latino/a or of Spanish Origin, American Indian or Alaska Native, and Pacific Islander into one category: underrepresented minority or URM students. These students share the experience of being underserved by institutions of higher education. We acknowledge that the experiences of these students are different, but the small sample sizes necessitated that we pool these identities as a single factor in our analyses.

On average, how often do students report asking questions in large-enrollment science courses during a semester and what discourages students from asking questions?



Nearly half of the students who we surveyed (47.7%) reported that, on average, they never ask questions to their instructor in front of others in their large-enrollment college science courses during a semester.

Women were 2.4x more likely than men to report on average never asking a question to their instructor in front of others in their large-enrollment college science courses during a semester. We did not identify any other significant demographic differences.

Table 2. Of students who reported never asking questions, percent and demographic differences in who selected each reason that discourages them from asking questions in large-enrollment science courses.

Reasons that discourage students from asking questions in large-enrollment science courses	% (n)	Summary of demographic differences of which students selected each reason
I feel anxious when I ask questions	74.9% (149)	Women, students who have been in college longer, and students with high fear of negative evaluation (FNE) were more likely to select this reason.
I can look up the answer to my question myself	66.3% (132)	No significant differences
I worry others will judge me	64.3% (128)	Students with high FNE were more likely to select this reason.
I have the option of asking my questions to other students during class	58.8% (117)	No significant differences
I don't know the material well enough to ask a good question	55.3% (110)	Students with high FNE were more likely to select this reason.
I have the option of asking the instructor my question outside of class	53.3% (106)	No significant differences
It would take away from other students' class time	36.2% (72)	No significant differences
Another student will likely ask my question	23.1% (46)	No significant differences
I don't think I will get a detailed enough answer to my question during class due to limited time	22.1% (44)	Students who have been in college longer are more likely to select this reason.

Logistic regression was used to test to what extent student demographics predict whether a student would select a particular factor that discourages them from asking questions in large-enrollment college science classes. All significant findings are summarized in the last column of the table. We only included students in these analyses who reported on average never asking questions in large-enrollment college science classes (n = 199). No student reported that none of the reasons applied to them.

Conclusions

- Over 90% of students perceived that other students asking questions to their instructor in front of others in large-enrollment college science courses is helpful to them
- First-generation college students were more likely than continuing generation college students to perceive others asking questions to their instructor in front of others in large-enrollment college science courses is helpful to them
- Nearly half of students reported that, on average, they never ask questions to their instructor in front of others in large-enrollment college sciences courses during a semester
- Women, on average, were more likely than men to report never asking questions to their instructor in front of others in large-enrollment college science courses during a semester