The Relation between Students' Sense of Belongingness, Gender, and Their Resistance to Active Learning

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Abstract

In this study, we examined the relation between university students' sense of course-level belongingness and their affective and behavioral response to active learning, theorizing that students' affective response would mediate the relationship between their sense of course-level belongingness and their behavioral response. Additionally, we examined the moderating influence of students' gender identity on all three constructs. Our results did not support the theorized mediating influence of students' affective response on the relation between students' belongingness and their behavioral response. In addition, we found that, despite mean differences in belongingness, affective response, and behavioral response, there were few gender differences in the pattern of relations. For both female- and male-identifying students, belongingness predicted both students' affective and behavioral responses. These findings suggest that course-level belongingness plays an essential role in how students respond to active learning and that fostering an atmosphere that supports belongingness may benefit all students.

1. Introduction

Engineering education has long understood the importance and value of instructional practices that invite students to construct rather than passively receive knowledge – broadly referred to as "active learning" [1]. Despite the benefits of active learning, researchers have found that students do not always respond well or participate in these classroom activities [2]. Instead, students may experience a negative *affective response*, feeling negatively towards the activity or failing to see its value [3] [4]. They may also have a negative *behavioral response*, becoming distracted [5] or not participating [7]. To better support students' affective and behavioral response to active learning, researchers [6] have begun examining factors that influence how students respond to active learning to identify potential points of inflection where targeted support and interventions might be particularly efficacious. Of particular interest has been classroom-level factors that can be addressed by instructors.

One key factor that may influence students' response to active learning is their sense of course-level belongingness [6] [8] [9]. A substantial body of research has found that, broadly, students' sense of belongingness is a key factor to a variety of student academic and well-being [11]. Sense of belongingness may be particularly important for students from historically underrepresented groups; for example, prior research has found that female-identifying students report that they feel less belongingness in STEM than their male-identifying classmates [12]. Within engineering education, belongingness has been studied at the level of discipline, major, and identity [13] [14], and recent research has begun to explore the importance of course-level belongingness across multiple academic fields [14] [15], with particular interest in STEM broadly [16] and engineering specifically [13] [14] [17]. Higher levels of course-level belonging has been related to increases in student motivation and participation [15] and associated with positive academic outcomes such as performance [16] [18]. These findings provide guidance for targeted interventions that instructors can implement to support students' participation, performance, and well-being [19]. However, prior research has typically focused on school/university belongingness or disciplinary belongingness [13] [14]. Researchers have rarely examined the importance of belongingness in the context of a single course.

Although students' disciplinary belongingness is important for their persistence and academic success, we argue that students' experience of belongingness can be as localized as their experience within an individual class and that this may impact their experience and engagement in that class. When researchers have examined the relation between students' course-level belongingness and their affective and behavioral responses [6], they have often not attended to course-level factors that may moderate these relations. Although this limitation has often been necessary given the difficulty of sampling students from enough courses to conduct the requisite hierarchical analyses to attend to these nested data structures, it has limited the generalizability of these findings in addition to potentially leading to bias estimates.

In this study, we build on prior theoretical research in engineering education [2] [20] and empirical research both within STEM education broadly [6] and engineering education specifically [13] [14] [17] to explore the impact of students' sense of course-level belongingness on their affective and behavioral response to active learning. Additionally, we statistically account for the nested data structure using Multilevel Structural Equation Modeling (MSEM [21]). Specifically, we answer the following research questions:

> RQ1: Does students' sense of course-level belongingness predict their affective and behavioral response to active learning in STEM classrooms?
>
> RQ2: Does students' affective response to active learning mediate the relation between their sense of course-level belongingness to their behavioral response?
>
> RQ3: Does students' gender identity moderate the relation between students' sense of course-level belongingness on their affective and behavioral response to active learning?

2. Theoretical Framework

We ground our analysis in contemporary theories of belongingness. Baumeister and Leary [8] posited that individuals must maintain a minimum number of lasting, positive, and significant interpersonal relations to fulfill this basic need. Although there is a general need for a sense of belonging, a situational and context-dependent sense of belongingness is also important [22] [23]. In academic settings, school belonging, or the extent to which students feel personally accepted, respected, included, and supported by others [24], may be critically important for a variety of academic outcomes [24]. Prior research within STEM disciplines indicates that a greater sense of school belongingness positively relates to engagement [17] and performance [25].

In higher education, a substantial body of literature has explored the importance of institutional belongingness [26] [27]. Although an understudied area of research [28], researchers have begun to explore the importance of university students' sense of belongingness within a specific course [6] [15] [16]. However, much of the prior research on belongingness has focused on the influence of active learning on students' sense of belongingness [29] [30]. When the focus of the research shifts from the activities themselves to considering students' responses to these activities, a more complex model in which students' beliefs influence their response to active learning may be explored. Qualitative studies have demonstrated that students who do not feel they belong in a course [31] may be less willing to engage in classroom activities, suggesting that the students who may benefit the most from engaging in active learning may be the ones who are least likely to do so. Emerging research has found that higher levels of course-level belonging have been related to increases in student motivation and engagement and are associated with positive academic

outcomes such as performance [6] [16] [18]. Unfortunately, less has been studied regarding the relation between students' course-level belongingness and how they respond to active learning [2] [6]. We argue that, as an affective construct, the relation between students' belongingness and behavioral outcomes will be mediated by the students' affective response to active learning [2].

Additionally, research has only rarely examined the relation of students' sense of course belongingness simultaneously across multiple courses and in a variety of STEM disciplines. In this study, we look at these relations in 175 different university classrooms at 64 different institutions across a wide range of STEM courses. The findings from this study provide insight into the relation between students' sense of course-level belongingness on their affective and behavioral response to active learning while providing insight into the moderating influence of the nested data structure.

3. Methods

3.1. Participants

Student participants (n = 1,649) were recruited from STEM classes taught by 175 instructors from a national sample of 64 colleges and universities, including 36 faculty who taught at an Associates college, 33 who taught at a Baccalaureate college, 43 who taught at a Master's college or university, and 63 who taught at a Doctorate-granting university. Faculty came from a range of disciplines, including 82 in science, 27 in engineering, and 66 in math/computer science. As part of the survey, students were asked to provide demographic information; we present this information in Appendix 1. Given their small n (< 2%), students who identified as "Transgender," "Gender Non-conforming," "Something else" or "Unsure," were excluded from the present analysis due to methodological limitations.

3.2. Procedures

Following research procedures approved by the IRBs at the institutions overseeing this research project, instructors were asked to distribute anonymous online surveys to students immediately following a class period in which the instructor indicated they had used active learning. For this project, we defined active learning as "…a course-related activity other than listening and taking notes, such as group work or solving problems individually." Faculty reported a specific active learning activity from the specific class, with examples ranging from "think, pair, shares," to group hands-on "student group work." Surveys included all required elements of informed consent consistent with the revised common rule. Each instructor was provided a unique link to track the course from which students responded. Students completed the survey via an online survey platform (i.e., Qualtrics).

3.3. Measures

Survey measures included students' course-level belongingness [6] [9] and affective and behavioral response to active learning (StRIP; [2]). Students were instructed to respond to all items in the context of the course in which the surveys were distributed and the instruction that happened on the day the surveys were distributed. All subscales from the StRIP questionnaire prompted participants to reflect on the class activities in which they were asked to engage during a specific class period. Additionally, students self-reported their gender identity. We present all measures used in the present study in Table 1 and descriptive statistics and correlations between measures for all students and by students' gender identity in Table 2.

Table 1.

Abbreviations & Sample Items for Measures

Measure	Abbreviation	Sample Item
Belongingness	BEL	"I have a sense of belongingness in this class."
Affective Response	AR	"I enjoyed the activities."
Behavioral Response	BR	"I participated actively in the activities."

Table 2.

Means, SD, ICC, and Within- and Between-group Correlations for Variables Overall and by Student Gender-identity.

	Group	Mean	SD	1	2	3
	All	5.38	1.70	.12	0.69	0.57
1. Belongingness	Female	5.39	1.68	.17	0.76	0.84
	Male	5.44	1.67	< .01	0.51	0.33
	All	5.76	1.35	0.36	.12	0.88
2. Affective Response	Female	5.84	1.25	0.30	.15	0.82
	Male	5.68	1.43	0.42	.07	0.97
	All	6.06	0.79	0.29	0.34	.12
3. Behavioral Response	Female	6.14	0.78	0.22	0.30	.10
	Male	5.98	0.77	0.39	0.40	.01

Notes. Within-group correlations are presented in the bottom triangle, Between-group correlations presented in the upper triangle, and ICCs reported on the diagonal. All parameters significant at $p < .05$.

Students' course belongingness was measured using six items designed to ground students' sense of belongingness in a specific academic course [6] [9]. The scale included three positively-worded items (e.g., "I have a belongingness in this class.") and three reverse-coded negatively-worded items (e.g., "I feel like an outsider in this class") measured on a 7-point Likert-type scale with values ranging from 1 (not at all true of me) to 7 (very true of me). Internal consistency for the six belongingness items was excellent; $\alpha = .88$.

Students' affective response was measured using two subscales from the StRIP instrument [2] – students' sense of positivity and value for active learning activities used in class. Positivity was measured using three items, asking students to evaluate the degree to which they felt positively towards the classroom activities (e.g., "I enjoyed the activities") and were measured on a 7-point Likert-type scale with values ranging from 1 (strongly disagree) to 7 (strongly agree). Internal consistency for our positivity measure was acceptable, $\alpha = .83$. Value was measured using three items asking students to evaluate the degree to which they found the activities to be of value (e.g., "I saw the value of today's activities") and were measured on a 7-point Likert-type scale with

values ranging from 1 (strongly disagree) to 7 (strongly agree). Internal consistency for our value measure was high, α = .92. Both subscales were averaged together in order to create a score for students' affective response.

Students' behavioral response was measured using two subscales from the StRIP instrument [2] – students' self-reported participation and distraction during the active learning activities. Participation was measured using four items asking students to self-report the degree to which they actively participated in class activities (e.g., "I participated actively in the activities") and were measured on a 7-point Likert-type scale with values ranging from 1 (strongly disagree) to 7 (strongly agree) Internal consistency for our participation measure was acceptable, α = .79. Distraction was measured using four items asking students to self-report the degree to which they were distracted or distracted their classmates (e.g., "I distracted my peers during the activities") and were measured on a 7-point Likert-type scale with values ranging from 1 (strongly disagree) to 7 (strongly agree). Internal consistency for our distraction measure was acceptable, α = .81. To average the two scales together, we reverse-coded students' sense of distraction so that higher values would be associated with less distraction. After reverse coding, the two scales were averaged together to create a score for students' behavioral response.

3.4. Analyses

We tested all hypotheses using Multilevel Structural Equation Modeling (MSEM) using Bayesian estimation to evaluate the indirect effect of students' course belongingness on their behavioral response through their affective response in MPlus v.8.3 [32]. MSEM extends the strengths of traditional structural equation modeling while attending to hierarchical data structures such as students nested within classes [21]. MSEM affords additional advantages over traditional multilevel regression models in that the variance of level 1 variables are decomposed into latent within- and between-group components, removing the need to center them [21]. Additionally, group means are treated as latent, correcting for measurement unreliability and yielding unbiased estimates at Level 2 [33] [34]. We used Bayesian Estimation because prior research has demonstrated that it may outperform traditional frequentist approaches, particularly with complex models [35]. We present our tested model in Figure 1.

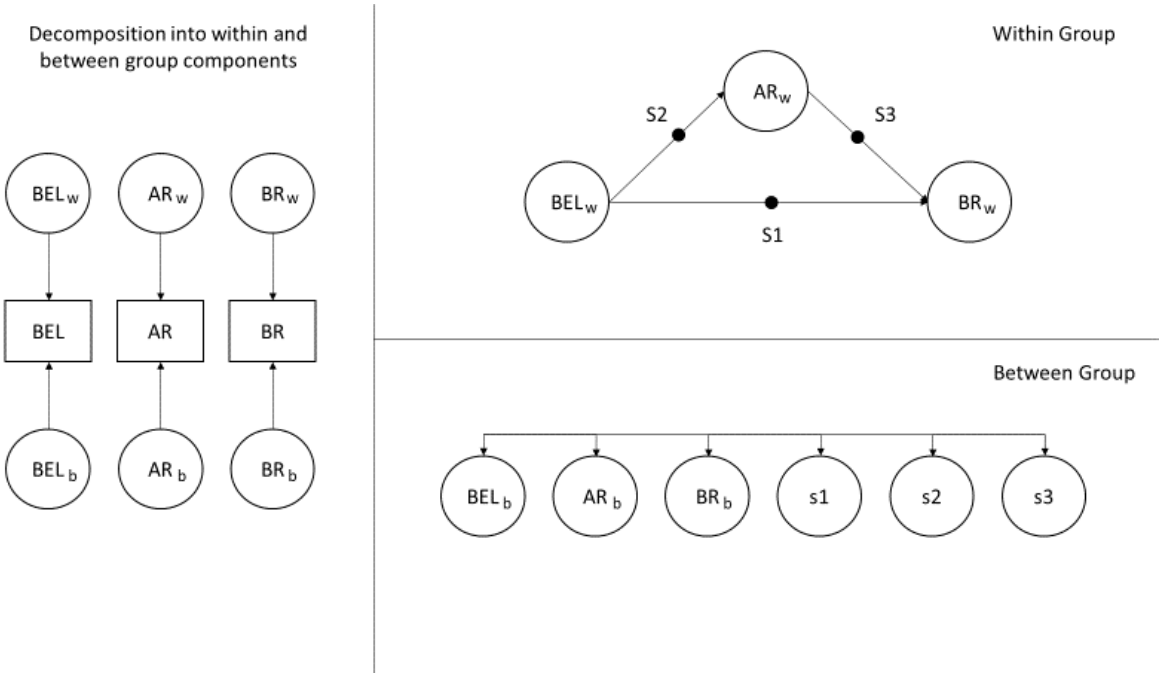

Figure 1. *Path diagram for Theorized Multilevel Indirect Effect Model with Random Slopes.*

In this study, we modeled the indirect effect of students' sense of course belongingness on their behavioral response through their affective response at level 1. We allowed both intercept and slope for variables to randomly vary across groups. At level 2 (between-groups), we modeled the correlation between random intercepts and slopes. We used Mplus default priors (i.e., uninformative prior distributions) for our model estimation. Following the recommendation for evaluating model fit for MSEM model with random slopes using Bayesian estimation, we compared Deviance Information Criterion (DIC) for our theorized model ($Model_2$) with neighbor models, including a model with correlated factors at level 1 and random intercepts at level 2 ($Model_0$) and a model testing the indirect effect of belongingness on students' behavioral response at level 1 and only random intercepts at level 2 (Model1). We evaluated gendered-differences using measurement invariance by fitting models for female- and male-identifying students and compared parameter estimates.

4. Results

We present model comparison between our theorized model ($Model_2$) and neighboring models in Table 3 and unstandardized parameter estimates for our best-fitting models in Table 4.

Table 3.
Model Fit Statistics for Theorized and Neighbor Models.

	# Parameters (D)	Estimated Parameters (pD)	DIC	ΔDIC
All Students				
$Model_0$	15	148.92	10,963.89	
$Model_1$	15	145.03	10,958.31	-5.58
$Model_2$	30	253.15	10,895.76	-62.55
Female-identifying				
$Model_0$	15	131.30	5,328.47	
$Model_1$	15	134.94	5,329.91	1.43
$Model_2$	30	238.82	5,274.73	-55.18
Male-identifying				
$Model_0$	15	80.69	4,680.84	
$Model_1$	15	85.71	4,680.04	-0.81
$Model_2$	30	180.32	4,647.24	-32.80

Notes. DIC - Deviance Information Criteria. ΔDIC – Change in DIC from neighbor model, lower values suggest improvement to model fit. $Model_0$ – Level 1 correlation only model. $Model_1$ – Random intercept and fixed slope model. $Model_3$ – Random intercept random slope model.

Table 4.

Unstandardized Parameter Estimates (Posterior SD) for Indirect Effect Multilevel Model.

	All Students	Female-identifying	Male-identifying
Means			
BEL	5.45 (0.06)	5.39 (0.08)	5.53 (0.07)
$Variance_{BEL}$	0.22* (0.05)	0.46* (0.12)	0.19* (0.07)
AR	5.87 (0.05)	5.93 (0.07)	5.81 (0.08)
$Variance_{AR}$	0.19* (0.04)	0.29* (0.07)	0.31* (0.09)
BR	6.11 (0.04)	6.17 (0.05)	6.03 (0.05)
$Variance_{BR}$	0.08* (0.02)	0.11* (0.04)	0.12* (0.05)
Within-group parameters			
BEL → BR (s1)	0.16* (0.03)	0.15* (0.05)	0.23* (0.07)
$Variance_{s1}$	0.02* (0.01)	0.11* (0.04)	0.04* (0.02)
BEL → AR (s2)	0.30* (0.03)	0.23* (0.05)	0.35* (0.07)
$Variance_{s2}$	0.06* (0.02)	0.07* (0.04)	0.13* (0.05)
AR → BR (s3)	0.25* (0.04)	0.23* (0.06)	0.23* (0.05)
$Variance_{s3}$	0.03* (0.01)	0.08* (0.04)	0.12* (0.05)
Indirect effect BEL → AR → BR	0.06* (0.02)	0.04 (0.03)	0.04 (0.05)
Between-group parameters			
BEL ↔ AR	0.13* (0.04)	0.23* (0.07)	0.14* (0.07)
BEL ↔ BR	0.06* (0.03)	0.12* (0.05)	0.06* (0.04)
AR ↔ BR	0.10* (0.03)	0.12* (0.04)	0.16* (0.04)
BEL ↔ s1	0.03 (0.02)	0.07 (0.06)	0.01 (0.03)
BEL ↔ s2	0.03 (0.03)	0.03 (0.05)	0.02 (0.05)
BEL ↔ s3	0.01 (0.02)	-0.01 (0.05)	0.02 (0.05)
AR ↔ s1	0.01 (0.02)	0.05 (0.04)	-0.02 (0.03)
AR ↔ s2	-0.02 (0.02)	-0.05 (0.03)	-0.03 (0.05)
AR ↔ s3	0.02 (0.02)	< 0.01 (0.04)	0.03 (0.05)
BR ↔ s1	-0.01 (0.01)	-0.04 (0.03)	-0.01 (0.02)
BR ↔ s2	-0.01 (0.02)	-0.01 (0.02)	-0.02 (0.04)
BR ↔ s3	0.01 (0.01)	0.04 (0.03)	-0.01 (0.03)
s1 ↔ s2	< 0.01 (0.01)	-0.01 (0.03)	0.02 (0.03)
s1 ↔ s3	-0.01 (0.01)	-0.06* (0.03)	-0.05* (0.03)
s2 ↔ s3	-0.02 (0.01)	-0.01 (0.02)	-0.04 (0.04)

Notes. BEL – Belongingness. AR – Affective Response. BR – Behavioral Response. * $p < .05$.

We found that both overall and for the models with both female- and male-identifying students, the model including the indirect effect of belongingness on students' behavioral response through their affective response with random intercept and slope outperformed all other models. We present standardized (over cluster) within-group parameter estimates in Figures 2. We found a significant direct effect of belongingness on students' behavioral response, $b = 0.16$, 95% CI [0.10, 0.21], $p < .01$. Additionally, we observed a significant direct-effect of belongingness on students' affective response, $b = 0.30$, 95% CI [0.23, 0.36], $p < .01$. In turn, students' affective response had a significant direct-effect on their behavioral response, $b = 0.25$, 95% CI [0.18, 0.32], $p < .01$. We also observed a small but statistically significant indirect effect of students' belongingness on their behavioral response through affective response; $b = 0.06$, 95% CI [0.02, 0.09], $p < .01$.

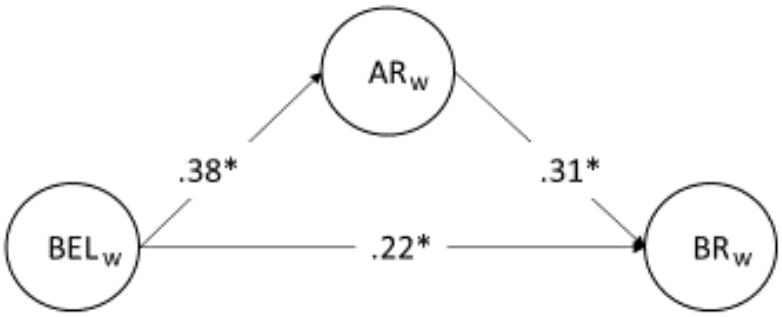

Figure 2. *Path Diagram with Standardized Parameter Estimates for Within-subject Relations for All Participants.*

When comparing the results for female- and male-identifying students, we observed that female-identifying students reported lower sense of belongingness ($\bar{x} = 5.39$, $SD = 0.08$) compared to their male-identifying classmates ($\bar{x} = 5.53$, $SD = 0.07$). Conversely, female-identifying students were higher in both affective ($\bar{x} = 5.93$, $SD = 0.07$) and behavioral ($\bar{x} = 6.17$, $SD = 0.05$) response to active learning compared to male-identifying students affective ($\bar{x} = 5.81$, $SD = 0.08$) and behavioral ($\bar{x} = 6.03$, $SD = 0.05$) response. Overall, however, we found the pattern of relations to be largely similar for both female- and male-identifying students. We did observe that the direct effect of belongingness on students' behavioral response was greater for female-identifying students ($b = 0.15$, 95% CI [0.05, 0.25], $p < .01$) compared to male-identifying students ($b = 0.23$, 95% CI [0.13, 0.33], $p < .01$). The influence of belongingness on affective response was similarly less strong for female-identifying students ($b = 0.23$, 95% CI [0.12, 0.33], $p < .01$) when compared to their male-identifying classmates ($b = 0.35$, 95% CI [0.13, 0.33], $p < .01$). However, there was little difference in relation the influence of affective response on behavioral response for female- ($b = 0.23$, 95% CI [0.12, 0.34], $p < .01$) and male-identifying students ($b = 0.23$, 95% CI [0.09, 0.38], $p < .01$). Interestingly, we did not find the indirect effect of belongingness on students' behavioral response through their affective response to be significant for either female- ($b = 0.04$, 95% CI [-0.01, 0.09] $p = .06$) or male-identifying students ($b = 0.04$, 95% CI [-0.05, 0.14], $p = .20$). This may be due to the significant negative correlation between random slope term for the relation between belongingness and their behavioral response and the relation between their

affective response and behavioral response for both male- (r = -.70, 95% CI [-.92, -.03], $p < .01$) and female-identifying students (r = -.66, 95% CI [-.93, -.14], $p < .01$).

5. Discussion

In this study, building on prior theoretical research in engineering education [2] [20] and empirical research both within STEM education broadly [6] and engineering education specifically [13] [14] [17], we examined the relation between students' course-level sense of belongingness and their affective and behavioral response to active learning in STEM classrooms. This study was novel for examining the influence of students' course belongingness on their response to active learning and the use and modeling of a large sample from a variety of STEM courses across multiple disciplines.

Overall, we found that students' sense of course belongingness predicted both their affective response and behavioral response to active learning. These findings support prior research on active learning [6] [36] and suggest that course-level factors play an important role in how students respond to student-centered teaching practices. Students' sense of course-level belongingness was significantly related to both how they felt (i.e., affective response) and responded (i.e., behavioral response) to the active learning activities in which they were asked to participate. Given the substantial body of research from education broadly [37] and engineering education specifically [1], regarding the value of participation in active learning, these findings suggest that supporting students' sense of course-level belongingness may have a substantial impact on students' persistence and performance in their courses. Prior studies have found several instructor behaviors and classroom practices that support students' sense of course-level belongingness [15] [38], including instructor enthusiasm and tone, availability, and setting a tone of mutual respect among classmates. The findings from this study suggest that in addition to the broad range of well-being and other academic outcomes [11], implementing these and similar classroom practices to support students' sense of belongingness may also increase students' sense of positivity and perception of the value of active learning, leading to increased participation and decreased distraction.

Although we did observe that, overall, students' sense of belongingness predicted both their affective and behavioral response to active learning, we did observe significant variance in our latent slope terms and significant covariance between our random intercepts between courses. This finding suggests that although this pattern generally held, there was significant variability across the wide range of courses present in our sample. The significant correlations at the course level between students' sense of belongingness, their affective response, and their behavioral response suggest systematic differences in these factors at the course levels – courses with students who report higher levels of course belongingness also have students who reported more feelings of positivity and value for active learning activities in the course as well as greater participation and less distraction during the activities. Further research to understand the discipline and course-level factors that influence the differences in these patterns of relations is needed.

Additionally, we tested the degree to which students' affective response to active learning mediated the influence of belongingness on their behavioral response. Although we did observe a small but statistically significant indirect effect when looking at all participants, when we independently examined these relations for female- and male-identifying students, we did not see a significant result. Our findings suggest that in classrooms where there was a greater direct effect of students' course-level belongingness on their behavioral response, the indirect effect through affective response would be attenuated. This would further support the need for additional research

examining classroom characteristics, unaccounted for in this study, that moderate the relation between these factors.

Finally, we examined the degree to which students' gender identity moderated these relations. We found, as anticipated, male-identifying students experienced greater belongingness in STEM courses. However, there were only minor differences in the strengths of the relations between factors. This suggests that fostering an atmosphere that supports belongingness may be beneficial for all students by improving their affective and behavioral responses to active learning.

There were several limitations to the present study. First, data were collected cross-sectionally, so inferences regarding the directionality of relations are derived theoretically rather than from temporal precedence. Future longitudinal research should be conducted to examine the directionality of these relations and the potential dynamic interplay between belongingness, affective response, and behavioral response to active learning. Longitudinal research is especially warranted given the proposed mediation, as without temporal precedence testing these relations, it is not possible to establish true mediation. Second, data were collected from students who were willing and able to engage in this research project, creating a potential response bias. Future research should consider different recruitment, incentive, and sampling methods in order to ensure the generalizability of these findings. Third, we were unable to examine classroom-level factors that may potentially moderate or explain the observed differences between classes. Future research should look at what classroom factors explain the observed classroom-level differences we observed in this study.

6. Conclusion

In this study, we examined the relation between university students' course belongingness and their affective and behavioral response to active learning. Additionally, we examined the moderating influence of students' gender identity. We found that, despite mean differences in belongingness, affective response, and behavioral response, there were few gender differences in the pattern of relations. For both female- and male-identifying students, course belongingness predicted both students' affective and behavioral responses. However, the results did not support the theorized mediating influence of students' affective response on the relation between students' belongingness and their behavioral response. These findings suggest that belongingness plays an essential role in how students respond to active learning and that fostering an atmosphere that supports belongingness may benefit all students.

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Appendix 1.

Demographic Information for Student Participants.

	Female	Male	Transgender	Gender non-conforming	Something else	Unsure	No Response	Total
Asian or Pacific Islander	66	60	0	1	0	1	0	128
Black or African American	29	21	0	0	0	0	1	51
Native American or Alaskan Native	4	2	0	2	0	1	0	9
White Non-Hispanic	400	358	5	17	6	13	0	799
White Hispanic	23	26	0	0	0	0	0	49
Multiracial	55	42	0	1	3	2	0	103
Other Racial or Ethnic Identity	43	26	0	2	1	2	0	74
No response	3	7	0	0	0	0	426	436
Total	623	542	5	23	10	19	427	1,649