

Reducing Student Resistance to Active Learning Through Instructor Development: Project Update

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Introduction

This work-in-progress paper will provide an update on our research studying instructor development in science, technology, engineering, and mathematics (STEM) classrooms. The overall aim of this study is to increase the adoption of active learning in STEM classrooms. We define active learning as any time an instructor engages students in the course content in ways that go beyond simply lecturing to their students while their students are passively taking notes (e.g., think-pair-shares, in-class group projects). Previously, active learning has been shown to improve student retention rates, grades, and understanding of course material, particularly in those underrepresented in STEM [1-4]. Despite these positive outcomes, instructor adoption of active learning in STEM classrooms has been slow [5]. Past research into this slow implementation has shown that instructors often cite many different barriers towards enacting active learning, including: the time it takes to create activities, their ability to cover the entire syllabus, the efficacy of active learning, and the fear of student resistance [6-8]. For this study, we created an instructor development workshop to educate STEM instructors on what active learning is and ways to implement active learning into their classrooms. An additional goal of this workshop was to provide instructors with evidence-based strategies that focus on reducing student resistance to active learning.

Student resistance can be defined as any negative student reaction to active learning, including distracting others, giving lower course evaluations, or refusing to participate in the activity. Student resistance has been repeatedly documented in research focused on active learning in STEM courses and many researchers have offered advice on how to address this issue; however, until recently, little research has been done to empirically show which strategies were effective as well as what student responses have been towards active learning when these strategies have been employed. In a recent study by Tharayil, et al., researchers showed instructors could use two different types of strategies in order to reduce student resistance in their classrooms: explanation strategies, and facilitation strategies [9]. Additionally, a literature review by Finelli and Borrego suggests that planning strategies can also be effective [10].

Planning strategies are those that an instructor uses to think through an activity and its implementation. Some examples of these strategies include using student feedback from a previous activity or thinking through what did and did not work the last time they used it. Explanation strategies pertain to how an instructor describes the purpose of the activity as well as what is expected of students during the activity. This can also refer to how an instructor relates the activity to the student's assessments or overall learning. Facilitation strategies focus on how an instructor best engages a student during an activity, such as walking around the room during the activity to check on student progress, encouraging students throughout it, or leading a debrief following an activity. With these strategies in mind, our team set to develop and test an instructor development workshop as a way to teach instructors about the latest research in active learning, to introduce them to the strategies to reduce student resistance, and to help them plan to implement it in their own classrooms.

With this workshop, we seek to answer the following research questions:

- How does the workshop impact faculty attitudes towards active learning and their likelihood in using active learning?
- How does the workshop impact faculty's attitudes towards strategies, use of resistance strategies and student response to active learning?
- What is the effect of instructors' use of strategies to reduce resistance on student affective response and on student resistance to active learning?

Workshop Development

In the past year, much of the focus of this research project has been on refining a workshop that would help instructors to better understand active learning and ways in which they could implement it in their courses. We developed this workshop to specifically teach instructors on the strategies they could employ to reduce student resistance to active learning in their classrooms. Initially, this workshop was intended to be in person; however, with the onset of Covid-19, we developed this workshop to be conducted in an online format. In order to do this, we piloted our workshop three times and refined it after each session using instructor feedback for improvement. The process of developing this workshop can be found in our previous work [11]. The finalized workshop consisted of the following sections, which we detail below:

1. Introduction and an overview of the workshop's objectives
2. Definition of active learning
3. What the research tells us about active learning
4. Examples of active learning, followed by instructors breaking out into groups to create potential activities for their courses
5. Common mistakes in implementing active learning
6. Student responses to active learning (including student resistance)
7. Strategies for reducing student resistance (with examples of planning, explanation, and facilitation strategies)

At the beginning of the workshop, we set the tone with participants to ensure that they were comfortable asking questions of the moderators and to let them know that we encourage them to actively participate throughout the workshop. The workshop was set-up to demonstrate what active learning could look like, so we stopped frequently for activities that we asked the participants to take part in. For instance, after the introductions, we defined what active learning was for the participants. After spending a few minutes describing and giving examples of active learning, we had the participants do a poll on an activity to discuss whether or not it constituted active learning. From there we had participants discuss why they did or did not think the activity was active learning. We hoped to both model active learning for the participants as well as give them the space to create active learning activities for their own courses. Again, lack of time is often cited as a reason why instructors struggle to implement active learning in their classrooms, and we aimed to have a dedicated space in our workshop to allow them some time to think through their classes and how to improve them.

Once we ensured our participants understood what active learning was and had some ideas on what they would like to do in their own classrooms, we then shifted gears to talk about how they could actually implement it in their courses. For this, we began with discussing common mistakes instructors do when starting to implement active learning in their classrooms such as using trivial activities. This led into different responses that students might have to active learning. With this, we pointed to research that shows that most student responses are positive, but that faculty still worry about students resisting the activities [12-14]. We also gave participants strategies for potentially overcoming any student resistance. While showing them the research in this area, we asked participants to again brainstorm and volunteer their own strategies that they have used in the past that have worked for them. The workshop ended with participants being given additional time to come up with a plan that they believed would help them successfully implement active learning in their courses in the future. This was an overall synthesis of all of the workshop that had the goal of ensuring active learning adoption in their courses after they left the workshop.

Data Collection

In order to study the impact of this workshop, this study employed a randomized control trial (RCT) that focused on learning STEM instructors' attitudes and behavior towards using active learning in their classrooms as well as their use of strategies for reducing student resistance to active learning. In order to implement the RCT, we created and randomly assigned participants to one of two groups: 1) a group that received the workshop in the middle of the study (intervention group), and 2) a group that received the workshop only after data collection was complete (control group). An overview of the research design can be found in Figure 1. Instructors and students were surveyed a total of four and two times, respectively, throughout the course of this study with each survey using a Likert scale. An overall timeline for the data collection for this study can be found in Table 1 and we detail each step of the RCT below. All four instructor surveys were the same throughout the entirety of the study, with each section being validated prior to implementation [15]. The instructor survey sought to measure the following:

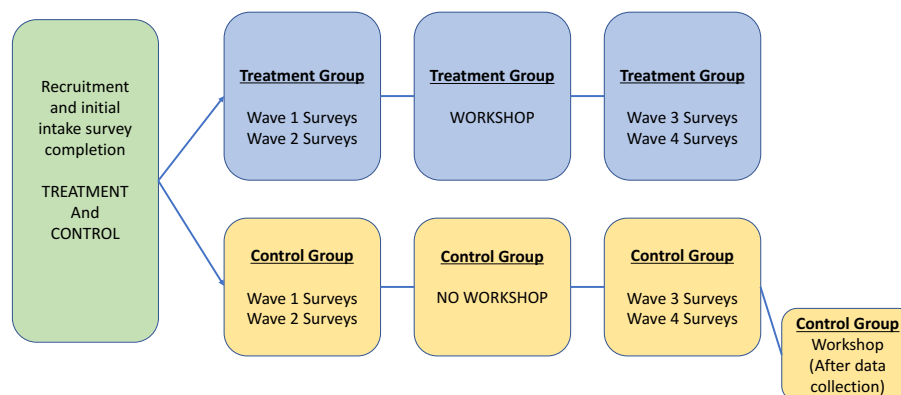


Figure 1: Research design

1. How an instructor is currently using active learning;
2. An instructor's self-efficacy in using active learning;
3. The value the place on using active learning in their classrooms;
4. An instructor's use of strategies for reducing student resistance,
5. How confident is the instructor in using these strategies;
6. An instructor's perceptions of student responses to active learning; and
7. The barriers they encounter when using active learning.

We developed the student survey in tandem so that the student survey was measuring similar items to the instructor survey. As the students were administered their survey around the same class period as their instructors, we hope to be able to compare the student responses to active learning to specific in-class active learning activities. The student survey measures the following:

1. How their instructor is using active learning;
2. Their instructor's use of explanation and facilitation strategies during active learning activities;
3. Their potential Behavioral and affective responses to active learning activities;
4. Their affective response to active learning activities;
5. Their self-efficacy towards the class materials and overall course; and
6. Their sense of belongingness in the class and STEM overall.

i. Recruitment

Before recruitment began, we reached out institutions across the US in order to ask for permission to collect data on their campuses. IRB and/or overall institutional approval were obtained for every school that we would eventually recruit from, and we ensured that we included a wide range of institutions, from community colleges to R1 institutions. We compiled a list of STEM instructors at each institute, and in the case of larger institutions, the department chairs or deans. From there, instructors were invited to apply during the summer of 2021. Incentives for this study were the opportunity to attend the active learning workshop and to earn up to \$250 for completing our surveys. Each applicant was assigned to one of four categories, based on their institutional type (as considered by the Carnegie Classification): Community College, Bachelors granting, Masters granting, and Doctoral granting so that we will be able to potentially learn any differences noted across these different institutional types. Within each category of schools, half of the participants were randomly assigned to a control group with the other half being put into the intervention group. In the end, we recruited approximately 170 participants from 60 different institutions from across the US.

Table 1: Timeline for data collection (2021-2022)

	August	September	October	November	December	January
Recruitment						
Wave 1						
Wave 2						
Intervention						
Wave 3						
Wave 4						

ii. *Pre-intervention Data Collection Waves*

All instructors were administered two surveys (Wave 1 and 2) prior to the active learning workshop. The Wave 1 survey was aimed to be administered in the first weeks of an instructor's semester/quarter. The language of this survey was slightly altered so that it focused on asking how an instructor planned their active learning implementation in the semester ahead and their feelings about active learning in general. The Wave 2 survey was focused on a single class activity of the instructor's choice. Again, the same questions were asked as the Wave 1 survey, but with slight alterations to the language so that it was applicable to only this class activity. Students were also surveyed in Wave 2 about the same class activity their instructor selected.

iii. *Intervention*

Two workshops were given in late October for the instructors selected for the intervention portion of the RCT. The workshops were conducted online, through Zoom, and were approximately three hours in length. The workshops used the same slides and moderators throughout in order to have them be as similar to each other as possible.

iv. *Post-intervention Data Collection Waves*

After the intervention was complete, we conducted two additional surveys, similar to the pre-intervention data collection. All instructors were again asked to select a class in which they planned to use an active learning activity, and the Wave 3 instructor and student surveys focused on that single class. The Wave 2 and Wave 3 surveys employed the exact same language. We conducted the final wave of surveys, Wave 4, at the beginning of the following semester and used the same language used in the Wave 1 survey with the goal of being able to learn any longer-term impacts of the workshop.

Table 2: Total number of instructor participants for each survey wave

Control	Wave 1	Wave 2	Wave 3	Wave 4
Community College	17	16	13	14
Doctoral	23	20	18	20
Masters	30	27	27	27
Bachelors	14	12	10	12
<i>Total Control</i>	<i>84</i>	<i>75</i>	<i>68</i>	<i>73</i>
Intervention				
Community College	19	19	16	18
Doctoral	24	23	23	21
Masters	27	25	23	25
Bachelors	14	12	12	12
<i>Total Intervention</i>	<i>84</i>	<i>79</i>	<i>74</i>	<i>76</i>
Total Instructors	168	154	140	149

Next Steps

We've begun the process of cleaning and merging data across all four waves of data sets. The total number of instructors and student participants who completed a survey during each wave can be found in Table 2 and Table 3, respectively. With this data, we plan to analyze the differences seen in active learning use and the student response to active learning that can be shown between the control and intervention groups. We hope to gain a better understanding of how active learning is being implemented and received by students at different types of institutions, and potentially with different demographics of instructors/students. Additionally, we aim to assess the impact of the workshop overall with the goal of gaining a better understanding of ways in which we should be training instructors to improve their classrooms.

Table 3: Total number of student participation for each survey wave

Control	Wave 2	Wave 3
Community College	100	70
Doctoral	470	263
Masters	234	181
Bachelors	95	74
<i>Total Control</i>	<i>899</i>	<i>588</i>
Intervention		
Community College	139	92
Doctoral	283	124
Masters	249	129
Bachelors	106	37
<i>Total Intervention</i>	<i>777</i>	<i>382</i>
Total Students	1676	970

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