

# Enhancing Online Mathematics Learning: The Cohesive Work of an Instructional Platform and an Instructional Team

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## Abstract

Studies in online STEM education have shown that instructional platforms enhance communication and students' engagement. Despite the relevance of these platforms as communicative tools to support online learning, we cannot neglect the impact of the human connection if we want to ensure an equitable learning environment for online asynchronous students. Mathematics online education has lacked research on how an instructional team can use an instructional platform to promote participation and enhance students' performance. In our study, we used a descriptive-correlational research design to explore this connection in the context of an online asynchronous math course across eight semesters. Our findings showed that the combination of these technological and human resources (Microsoft Teams and an instructional team) improved student participation and performance in our online asynchronous course. While each group of students (online campus and main campus) saw improvements in participation and performance, online campus students saw greater improvement. We hope our findings inform online math teaching to improve students' learning experience and provide new research opportunities to study the reasons behind them.

*Keywords:* Mathematics education, learning assistants, online learning, undergraduate

Hoffman, S., Darnell, M., & Moreira, P. (2025). Enhancing online mathematics learning: The cohesive work of an instructional platform and an instructional team. *Online Learning*, 29(2), pp. 168–187. <https://doi.org/10.24059/olj.v29i2.4464>

For decades, numerous studies have explored the challenges of online and in-person teaching and learning environments in mathematics education. A literature review focused on online undergraduate education, considering studies published between 2000 and 2024, showed that mathematics learners had lower performance in comparison with students enrolled in other online courses as well as in-person (Trenholm et al., 2019). Meanwhile, other researchers found that learners in online environments may have more opportunities for reflection than in face-to-face environments (Smith et al., 2003).

A successful online teaching and learning experience requires the proper use of technological tools for students to communicate with instructors, enable communication between students, and facilitate interaction with materials and assignments. In the field of online learning, Liang and collaborators found that students with less mathematical knowledge used an instructional platform with higher frequency than their knowledgeable peers (Liang et al., 2018). In addition, in the same study, all students used videos and quizzes as complements during their learning process, finding a positive association between learning and the studied platform. Indeed, other studies have found that digital collaboration and engagement tools play an important role in the building of community in online students (Shaw et al., 2023), and how interactive tools can enhance learning experiences (MacKenzie & Ballard, 2015).

Instructional platforms have numerous benefits for online learning; however, they are not the only aspect instructors can use to support distance learning. The use of human resources in this particular context may also play a relevant role. The Teaching and Learning Lab at Massachusetts Institute of Technology highlighted the relevance of a sense of belonging for learning at the academic level where students can feel socially related and part of a university community (Teaching + Learning Lab, n.d.). Using instructional teams (a group of undergraduate students—learning assistants—working with the instructor to enhance learning experiences) has been shown to improve students' impression of learning, engagement, and sense of belonging in online and in-person STEM classes (Clements et al., 2022).

Even though there is a significant amount of research around mathematics online learning, a closer look at the influence of the combined use of technology (online platforms) and human resources (instructional teams) to support mathematics online learning is a field to explore. Therefore, in our research, we seek to study the combined influence of an instructional team and the use of an online platform in the performance and participation of students in an online asynchronous mathematics class at the college level.

## **Literature Review**

Online learning has had numerous definitions over time. For the purposes of this study, we will use the guidelines laid out by Singh and Thurman (2019)—learning in an online setting refers to teaching and learning that takes place in a distance environment mediated by the internet, without in-person interaction. In addition, considering the sociocultural approach (Vygotsky, 1978), the communication required to co-construct knowledge in this environment is mediated by technological resources to facilitate participants' interaction. Online learning can take place in two modalities: (1) synchronous, where students and instructor are connected at the same time using a video chat platform and (2) asynchronous, where students can access a

platform that holds learning materials, assignments, and communication with the instructor, not requiring real-time interaction between participants.

Our study was conducted in an online asynchronous mathematics classroom of an entry-level quantitative reasoning course. These non-STEM students enter this terminal math class to complete a liberal arts requirement and often lack comfort with mathematics and have various levels of preparation. For years, students in our institution accessed the material using the platform provided by the university. However, after semesters of experience using the platform, the instructor found limitations regarding communication with the students and decided to use a new tool, Microsoft Teams.

### ***Instructional Platforms to Support Online Learning***

Research has reported the benefits of using the internet and learning platforms to engage students in their learning process, enhancing their performance and increasing the chance of deep thinking and reflection (Chen, 2010). Rojabi (2020) found that students struggle to interact with their online instructors and classmates and find there are often more miscommunications. This evidence shows that instructional technology alone is not enough to ensure an equitable learning environment for online asynchronous students. It is necessary to consider different factors, such as course structure and organization, learner interaction, student engagement, and instructor presence (Gray & DiLoreto, 2016).

Any successful instructional platform should facilitate learner/instructor interaction and engagement. Park et al. (2020) reported that regarding a student's satisfaction in their online classroom, it was the perceived notion of instructor presence bolstered by the interactive communication tool, rather than the tool itself that was the most important. Eom (2006) and Watson et al. (2023) showed a similar finding, reporting that instructor presence, individual attention, and responsiveness in the form of instructor feedback including responses to emails, notes on written assignments, and responses to discussion posts were one of the main factors that improved perceived learning outcomes. Numerous other papers discuss the importance of instructor presence and bringing forth various methods to achieve it (Anderson et al., 2001; Baker, 2010; Lowenthal & Parscal, 2008; Miller et al., 2014).

A wide variety of instructional platforms are available for instructors—Blackboard, Desire to Learn, Google Classroom, Microsoft Teams, Moodle, Padlet, and Canvas, just to name a few. These are all designed to increase points of contact between the students and the instructional team (Dixson, 2010). In our context, the instructor chose Microsoft Teams (MT) as the online mediator to interact with the students after experiencing limitations with previous platforms and the new opportunities MT presents to enhance communication. Microsoft Teams is a collaboration and communication hub built as a part of the Microsoft 365 suite. Within MT, people can work together in real-time, interacting in chat and live web-conferencing, sharing perspectives in discussion boards, watching content in Stream, or collaborating on Word, PowerPoint, and Excel files (Cankaya, 2020). MT for education additionally allows instructors to assign tasks and assignments, attach rubrics and learning objectives, and provide feedback (Microsoft Education, n.d.). Sharip et al. (2023) found that when given access to Google Classroom, Padlet, and Microsoft Teams, most students (46%) preferred Microsoft Teams.

Research has shown that Microsoft Teams can enhance online instruction. Alameri et al. (2020) found that students have a good perception of Microsoft Teams, with more than 80% of students surveyed believing that the Microsoft Teams platform improved learning by increasing contact between teachers and students. Additionally, in the same study, 84.2% of students felt working with Teams was a valuable use of their time, with 81.1% additionally feeling the platform improved the speed of their learning. Purba (2021) found similar results with 94% of respondents agreeing or strongly agreeing to the statement, “Online learning using Microsoft Teams encourages me to be active in learning.” They also found 79% of students agreed or strongly agreed to “Microsoft Teams makes it easier to understand the learning material.” Alzubi (2022) found that students taught math using Microsoft Teams outperformed students taught in the traditional whiteboard format. Park et al. (2020) also found Microsoft Teams useful in promoting the instructor presence necessary for student engagement and satisfaction.

### ***Instructional Team in Online Learning Environments***

Other studies focused on exploring the online learning environment have found the benefits of working collaboratively with instructional teams (human teaching and learning resource) to promote a sense of belonging, enhance engagement, and improve instructional and learning experiences, among other benefits. Clements et al. (2022), from the lenses of inclusive learning environments, found that working with learning assistants in in-person and online courses promoted a sense of belonging and supported students’ engagement.

Hester et al. (2022) studied the influence of an instructional team working with a large group of students in a chemistry course. They found that the integration of an instructional team in the online course increased students’ social and cognitive engagement, as well as instructor presence, showing a positive influence in students’ online learning experience. In another study, Kim et al. (2021) found that specialized roles in their instructional teams allowed the STEM instructors to adjust teaching resources based on the team’s feedback and achieve a higher connection with students in the online environment.

Although studies have shown the benefits of working with an instructional team in online courses from the teaching and learning perspectives, the research in this area is scarce, and more studies are needed to build knowledge in this specific field.

Because of the challenges of online Math learning and the benefits that the individual use of instructional platforms and instructional teams offer to online students, in our study, we seek to explore the influence of combined use of Microsoft Teams and an instructional team with specialized roles on students’ performance and interaction in an online asynchronous mathematics college course by answering the following research question:

How do an instructional team and the use of an instructional platform influence students’ performance and participation in an asynchronous math class across semesters?

## Context and Participants

This study took place in a math course called “Exploring and Understanding Data” at a large public university in the southwestern United States. This seven-week course seeks to develop the ability of students in social and behavioral sciences to engage in quantitative reasoning and assess the validity of the information received from different sources. The course was taught in an online asynchronous environment and data were collected each semester from fall 2018 to spring 2022. Students in this class included a mixture of traditional students taking other in-person courses on campus (Main Campus students), students completing all courses online (Online students), and international students affiliated with a global university program (Global students). Due to the small number of Global students in the course (under 5% of the total population), only data from Main Campus and Online students were considered in this study.

The course was led by the same instructor each semester; however, in the fall of 2020, the instructor adopted an Instructional Team Model (ITM) incorporating a group of undergraduate students with specialized roles to support the teaching and learning experience (Kim et al., 2021). At the same time, the formal use of Microsoft Teams was included to support the work of the instructional team. This instructional team was comprised of six to eight undergraduate learning assistants selected from past sessions of the course, and thus they were representative of the students in the course (non-STEM main campus, online, and global majors). Backed by research by Eom (2006), Watson et al. (2023), and Park et al., (2020), we knew that translating the idea of instructor presence to the online asynchronous world would involve using Microsoft Teams extensively and structuring the instructional team in a way that prioritized individual attention and individualized responses to their course work and participation—both negative and positive. Each learning assistant fulfilled a specific role in supporting the class as defined in the ITM. These roles included:

- **Instructional Manager (IM):** Key communicator between the students and the instructional team. The IM monitored student interactions within Microsoft Teams, using the Insights app. This allowed us to see the dates and times students logged in, the materials they interacted with, and the amount of time they spent on the course (Figures 1a and 1b). They also kept tabs on who missed assignments and any trends we were seeing in a student’s participation. The IM then personally reached out to encourage students to get back on track and offered to meet with them to answer any questions they may have. The instructor was copied on each of these communications, allowing them to follow up with the students who needed it most. The IM would also notice student dedication and offer congratulations on their continued diligence to the course.
- **Learning Researcher (LR):** Informally engaged with students to gauge students’ perception of progress in the course and their math anxiety levels. Regular surveys were sent out, asking students to reflect on their comfort with the material, the class, and their overall math ability. Students were presented with an emoji scale (Figure 1c) and an opportunity to leave feedback. These informal methods allowed us to get a sense of our students’ states of mind. If a student started to struggle, our LR would reach out. These

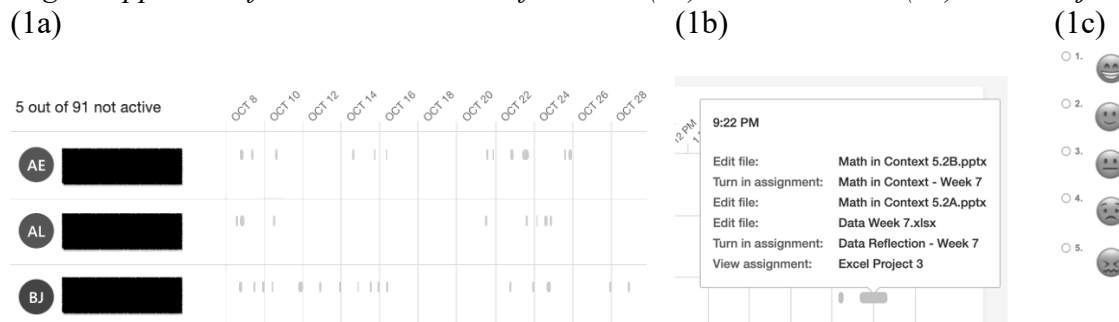
interactions allowed us to catch difficulties while they were small and opened a line of dialogue between the student, the LR, and the instructor.

- Learning Assistants (LA): Held weekly help sessions in Zoom and assisted in increasing instructor presence through quick question turn around on discussion boards and leaving detailed feedback on formative assessments. Our LAs would document the students who attended help sessions and left summaries of common questions that were brought up during their sessions. These learning assistant reports allowed the instructor to create “Just in Time” videos that were tailored to the needs of the particular class.

All members of the IT received basic training to perform their assigned roles.

## Figure 1

*Insights App View of Teams Interactions for Class (1a) and Individual (1b); LR Emoji Scale (1c)*



The total number of main campus and online students enrolled in the course each semester of the study is listed in Table 1.

**Table 1**

*Number of Students Across Semesters*

Semester	Student Population Group	Number of Students
Pre-ITM		
Fall 2018	Online	16
	Main Campus	16
Spring 2019	Online	16
	Main Campus	0
Fall 2019	Online	13
	Main Campus	14
<b>Total</b>		<b>75</b>
Post-ITM		
Fall 2020	Online	16

	Main Campus	90
Spring 2021	Online	36
	Main Campus	49
Fall 2021	Online	28
	Main Campus	53
Spring 2022	Online	18
	Main Campus	34
<hr/>		
Total		324

*Note.* The Spring 2019 course offering was open to our Online Campus students only.

Starting in the fall 2020, the main instructor and the instructional team delivered course content and activities and interacted with students through a Microsoft Teams interface. There, students had access to the same lecture videos and formative and summative assessments but could now interact synchronously and asynchronously with instructional team members. Questions were regularly asked and answered using this platform, encouraging students to interact with the material and practice their mathematical skills daily.

## Methods

### *Study Design*

We used a descriptive-correlational research design to answer our research question (Creswell, 2013). Math courses are often seen as impediments toward degree progression. This needs to be improved without lowering the quality of the education delivered. The instructor implemented a variety of changes to the course structure. Clements et al. (2022) and others found that the instructional team improved engagement, not just performance, so it became important that our study measure not just final course grades. Instead, we dove deeper, examining engagement through both homework participation and regular use of the Teams learning environment, where we will attempt to verify Liang et al.'s (2018) assertion that the instructional platform has a positive association to learning. First, we studied the differences in our sample populations by completing a descriptive quantitative study on student performance and participation. Then, we focused on our post-ITM population in a correlation study of the effects of interacting with Microsoft Teams and the instructional team.

### *Data Collection*

Data were collected between fall 2018 and spring 2022 as shown in Table 1. Data from the spring of 2020 were excluded from the analysis due to the COVID-19 pandemic, when all students were given the opportunity to freely withdraw or switch to Pass-Fail up until the last day of classes. This opportunity, along with the turmoil at the start of the pandemic, greatly altered students' motivation, and strongly affected course dynamics in the seven-week session starting mid-March 2020. (In fact, 23 out of 68 students took advantage of these policy changes during spring 2020.) Data were collected in two main categories, student performance and student participation, as detailed in Table 2. All data collection was approved by the Institutional Review Board at the institution and all participants (instructor, instructional team members, students) consented to participate in the study.

**Table 2***Description of Data Sources*

Data Collected	Description
<b>Student's Performance</b>	
Excel Project Scores	Over the course of a 7-week semester, students work on six Excel projects, each focusing on a key skill. These included basic visual representations of data, filtering, histograms and data statistics, normal probability functions, and linear regression. Each project included a large spreadsheet of data to analyze and a list of questions to focus the data analysis. Besides submitting their completed Excel files and answers to questions, students created video demonstrations of key Excel skills. Showcasing their mastery of the key skills in the course, this is an important area to measure success.
Final Course Grades	Multiple formative and summative assessments were implemented each week. Grades from 40 to 50 homework assignments and 4 to 6 exams per semester were combined to generate final course grades. This data is maintained as both a percentage score, as well as a letter grade awarded.
DFW rate	Percentage of students who withdrew from the course or received a final grade of D or F.
<b>Student's Participation</b>	
Number of homework assignments missed	On average students completed 2-3 low-stakes assessments every week. Upon completion of these assignments, students worked on 2 to 3 summative assignments in the online homework environment and completed an Excel project. When the instructional team model was implemented, it was decided that online students needed more flexibility to complete course assignments. Due dates were altered so that an initial due date was set to earlier in the week with a 48-hour grace period in which students could still complete the assignment with little to no penalty.
Interactions Microsoft Teams Virtual Classroom 2021-22 school year	Number of days students logged in to Microsoft Teams Virtual Classroom and interacted with team members or the instructor, using the communication channels provided by the instructional team.

**Data Analysis**

Students' performance in the course, considering their final grades and average scores on the Excel Projects, was analyzed for each class from 2018 to 2022 and divided into two main categories: pre-ITM (fall 2018 to fall 2019) and post-ITM (fall 2020 to spring 2022) to

characterize changes in students' performance before and after the incorporation of the instructional team (see Table 3). Boxplots were created to visualize the center and spread of student performance and one-sided hypothesis testing on the two population means was used to determine the significance of any changes.

To add perspective to any observed changes in student success, we compared our results to values available from department grade distributions from the in-person, on-campus sections during the same time periods. This large group of students (801 pre-ITM and 1,140 post-ITM) had access to the same materials and the same software as the online asynchronous students, but they did not have access to the Instruction Team Model. As this dataset only records the grade awarded to students, we will focus our analysis on period GPAs for the course. With these values, we can then run our hypothesis testing to evaluate significance.

A similar approach was used to characterize students' participation in the course. The number of assignments missed during the pre-ITM (fall 2018 to fall 2019) and post-ITM (fall 2020 to spring 2022) were used to identify changes in students' participation before and after the implementation of the instructional team model.

Interaction data on Microsoft Teams is only maintained by Teams for one year. Because of this limitation, we analyzed data regarding students' interaction with the platform for the fall of 2021 and spring of 2022 (see Table 3). We used boxplots to show the center and spread of students' participation results, along with one-sided hypothesis testing on the difference to determine the significance of any changes in their participation. Linear regression was then used to explore the relationship between days spent interacting with Microsoft Teams and final course grades (only for the 2021–22 school year).

Additionally, for both sets of data (student performance and participation), differences across the two groups of students in the course, main campus and online students, were identified.

**Table 3**

*Distribution of Sources of Data Across Semesters*

Pre-ITM		Post-ITM				
Fall 2018	Spring 2019	Fall 2019	Fall 2020	Spring 2021	Fall 2021	Spring 2022
Students' Performance						
		<ul style="list-style-type: none"> <li>● Excel Project Average Grades</li> <li>● Final Grades</li> <li>● DFW Rate</li> </ul>				
Students' Participation						
<ul style="list-style-type: none"> <li>● Assignments Missed</li> </ul>			<ul style="list-style-type: none"> <li>● Assignments Missed</li> <li>● Interactions Microsoft Teams</li> </ul>			

## Main Findings

Our analysis allowed us to identify distinct trends in the performance and participation of main campus and online students in the asynchronous math class. Major findings are presented below, organized into two main sections. In the first one, we present our results from the analysis of student performance across semesters, and in the second section, we focus on changes in student participation. In both cases, we highlight differences observed between the two main groups of students enrolled in the course.

### *Student Performance*

We analyzed student performance by looking at average grades on Excel projects and final course grades. We also examined the period DFW rates.

As shown in Figure 2, the performance of all students in the course Excel projects improved in those semesters where the ITM was implemented. In general, online students received higher grades than main campus students on these projects in all semesters. The average Excel project grade for online students increased significantly ( $p = 0.034$ ) from 85.2 pre-ITM to 90.9 post-ITM, while this average grade for main campus students increased ( $p = 0.30$ ) from 78.8 pre-ITM to 81.0 post-ITM. As these numbers indicate, the average grade change was larger and only significant for the online student population.

**Figure 2**

*Average Excel Project Scores per Student for Online (2a) and the Main Campus (2b) Students*

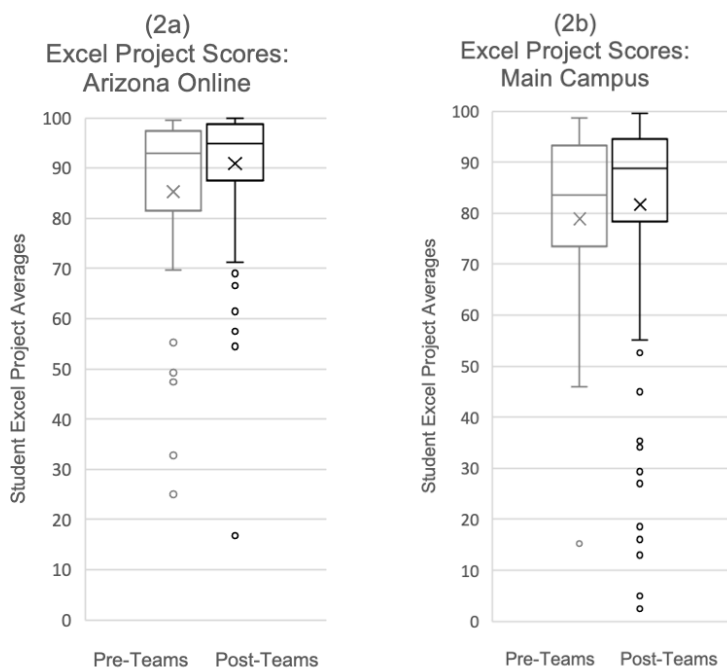
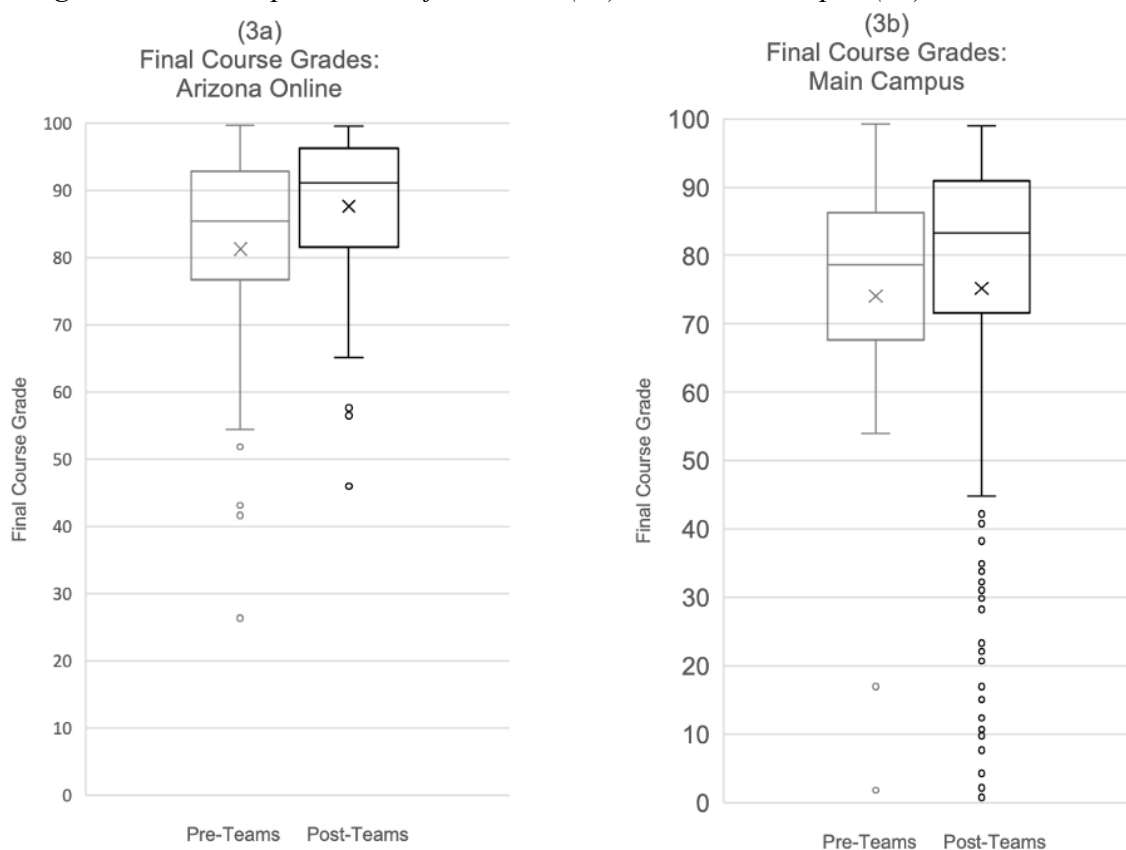


Figure 3 shows changes in student performance as measured by final course grades. Again, online students outperformed main campus students in all semesters in this area. Average final grades for the online population increased ( $p = 0.0091$ ) from 81.2 pre-ITM to 87.6 post-ITM, while it changed ( $p = 0.04032$ ) from 74.1 pre-ITM to 75.1 post-ITM. Both increments were significant in this case. More than 50% of the online students enrolled post-ITM earned an “A” letter grade compared to nearly 30% pre-ITM. On the other hand, although the percentage of main campus students earning an A also increased from the pre- to the post-ITM semesters, it remained below 25%. Notice the larger number of outlier main campus students earning grades below 45% during post-ITM semesters.

**Figure 3**

*Average Final Grades per Student for Online (3a) and Main Campus (3b) Students*



Considering these differences in two populations, we compared them to the comparison group of in-person, on-campus students taking the course. As they use the same materials and software, it allows us to dial in on the impact of the ITM. Table 4 summarizes the GPA changes pre- and post-ITM for these disparate student populations. Both main campus and online student populations finishing the course saw significant improvements in overall course GPAs—0.54 for main campus students ( $p = 0.0160$ ) and 0.43 for online students ( $p = 0.0227$ ). Main campus, in-person students saw no significant increase over the same time periods.

**Table 4***Course GPA for Each Population*

Student population	GPA (pre-ITM)	GPA (post-ITM)	Changes GPA
Online	2.91	3.34	+0.43 (p = 0.0227)
Main Campus (Async)	2.30	2.84	+0.54 (p = 0.0160)
Main Campus, In-Person	2.57	2.60	+0.03 (p = 0.2923)

As a final measure of changes in student performance, we analyzed DFW rates in the class across different semesters. While this is related to class GPA, the DFW rate also incorporates the students who withdrew early from the course. The results are summarized in Table 5, where we can see that DFW rates for online students decreased from 23.40% pre-ITM to 12.26% post-ITM. There was, however, an increase in the DFW rate for main campus students from 23.53% to 31.27% for the same set of compared semesters. For comparison purposes, it is noteworthy that main campus students who took the course in-person with other instructors also experienced an increase in their respective DFW rates over the same time periods from 19.35% (n = 801) to 25.79% (n = 1140).

**Table 5***DFW Rates for Each Population*

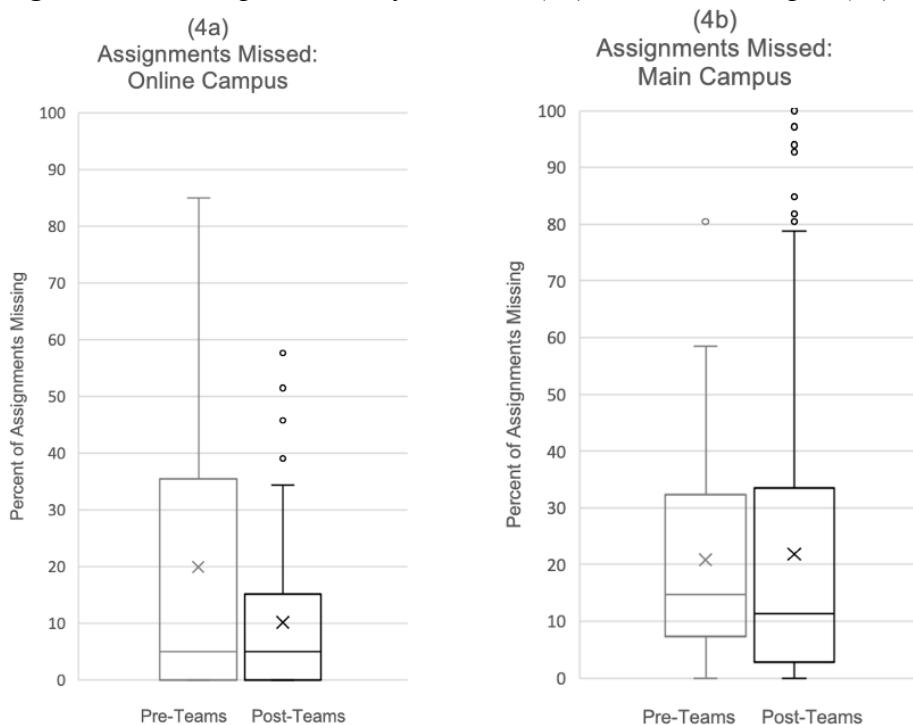
Student population	DFW (pre-ITM)	DFW (post-ITM)	Changes DFW
Online	23.40%	12.26%	-11.14% (p = 0.054)
Main Campus (Async)	23.53%	31.27%	+7.74% (p = 0.16)
Main Campus, In-Person	19.35%	25.79%	+6.44% (p = 0.00036)

***Students' Participation Across Semesters***

To develop a sense of changes in student participation in the class before and after the implementation of the ITM, we analyzed the number of assignments not completed by students in any given semester. This decision was made because the previous platform did not allow us to measure students' participation (number of interactions in the platform). As shown in Figure 4, the percentage of missed assignments dropped (p = 0.0079) by nearly half, from 19.85% pre-ITM to 10.09% post-ITM, for online students, while it remained practically unchanged for main campus students. This figure reveals a marked contrast in assignment completion between online and main campus students from pre-ITM to post-ITM semesters, with a much larger variation in behavior in this area for main campus versus online students.

**Figure 4**

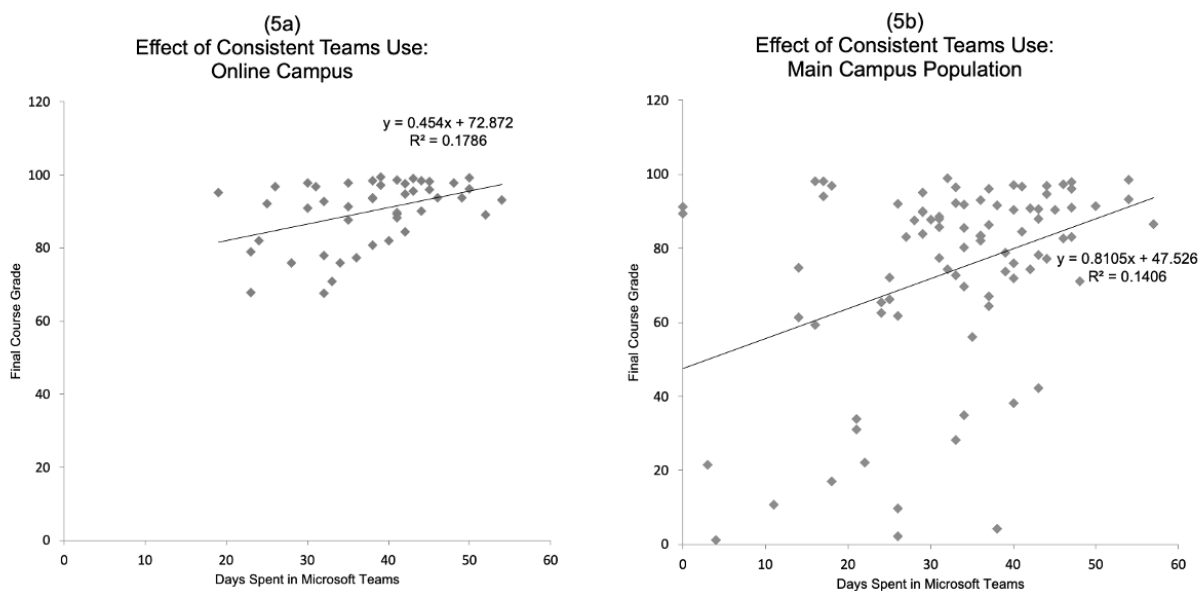
*Assignments Missed per Student for Online (4a) and Main Campus (4b) Students*



Student participation starting in fall 2021 was also measured in terms of student engagement within the Microsoft Teams platform. On average, during the seven-week course, online students spent more time engaged with the platform (37.74 days) than main campus students (32.69 days). Statistical analysis of this data revealed a moderate positive correlation ( $r = 0.42$  for online students and  $r = 0.37$  for main campus students) between days spent interacting with the platform and final course grades as shown in Figure 5.

**Figure 5**

*Effect of Consistent Microsoft Teams Use for Online (5a) and Main Campus (5b) Students*



## Discussion and Implications

Our findings showed that the combined use of the ITM and Microsoft Teams favored online students over the main campus in terms of participation and performance. Online students logged an average of 37.74 days over the seven-week course, compared with only 32.69 days for main campus students when both resources were used. Regarding their performance, online students showed higher performance in all measurements, in addition to lowering the DFW from 23.4% to 12.26% compared to the main campus group which increased from 23.53% to 31.27%. The reasons for these variations in how the use of these instructional tools influenced students' participation and performance in the asynchronous course may be due to different factors, such as the fact that main campus students are involved in other courses on campus. They interact with their classmates, participate in activities, and have a full university experience that may provide them the opportunity for educational discourse, not needing to explore that in an asynchronous course. Research has posited that students on-campus have a sense of “*macro* (institution-level) community,” but that exclusively online students instead have a need to seek out “*micro* (class-level) forms of community” (Long et al., 2023).

Studies have previously suggested that online students value different forms of communication and course interaction than on-campus students (Turk et al., 2024). The results of our study support the claim that other researchers have mentioned in terms of the benefits of instructional platforms for engagement and communication in online environments (Alameri et al., 2020; Chen, 2010). In our study, the addition of MT allowed us to open more channels of communication between the instructor and students, as well as the mediation of the instructional team. In addition, the fluent communication may foster a sense of community among the members of the class, including instructional team members, students, and the instructor

(Clements, 2022; Hoffman, Darnell, & Moreira, 2021). As one spring 2021 online student mentioned in the end of the semester student course evaluations, “Your method and style of teaching has made this class what it is. Even as a student you feel like you are a part of the team already and everyone is on the same level and mission for success. Which I admire so much.”

Indeed, Long et al. (2023) found that their online student population viewed connection to other students to be a key aspect to their success in a course. On the Likert scale survey question used in Long and collaborators’ study, “I learn best when I feel connected to other students,” online student groups had a higher average agreement of 6.46 and 5.30 on a scale of 1 to 10, compared to only a 4.00 for on-campus students. Previous research about the use of an instructional team in online environments highlights the relevance of its role in promoting a sense of cohesiveness, community, and engagement and making mutual benefits for instructors and students visible (Clements, 2022; Kim et al., 2021). Kim et al. (2021) found that the intentional use of learning assistants focused on specific roles had a positive impact in online asynchronous learning environments. The study used online learning managers and online learning researchers to enhance communication with students and facilitate formative assessment. Their findings are evidence of the relevance of an instructor familiarizing themselves with the learning assistants that are part of the instructional team, so instructors can properly assign them roles that are coherent with their characteristics and motivations to participate in the group (Kim et al., 2021).

The characteristics of the instructional team in our study may be one of the factors that influenced the growth of a sense of community within the class. The instructor in our study selected former students, allowing for students to be recruited based off of their strengths for the appropriate roles. The Instructional Team was also selected to reflect the student population it served. This meant that our team had members from the main campus, online campus, and global campus. Different time zones and life stages were represented, so every student could see themselves in some way reflected on the instructional team. Additionally, using students who had been in their position a semester before may make the course more approachable, allowing students to visualize their own success.

Beyond the benefits to our current student population, we should not neglect to reflect on the benefits for the learning assistants themselves. On-campus students have a plethora of opportunities to gain leadership experience, form a closer connection with faculty, and receive mentorship. To truly bring our online students an equivalent experience, we should be providing similar opportunities for our online students. Learning assistants in our study were given the opportunity to earn elective credit or work for pay, but the chance to solidify their mathematical knowledge, increase their confidence, and grow as leaders is so much more valuable.

## **Conclusion**

The purpose of communicating our findings was to share the experience of humanizing an asynchronous mathematics learning environment. As mentioned in our literature review, instructional online platforms are a valuable resource to provide learning opportunities to distance students (Liang et al., 2018; Shaw et al., 2023). However, their use alone is not enough

to provide meaningful learning opportunities to our students, who should be supported by an environment where they feel listened to, engaged, and part of the group.

Our findings provide evidence of the influence of the combined use of an instructional platform, such as Microsoft Teams, with the instructional support of a group of learning assistants with specialized roles in students' performance and participation in an online asynchronous class. Students with the additional support missed fewer assignments and scored higher on key summative assessments. This resulted in a lower DFW rate and increased session GPAs. Additionally, there was a correlation between interactions with the support and final course grades.

We found differences in the two main student populations in the asynchronous course (online and main campus). While some research may suggest that online students have different needs for community and connection than their main campus counterparts, further research is needed to provide insights regarding the reasons behind these findings and how we can capitalize on it for our online courses. In addition, it is relevant to mention that due to the overhaul of the course at the start of the pandemic, we are unable to fully ascertain which benefits are due to the use of a communication hub like Microsoft Teams versus the interaction with the instructional team itself.

Due to the nature of our study (descriptive-correlational research design), our findings are limited to describing the relationship between the use of an instructional team in combination with an online platform, with students' outcomes and participation. For this reason and as part of the limitations of our study, we didn't take into account students' cultural and prior education backgrounds when comparing our different populations. Many life factors differ greatly in our online student population. Demographic information from the online instruction section of our institution mentioned in a welcome email that 51% of online students are married or in domestic partnerships, 42% tend to have children at home, 37% work more than 40 hours a week, and only 15% don't work. Further research considering these factors is necessary to provide a deeper characterization of the online environments and factors that influence students' performance and participation.

Lastly, investigating ways to make the strategy of combining technological and human resources sustainable on a large scale is necessary to improve online learning opportunities in classes with over 100 students. How can we ensure all students have access to peer assistance while keeping university costs down? We have begun to investigate increasing our team sizes to include multiple learning researchers and instructional managers who can focus in on a student subsection. With a larger team, we can facilitate more opportunities for live assistance and quicker turn-around times for posted questions. To reduce our operational costs, we are using an independent study course, allowing team members to earn elective course credit for their work. We are continuing to work with our university to find a way to allow our learning assistants the opportunity to participate in that mentorship relationship without burdening online students with additional tuition fees. For this to happen, we need to crystallize the message. A robust instructional team benefits everyone—students, instructional team members, and instructor alike.

**Acknowledgements**

We would like to give special thanks to all the instructional team members who supported the learning experience of all students enrolled in the course, as well as the Instructional Team Project who provided training for our team members and research support. This work is part of a large project supported by the National Science Foundation (DUE-1626531).

**Declarations**

The authors declare no potential conflicts of interest. Since analysis of the data, one author's spouse became employed at Microsoft. No other conflicts exist in authorship and/or publication of this article. All data were collected in accordance with protocols approved by the Institutional Review Board (IRB) at Affiliation.

## References

- Alameri, J., Masadeh, R., Hamadallah, E., Ismail, H. B., & Fakhouri, H. N. (2020). Students' perceptions of e-learning platforms (Moodle, Microsoft Teams and Zoom platforms) in The University of Jordan education and its relation to self-study and academic achievement during COVID-19 pandemic. *Advanced Research & Studies Journal*, 2692, 2800.
- Alzubi, K. A. A. (2022). The effect of teaching mathematic supported by Microsoft teams on the students' mathematical skills in a college course in Jordan. *Journal of Positive School Psychology*, 6(2), 4286–4292. <https://doi.org/10.17522/balikesirnef.827595>
- Anderson, T., Rourke L., Garrison, D. R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks*, 5(2), 1–17 (2001).
- Baker, C. (2010). The impact of instructor immediacy and presence for online student affective learning, cognition, and motivation. *Journal of Educators Online*, 7(1), n1.
- Çankaya, S., & Durak, G. (2020). Integrated systems in emergency distance education: The Microsoft Teams. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, 14(2), 889–920. <https://doi.org/10.17522/balikesirnef.827595>
- Chen, P. S. D., Lambert, A. D., & Guidry, K. R. (2010). Engaging online learners: The impact of web-based learning technology on college student engagement. *Computers & Education*, 54(4), 1222–1232.
- Clements, T. P., Friedman, K. L., Johnson, H. J., Meier, C. J., Watkins, J., Brockman, A. J., & Brame, C. J. (2022). “It made me feel like a bigger part of the STEM community”: Incorporation of learning assistants enhances students' sense of belonging in a large introductory biology course. *CBE—Life Sciences Education*, 21(2), ar26.
- Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.
- Dixson, M. D. (2010). Creating effective student engagement in online courses: What do students find engaging? *Journal of the Scholarship of Teaching and Learning*, 10(2), 1–13.
- Eom, S. (2006). The role of the instructors as a determinant of students' satisfaction in university online education. In *Sixth IEEE International Conference on Advanced Learning Technologies* (ICALT 20 2006) (pp. 985–988). IEEE.
- Gray, J. A., & DiLoreto, M. (2016). The effects of student engagement, student satisfaction, and perceived learning in online learning environments. *International Journal of Educational Leadership Preparation*, 11(1), n1.
- Hester, S. D., Elliott, J. M., Navis, L. K., Hidalgo, L. T., Kim, Y. A., Blowers, P., Elfrin, L., & Talanquer, V. (2022). Using an instructional team during pandemic remote teaching

- enhanced student outcomes in a large STEM course. *Journal of College Science Teaching*, 51(3), 12–21.
- Hubbard, M., & Bailey, M. J. (2018). *Mastering Microsoft Teams: End user guide to practical usage, collaboration, and governance*. Apress Berkley.
- Kim, Y. A., Rezende, L., Eadie, E., Maximillian, J., Southard, K., Elfring, L., Blowers, P., & Talanquer, V. (2021). Responsive teaching in online learning environments: Using an instructional team to promote formative assessment and sense of community. *Journal of College Science Teaching*, 50(4), 17–24.
- Liang, L., Yeung, K., Lui, R. K. W., Cheung, W. M. Y., & Lam, K. F. (2018). Lessons learned from a calculus e-learning system for first-year university students with diverse mathematics backgrounds. In J. Silverman & V. Hoyos (Eds.), *Distance learning, e-learning and blended learning in mathematics education: International trends in research and development* (pp. 69–92). Springer Cham.
- Long, M. G., Gebhardt, K., & McKenna, K. (2023). Success rate disparities between online and face-to-face economics courses: Understanding the impacts of student affiliation and course modality. *Online Learning*, 27(4), 461–485.
- Lowenthal, P. R., & Parscal, T. (2008). Teaching presence. *The Learning Curve*, 3(4), 1–2.
- MacKenzie, J., & Ballard, H. (2015). Interactive tools as a catalyst for learning in online education. *The Journal of Effective Teaching*, 15(4), 5–20.
- Microsoft Education (n.d). *Empower students and educators with Microsoft Teams for schools*. <https://www.microsoft.com/en-us/education/products/teams>
- Miller, M. G., Hahs-Vaughn, D. L., and Zygouris-Coe, V. (2014). A confirmatory factor analysis of teaching presence within online professional development. *Journal of Asynchronous Learning Networks*, 18(1). <https://doi.org/10.24059/olj.v18i1.333>
- Park, C., & Kim, D. G. (2020). Perception of instructor presence and its effects on learning experience in online classes. *Journal of Information Technology Education: Research*, 19, 475–488.
- Purba, L. S. L. (2021). Microsoft teams 365 and online learning: The student’s perception. *Jurnal Pendidikan Kimia*, 13(2), 130–136.
- Rojabi, A. R. (2020). Exploring EFL students’ perception of online learning via Microsoft Teams: University level in Indonesia. *English Language Teaching Educational Journal*, 3(2), 163–173.
- Singh, V., & Thurman, A. (2019). How many ways can we define online learning? A systematic literature review of definitions of online learning (1988–2018). *American Journal of Distance Education*, 33(4), 289–306.
- Smith, G., Ferguson, D., & Caris, M. (2003). The web versus the classroom: Instructor experiences in discussion-based and mathematics-based disciplines. *Journal of Educational Computing Research*, 29(1), 29–59.

- Sharip, A. A., Zain, S. M. M., Rahid, N. N. A., & Saidi, R. M. (2023). Usability evaluation of learning management systems: Google Classroom, Microsoft Teams and Padlet. *International Journal of Academic Research in Progressive Education and Development*, 12(2).
- Shaw, C., Bhardwaj, R., Condon, K., NeJame, L., Martin, S., Rich, J., Janson, N., Bryant, G., and Fox, K. (2023, September). *Listening to learners 2023*. Tyton Partners.
- Teaching + Learning Lab. (n.d.). Sense of belonging. <https://tll.mit.edu/teaching-materials/cultivating-sense-belonging>
- Trenholm, S., Peschke, J., & Chinnappan, M. (2019). A review of fully online undergraduate mathematics instruction through the lens of large-scale research (2000–2015). *Primus*, 29(10), 1080–1100.
- Turk, M., Toraman Turk, S, Muftuoglu, A.C., Karakaya, O., & Karakaya, K. (2024). Students' expectations and experiences about engagement strategies in online courses: A mixed methods study. *Online Learning*, 28(2), 1–29.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Watson, S., Sullivan, D. P., & Watson, K. (2023). Teaching presence in asynchronous online classes: It's not just a façade. *Online Learning*, 27(2), 288–303.