

Messages that foster a sense of belonging improve learning and satisfaction; an experiment in an online environment

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The literature in pedagogy has shown that having a sense of belonging affects learning (Murphy et al., 2020; Walton and Cohen, 2011). Like engagement, belonging can be fostered through learner-to-learner, learner-to-content, or learner-to-instructor interactions. However, the most critical interaction for belonging is that between the professor and the student (Martin and Bolliger, 2018).

This paper shows the result of a communication experiment in an online environment. For five consecutive terms (N=143), the instructor taught Introduction to Statistics using a set of learning strategies: retrieval practice, alignment of objectives, and a well-organized course. The instructor added a more direct communication strategy during two of those five terms (n=58). She used weekly communications that linked course material with current events discussed by students the previous week and a personal message tailored to each student. This intervention was meant to communicate to students that they are being heard and are valued and respected. The messages contributed to solving cognitive challenges identified in the literature of Teaching Economics: student mental mindset and student fear and mistrust (Chew and Cerbin, 2021).

The differences in differences analysis resulted in improved learning, measured by better grades in Exams and Discussions, and more enjoyment of the course, measured by student comments. The result is most significant for weaker students. Presumably, more vulnerable

students increased the amount of effort invested in statistics as a result of the messages as suggested by Allgood and McGoldrick (2020). This experiment took place in Summer 2020, Fall 2020, Spring 2021, Summer 2021, and Fall 2021 during the COVID-19 pandemic.

I. Teaching Online Economics

Decades of research and practice in online learning had a tremendous use due to COVID. The course where this experiment takes place is designed to be online from its origins. Unlike the example used in Cacault et al. (2021), this is not a live stream of an in-person Lecture. The course fulfills the characteristics of excellence in online learning as described by Martin et al. (2019). The course is aligned by learning outcomes, (Allgood and Bayer, 2017); the course utilizes retrieval practice (Roelle et al., 2022)¹, and uses a systematic design process (Martin et al., 2019).

Communication when teaching online is of particular importance since the format requires intentional and directed notifications via messages, videos, or other electronic means (Martin and Bolliger, 2018). The main strategies to strengthen the learner to instructor engagement are suggested to be: regular messages (emails, texts, announcements) (Martin and Bolliger, 2018; Dixson, 2010), and instructor feedback on assignments (King, 2014), including rubrics ((Martin and Bolliger, 2018). The treatment that the instructor uses in this experiment improves the regular, weekly messages. The treatment directly affects learner-instructor engagement. Depending on the message and the student preferences and characteristics, it can also affect learner-to-content engagement.

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¹Retrieval practice is the strategy of trying to remember concepts or performing skills instead of passively reading or listening about them.

Finally, the literature in teaching economics has “opened a black box”, in the words of Allgood and McGoldrick (2020), by dissecting a cognitive framework that allows economic educators to understand the learning process. Chew and Cerbin (2021) identify nine cognitive challenges and by doing so, provide clarity on the “black box”, the way learning happens. Students face several cognitive challenges; “fear and mistrust” is the third challenge. A student who feels out of place or afraid is less likely to thrive in the learning process. Few efforts have been conducted in the Economics literature to promote inclusion and diversity strategies. Al-Bahrani (2022) and Bayer et al. (2020) claim that establishing a supporting class climate that builds a sense of belonging is the first principle to foster diversity and inclusion in the economics classroom. The instrument presented in this paper attends to the challenge of fear and mistrust and fosters inclusion in the classroom.

II. The Experiment

From the first day of classes, every Monday, the instructor sends a message to students to tell them about the material covered each week and remind them to complete the assignments.

The weekly message delivered during the control periods follows the format below: All names are hypothetical to preserve the privacy of students.

Hello Class,
This week you are introduced to three new concepts: sampling, experiments, and ethics in the use of data. Here is the list of assignments for this week:

By Thursday at 11:59 pm:

- Complete Problem Set 5
- Post a Comment on the Discussion on ethics and the use of data.

By Sunday at 11:59 pm:

- Complete Quiz 6
- Respond to a peer in the Discussion on ethics and the use of data.

I am here in case you need me, Professor.

The treated weekly message had a different format:

Hello Class,

Sometimes we just get it. We do our readings, and exercises, watch videos, solve the quizzes, and get things done.

However, sometimes we struggle because R did not get installed correctly (Jason), or because we are traveling to the other side of the world (Sophia), or because we had a birthday to celebrate (Roan), or we are working a lot (Jeff and Brian), you name it. This week is like no other; you are introduced to three new concepts: 1) Sampling, 2) Experiments, 3) Biases in sampling and experiments.

Given what you discussed in the past two weeks, I think you might be interested in learning a bit more about Behavioral Economics and how it's related to statistics.

Here is the list of assignments for this week:

By Thursday at 11:59 pm:

- Complete Problem Set 5
- Post a Comment on the Discussion on Biases

By Sunday at 11:59 pm:

- Complete Quiz 6
- Respond to a peer in the Discussion on Biases

Thank you for inspiring the topic of biases. I am here in case you need me, Professor.

The treatment message's main features are: 1) A record is kept to ensure every student is mentioned in the general announcements by name at least once. 2) The professor uses the comments from the previous week to steer the direction of the examples and discussions in the following week. Therefore, the dialogue is current and tailored to this particular cohort. 3) Finally, the professor allows herself to enjoy the conversation; she 'speaks' to students and believes they listen.

In the treated group, there is also a personalized message that is sent as soon as the midterm is graded.

Hello Cooper,

It is refreshing to have your opinion through the discussion posts! I wonder how you are feeling (Cooper reported being sick before). This message is to reach out to you as we head to the second part of the course.

You have turned in most assignments on time, and your current grade is a B-. I like your strategy of consistently solving quizzes. To further improve, try solving all the exercises as well; even if you don't succeed 100%, they still count and allow you to practice. Also, review the videos where I solve problem sets because those videos match up closely with the content on quizzes.

If you struggle with the weekly work or just want to check in, visit me during office hours (day, time, and link), and we can discuss your questions.

I may not often reach out to you directly, but know that I am paying attention to you.
Professor.

Each student in the treated group received one personalized message while the control group did not. The main features of the personalized message are: 1) The professor intentionally conveys the message that she is trying to see who they are, and 2) The professor gives a practical strategy to improve the grade. The essential message is: "I see who you are, and I value and respect you, and I want to share this learning experience with you."

III. Data

The population served by this online course is primarily male (86%), with 21 females out of 143 students. The national average of male Economic Majors is 63% (Bayer and Wilcox, 2019). The racial composition in this course is 58% white. 35% are international students, some from Europe (2), New Zealand (1), and Latin America (3), but mostly from Asia (44). There was only one African American in the control group and one in the treatment group.

Motivational and behavioral processes explain which students are more likely to select online courses instead of face-to-face (McPartlan et al., 2021). This self-selection responds to competing responsibilities such as family or work. However, our students are all younger than 24, mostly men and mostly full-time students. The demographic composition of online students in this particular university has been consistent since 2019 and is likely influenced by the COVID Pandemic. The treatment and con-

trol groups hold statistically equal demographics (Table 1).

The content and materials of the course were designed from the beginning and were not modified during the time of the study. The Final Exam contains 30 questions randomly chosen from a test bank that covers all the material of the course. Each question is randomly chosen from among five possibilities of similar questions.

IV. Econometric Specification

The econometric specification for student i is (1)

$$Final_i = \gamma_0 + \gamma_1 Treated_i + \gamma_2 Summer_i + X_i' \beta + \varepsilon_i$$

Where *Final* is the final exam grade; *Treated* is 1 when the student is part of the control group; β_i is a vector of parameters to be estimated, and ε_i is the error term. This equation tests the effect of the treatment on students' cumulative final exam scores.

The vector X contains elements that control for student ability and also demographics. For lack of a better measurement of skill, the control for student ability is the grade of the first assignment, *ex1*. The demographic controls are '*female*', '*international*,' and '*White*.' The treated groups are the Spring and Summer 2021 terms, while the control groups are Summer and Fall 2020, and Fall 2021. To make sure there is not a learning curve by the professor, I add a time trend. Finally, I add controls for the terms that take place during the summer.

I then explore a differences-in-differences model where I analyze exercises, quizzes, discussions, and exams. I assume that the first exercise, the first quiz, and the first discussion are the previous untreated observations. I also assume that the midterm can be considered the previous observation. However, the midterm takes place after at least seven messages. Therefore a simple t-test rejects the hypothesis that the midterm grade is the same between the treated and control groups.

Then, I assume that the last exercise, the last quiz, the last discussion, and the cumulative final exam are the posterior observations. I find that the means of all exercises and quizzes are statistically equal. I find differences in the Final Exam, the Midterm, and the last discussion.

TABLE 1—COVARIATES TREATED VS CONTROL

variable	combined N=143	(N)	control n=85	(n)	treated n=58	(n)	p-value
	proportion		proportion		proportion		
Female	0.146 (0.03)	21	0.117 (0.03)	10	0.189 (0.05)	11	0.35
International	0.349 (0.04)	50	0.341 (0.05)	29	0.362 (0.06)	21	0.79
White	0.58 (0.04)	83	0.6 (0.05)	51	0.55 (0.06)	32	0.56
African Amer	0.013 (0.009)	1	0.012 (0.12)	1	0.017 (0.017)	1	0.78
Hispanic	0.055 (0.02)	8	0.023 (0.02)	2	0.103 (0.04)	6	0.06

*P-value evaluates H_0 : treated-Control=0
standard deviation in parenthesis

TABLE 3—GRADES TREATED VS CONTROL

variable	combined N=143	control (n=85)	treated (n=58)	p-value
	mean	mean	mean	
Exercise 1 grade	83 (1.88)	84 (2.6)	82 (2.7)	0.50
Midterm Exam	75.7 (1.3)	73.6 (1.7)	78.0 (1.8)	0.04
Final Exam	73.9 (1.6)	71.3 (2.1)	77.7 (2.2)	0.04

*P-value evaluates H_0 : treated-Control=0
standard deviation in parenthesis

The differences-in-difference estimation is not significant as we compare the first and the last exercise nor the first and the last quiz. However, it has a positive effect on exams and discussions. As expected, only the discussions have a significant result.

V. Results

There is no statistical difference between cohorts in demographics or ability. In this section, I show the results of the regressions as well as a brief analysis of the student's comments on the Teaching Evaluation.

A. Quantitative Analysis

The main regression shows that the effect of the treatment has an impact of 6 out of 100 points in the cumulative final exam grade. Those students who belonged to the cohorts that received personalized, tailored messages had on average six more points on the Final Exam than their counterparts in the control group.

As expected, the term when the course was taken (summer or not), the student's ability (exercise 1), gender, racial group, or being international do not affect the Final Exam Grade.

There are several possibilities to explain why students in the treatment group are doing better in the Final Exam. The messages we used in this experiment lessen the fear and mistrust for the professor and the material (Chew and Cerbin, 2021). They also promote a sense of belonging. However, these personalized messages also give practical feedback to help students improve their learning strategies. While we cannot establish which of these mechanisms is at work, we can assume that all of these factors may influence students' behavior. Finally, the experiment is not double-blind. The instructor knows which sections got treated and which didn't. Even though the exams are automatically graded by Canvas, there could be subconscious processes when giving the final exam grade that could have influenced the result.

When being addressed and nudged to study, students put more effort into studying, translating into a better grade on the Final Exam and richer class discussions. The t-tests from the comparison of means show that the midterm already has some difference between treatment and control. In this case, the only valid difference in difference estimation is the discussion.

This result is expected since discussions are

TABLE 4—DIFFERENCE IN DIFFERENCE ESTIMATION

	(1) diff_exer	(2) diff_quiz	(3) diff_exams	(4) diff_discuss
treated	-0.373 (-0.72)	-0.215 (-0.47)	1.072 (0.36)	2.657* (2.33)
_cons	-0.219 (-0.71)	-0.521 (-1.94)	-2.211 (-1.02)	0.812 (1.31)
N	143	143	143	143

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 5—EFFECT OF TREATED ON FINAL EXAM

	(1) final	(2) final	(3) final	(4) final	(5) final
treated	6.362* (2.05)	5.873* (2.03)	9.752* (2.18)	9.630* (2.11)	9.994* (2.17)
summer		8.381* (2.78)	6.482 (2.03)	6.396 (1.96)	6.074 (1.81)
ex1			0.500 (1.31)	0.493 (1.30)	0.515 (1.32)
time			-2.314 (-1.40)	-2.296 (-1.40)	-2.651 (-1.54)
female				1.336 (0.27)	1.037 (0.20)
intnl					-3.041 (-0.53)
white					-5.997 (-1.09)
_cons	71.38*** (33.36)	67.54*** (23.55)	64.57*** (8.67)	64.54*** (8.68)	69.68*** (7.15)
N	143	143	143	143	143

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

F-test for all covariates except treated:

F(6,136) = 0.86 Prob > F = 0.51

the forum where human interaction occurs in on-line asynchronous courses. Discussions are particularly prone to the effect of our intervention since they constitute the public media in which students interact with each other and the instructor.

B. Qualitative Outcome

At the end of each term, students comment on the course and the instructor through a Teaching Evaluation. Using the simple average of course evaluations, the treated courses received a higher grade than the control group.

When counting positive and negative comments, the control group has a ratio of 24 positives vs. 21 negatives, while the treated group has a ratio of 25 positives vs. 13 negatives. Overall, there was slightly higher student satisfaction when messages were delivered. This positive result in Teacher Evaluation can be because grades are slightly higher with the messages, and thus, students are happier. However,

the comments are explicit. For example, a student writes: ".this was a safe, respectful environment", "great learning environment," or "the professor cared for her students."

VI. Implementation Comments

This experiment was implemented online, where human interaction must be conveyed through intentional electronic messages. In a face-to-face format, online messages might have a weaker influence because the professor's behavior in class becomes the most important communication venue between student and instructor. Writing thoughtful weekly messages may not require much effort from the instructor other than a spreadsheet to make sure every student is addressed at one point or another. However, writing personalized messages can be time-consuming. The first personalized message might take about an hour to write, while each additional one might take about ten minutes. Judging from the box plot in figure

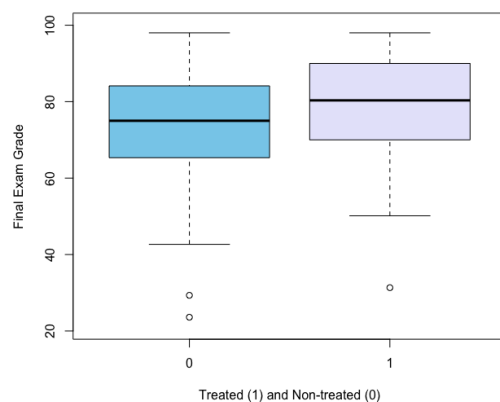


FIGURE 1. IMPACT OF TREATMENT ON FINAL EXAM

TABLE 6—AVERAGE COURSE EVALUATION

		Average
Summer 2020	Control	4.00
Fall 2020	Control	3.86
Fall 2021	Control	3.85
Spring 2021	Treated	4.50
Summer 2021	Treated	4.44

1, good students are good with or without messages. Still, assuming instructors have time constraints, it seems that weaker students will have higher benefits from personalized messages.

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