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Peer Motivation: Getting Through Math Together

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Abstract

Students have a complex relationship with mathematics. Some love it, but more often than not, the feelings are less favorable. These feelings can lead to decreased motivation which makes it difficult for students to engage with the subject as the semester progresses. Instructors also have difficulty addressing this waning motivation. In this paper, we claim peers are better able to connect with the students and this can be leveraged to better motivate students. We present an approach to having peers motivate their students. These peer interactions integrated with a mandatory mathematics course might improve students' motivation.

Keywords: motivation, developmental mathematics, undergraduate students

1. Introduction

Students enrolled in post-secondary mathematics courses but are not in mathematically-oriented degree programs, may face challenges different than those who are. As instructors of lower-division, general education, and (formerly) developmental math courses, we faced many challenges with students, such as lack of attendance, poor class participation, and low engagement. Confidence, math anxiety, and motivation are all possible contributors to these challenges, which tend to lead to poor academic performance.

Since lower-division courses are typically outside of students' majors or act as gateway courses, students have a difficult time maintaining interest and effort throughout the courses; that is, their motivation diminishes as the semester progresses. This article offers an approach to improving students' motivation to persist in their (gateway) mathematics course that leverages their peers' positive motivational experiences.

The context of this work is developmental math — a course sequence intended to bring under-prepared, in some way, students to the point of being able to engage with university-level mathematics courses — though what we propose could foreseeably be applied in any course. The curriculum in these courses is typically at the intermediate-algebra level, covering operations with fractions; proportions, percents, ratios; basic linear equation solving; and some basic algebraic manipulation. Despite the seemingly elementary nature of the curriculum, one-third of all post-secondary students in the United State of America are required to take developmental courses [15], which reveals the emphasis post-secondary institutions place on foundational math skills. Student outcomes in developmental math are mixed, with many students not persisting through their degrees [3]. Because of this, and the increased time to degree completion for those that do persist has led our parent institution, the California State University, to discontinue developmental education [4]. Though the California State University has moved away from developmental education, the students who would normally be required to take developmental math are still admitted, albeit under some other designation, and required to take general education courses. Therefore, any lessons we can take from developmental students are likely still very relevant to general education, and lower-division students more broadly.

Students of developmental mathematics tend to struggle. Think about it: after being accepted to university, the institution then tells the student they are not quite good enough and must take a course on the material they had already seen before. The material is overly procedural and familiar to the students, though to varying degrees of facility. As George [6] writes, "[the reason students] do not master these algorithms is that they do not do the homework. Many consistently skip class. Many gradually drift out" (page 256).

This foregrounds the students' motivation as an indicator of their success. Improving these students' motivation can be as simple as being personable with them [6], or finding/re-discovering the beauty in elementary curriculum [16].

Our message here is not constrained to developmental mathematics students. Rather, we hope to present ideas for how instructors might more broadly improve their students' motivation to study and persist in their mathematics courses, even though such courses might not be the primary interest of the students. In particular, we seek to address these two questions:

(i) What does motivation mean to students enrolled in lower-division general education/prerequisite courses?

(ii) How can we leverage what successful students found as motivating to motivate current students?

The overarching goal in this study is to improve students' motivation to persist in their entry-level (in our case, developmental) mathematics course. We take the position that peers can relate to students better than instructors can. We propose that instructors need to engage with peer tutoring or student success programs in their classrooms to motivate their students. Successful students who are more able to connect with their peers should be leveraged to better motivate our students. Below, we present two studies that expand on these ideas above. In Study 1, we seek to better understand the motivations of successful students and, in Study 2, we have students, who experienced academic success in their course, motivate their current peers.

2. Literature Review

2.1. What is Motivation?

Motivation is a central focus of research in attitudes towards mathematics. Goldin *et al.* [7] provide a broad perspective on the attributes of motivation, examining motivation in terms of personal goals and interests, highlighting the interests and self-regulation of students. The act of setting goals and possessing engagement in mathematics constitute student motivation.

In a similar way, Schukajlow and Rakoczy [20] discuss how emotions and motivation influence the achievement of learning and academic excellence. The authors use self-determination theory [18] to describe motivation within the classroom. Self-determination theory posits that humans naturally possess a need for proficiency, independence, and acceptance. Meeting these needs produces positive emotions in humans which leads to positive experiences and high motivation in an activity. The article suggests that positive emotions and a positive attitude lead to high motivation.

Motivation can be conceptualized in many different ways and the literature tends to focus on two facets of motivation: intrinsic and extrinsic [12]. Intrinsic motivation means engaging in a behavior that is personally gratifying; a student's own interest and pleasure to reach a desired outcome [14]. For example, Matthews, Hoessler, Jonker, and Stockley [11] define intrinsic motivation as "the push to satisfy one's own psychological needs for competence and autonomy" (page 2). In this type of motivation, a student's interest and their own need for accomplishment and independence are personally gratifying. Intrinsic motivation can have a powerful effect on achievement and goals due to its persistent nature [14, 9].

Extrinsic motivation means engaging in a behavior driven by outside forces to achieve a desired outcome. Such outside forces may include money, grades, or family expectations. For example, when a student enrolls in a math course, they may not personally want to be in that class, or may have low interest in the subject, but are in that class to satisfy an academic requirement. Extrinsic motivation can push students to reach a sense of fulfillment, but it is often a fulfillment that is short-lived. Matthews *et al.* [11] describe "extrinsic motivation is the force behind doing something for some consequences separate from the immediate action" (page 2). This type of motivation fails to build long-term independence, skills, and knowledge due to its momentary nature.

2.2. Role of Motivation

Motivation plays a role in student academic success [5, 17, 19, 20, 22, 24]. High motivation tends to result in higher engagement, class participation, and attendance, whereas low motivation hinders students' learning, mathematical abilities, class participation, and class attendance. For example,

George [6] found that community college developmental math students did not put in sufficient study time and did not attend class regularly. The author attributes this to the motivation and autonomy of developmental math students. Reporting from a series of interviews with students, George [6] identifies instructor characteristics (i.e. being "fun" and positive) and the connection between instructor and student to be most important for student motivation.

We recognize that motivation is part of a much larger ecosystem of beliefs, dispositions, emotions, behaviors, knowledge, and experiences [8]. For example, Moore [13] reports that academic problems of developmental education students tend to stem from motivational deficiencies rather than strictly cognitive or knowledge deficiencies and that these motivational aspects are themselves entwined with other personal effects and characteristics. Developmental math students' general poor performance is not just about "the math", but rather includes their conceptions, habits, and well-being as students. Moore [13] identifies factors — locus of control, self-efficacy, self-regulation, effort regulation, among others — related to motivation that have a bearing on students' success. The results of the current study are best understood in this broader context.

2.3. Approaches to Change Motivation

One of the key characteristics of motivation is that it can potentially be actively modified through the course of education. For example, Karaali [9] demonstrates that educators can provide the opportunity for students to take personal responsibility for their learning and that this ignites motivation for learning and promotes self-efficacy. The author asked liberal arts math students to write weekly self-reflection journals about their experiences in the course. The results of these self-reports show students' positive changes such as higher engagement levels, better attendance, and more participation. Overall, these meta-cognitive activities of self-reflection capture students' self-awareness of students' own doings and thoughts. Karaali shows that motivation is something that as educators, we cannot "fix" but rather something we can influence. Reflecting on goals and aspirations can shift students' own mindsets and positively affect students' beliefs about mathematics [23].

2.4. Peer Tutoring and Student Success Programs

One potential way to improve student motivation is through peer tutoring and student success programs. Arco-Tirado, Fernández-Martin, and Hervás-Torres [1] show how an evidence-based peer-tutoring program affects first-year students' academic performance at a Spanish university. The study they report on consisted of two groups: one experimental and one control. There were 102 total freshmen students in this study divided equally between, and randomly assigned to, control and experimental groups. The experimental group participated in the university's peer tutoring program where each member of the group was matched with a student-tutor, who received extensive training, based on their degree program and time availability. Each tutoring session was on a 90-minute, one-on-one basis between tutor and tutee. The control group was notified that they have not been chosen to participate in the peer-tutoring program. The results show a statistically significant difference between the experimental group and control group in their academic performance. Grade point average, performance rates, success rates, and dropout rates measured students' academic performance. Overall, the paper confirms "the effectiveness of the Peer-Tutoring Program 3.0 increases the academic performance among freshmen" (page 9). The paper also emphasizes how intensifying the training for the student-tutors helped significantly reach their desired results.

We claim that peers can relate to students better than instructors can. Instructors and peers both play a role in student motivation just in different ways. As Shin, Ranellucci, and Roseth [21] discuss, instructors and peers have effects on motivation and achievement using rationales in their online course. The study demonstrates how communicating the reasons or rationales of why or how the course content is applicable to students' own personal lives affect students' motivation and achievement in a positive way. The results show how "peer rationales enhance achievement more than instructors rationales" (page 193). The paper concludes that peer rationales have the longevity that influences academic achievement due to some emotional aspect whereas instructor rationales do not have that effect on students. Rather, instructor rationales focus more on the course content and make less of a personal connection to the students. This observation is precisely what motivated us to undertake the current work.

3. Method

3.1. Participants and Setting

The students in this study were admitted to the San José State University, but failed an Entry Level Mathematics (ELM) test and were required to enroll in developmental mathematics. The developmental mathematics course ran in two parts, one in the Fall 2017 semester, and the other in the Spring 2018 semester. Students who achieved greater than 70% in the Fall completed their developmental requirements and did not take the Spring course. The details of developmental mathematics are not what is important here. Rather, we understand this cohort tends to have low motivation to engage in the mathematics course.

4. Study 1: Getting to Know Our Students' Motivations

4.1. Interview Process

The first author interviewed six first-year students enrolled in developmental math courses at San José State University in Fall 2017. An email was sent out to all students enrolled in the course, inviting them to participate in this interview study. The first six students who responded to the email and expressed interest were the students selected to be interviewed. Each student was interviewed individually following informed consent. Student participants completed three, one-half hour-long interviews occurring in the beginning, middle, and end of the semester. The interviews focused on gaining a better understanding of what motivation means to developmental math students.

In the first interview, students responded to the following questions:

1. What is motivation to you?
2. What motivates you to study math?

In the second interview, each participant was asked the following questions:

1. Describe your current motivation to study mathematics.
2. What is motivation to you?

3. What motivates you to study math?

Finally, in the third interview, students responded to the questions:

1. What is motivation for you?
2. Having just gone through a semester of mathematics, what is now your motivation to study mathematics?

4.2. Interview Analysis

Interviews were transcribed and analyzed using phenomenographical methods. Phenomenography is a methodology to catalog the different ways people experience, conceptualize, perceive, and understand a common phenomenon in the world around them [10]. The phenomenon of interest in this study was motivation to study mathematics: every student has their own experience with and conceptualization of motivation in math. Our interest was to categorize these experienced motivations, look for commonalities, and to summarize these in a way that deepens our understanding of students' motivations.

Two main dimensions were generated from students' responses after the analysis, as shown in Table 1.

Table 1: The types of student motivations arising from the six student interviews.

		Dimension 2: Willingness	
		Intrinsic	Extrinsic
Dimension 1: Outcome	Intrinsic	Intrinsic outcome Intrinsic willingess	Intrinsic outcome Extrinsic willingness
	Extrinsic	Extrinsic outcome Intrinsic willingness	Extrinsic outcome Extrinsic willingness

An *outcome* is the desired result a student wishes to achieve. *Willingness* is the force that assists in achieving the outcome. Below are descriptions of the four types of motivations arising from the student interviews. We chose the descriptors "intrinsic/extrinsic" so as to correspond to existing literature (cf. [12]).

Category 1: intrinsic outcome // intrinsic willingness

Students in this category tend to study math out of an internal desire to improve their math abilities and draw on personal resources to do so. For example, one student in this group said, "I [want to] take a math class just so my strengths could keep going." A student who has intrinsic willingness states that when they have homework, they complete the task "right after [they] get out of class," and finds "a friend that's also in [their] class [to have] study sessions together to try to work the problems out together." The students' own will to complete the homework in a timely manner and their own choice to form a study group show their intrinsic willingness to reach their desired outcome.

Category 2: intrinsic outcome // extrinsic willingness

Though students in this category have an internal desire to improve themselves in math, they draw on external resources to accomplish that. For example, a student who has an intrinsic outcome but has an extrinsic willingness expresses that having a good math teacher motivates them to study math. As an example, one student wrote, "[I] only had one good math teacher... the other ones weren't too good. Nobody really liked them. It was kind of hard to learn the coursework." To have a good math teacher represents an outside force to motivate them to study math.

Category 3: extrinsic outcome // intrinsic willingness

Students in this category have the internal resources to accomplish their goals in math but tend to have external reasons for learning math. A student who has an extrinsic outcome utters a statement, "I want to pass the math course." Their goal comes from the course itself. Another example of an extrinsic outcome is "I probably would really want to learn the formulas...

to be in some sort of work field." Their goal comes from a career choice. A student who has an intrinsic willingness to achieve an external goal utters a statement, "I struggle with [the course] but I think that was my motivation, just to do better at math." The desire to learn a concept is intrinsic willingness because it's from their own personal choice, but the reason to learn a concept is to accomplish some external goal.

Category 4: extrinsic outcome // extrinsic willingness

This category describes students who tend to have neither the personal reasons nor desire to learn mathematics. A student who has an extrinsic outcome desires "to just finish (the course) already...math isn't my favorite subject, so it's kind of hard motivating myself." This student struggles to seek intrinsic motivation with the course. They express that the class rule of receiving 85% on the final guaranteed passing the class "gave [them] a lot more motivation." The 85% class rule is an external force that motivates them to achieve their desired result.

These student interviews were held to gain a better understanding of what motivation means to developmental math students. Students who fall in any of the four categories have *some* form of motivation and this is what is important here. We attempt to avoid value judgments of the students' motivations. Instructors might desire to see an intrinsic outcome || intrinsic willingness orientation in our students, but we also need to recognize that this is not necessarily the only way a student can succeed in this type of mathematics class. Indeed, if the students in the course we are considering tend to have lower motivation, might it not be beneficial to have a peer with similar motivation to discuss how they found success?

5. Study 2: The Motivation Workshop

5.1. The Concept of the Workshop

The first author created and organized the Math Motivation Workshop in Spring 2018. Our driving question was: Can the presenters (successful students) reach current developmental math students to motivate them? We claim peers are better able to connect with the students and this should

be leveraged to better motivate our students. Thus, the intention of this workshop was to have successful students from the prior semester, each with different motivations, to present to current students on what motivated them to do well in the course. We also hoped that the workshop could improve current developmental math students' academic performance and success skills such as attending class, using campus resources, and going to professors' office hours.

5.2. Workshop Presenters

There were six total workshop presenters (not the six students interviewed for the first part of the study). The first author handpicked the workshop presenters and contacted them directly: five were successful in the Fall course, and the sixth was a promising Spring student. These students were chosen because they each had a desired outcome, either internal or external, they wanted to achieve and put in a great amount of work and effort to achieve this outcome. They attended class and office hours regularly and presented as strong role models for their peers.

5.3. Workshop Preparations

The first step in the creation of the workshop was to pitch the idea to the university's Peer Mentor program. This program trains undergraduate students to be embedded, in-class mentors who facilitate interactive class activities and, importantly for us, offers student-led workshops and seminars on topics relevant to being a successful university student. Once the peer mentors were on board with the workshop idea, we set the dates, planned an icebreaker session, and designed the activities of the workshop. We also designed flyers and posters to advertise the workshop to the students.

Then, the presenters needed to be prepared for the workshop. The first author asked them to write essays based on the following questions.

1. Describe briefly your personal experience with the course.
2. What are/were your concrete goals associated with this course?
3. What are/were your anxieties associated with this course?
4. What motivated you to do well in this course?

5. Did your motivation help you in this course? If so, how?
6. Describe how you studied for the course/how you prepared for exams. Think about study strategies that work for you and study strategies that don't work for you. Also, think about how long you did these tasks. (i.e., how long did you spend on homework, how long did you spend on studying for an exam, etc.)

5.4. Presenters' Responses

Presenter students' essays in response to the questions in Section 5.3 were analyzed in the context of the two-dimensional motivation framework that emerged in the first study (Table 1). Each presenter was classified as being in one of the four categories of motivation. Summaries of these categories in the context of the presenters are given below, with brief examples.

Category 1: intrinsic outcome // intrinsic willingness

Presenters in this category desired for "[their] foundation in math to be as strong as possible" in order to prepare them for higher math classes. Their willingness "[was] knowing that no matter where [they go] in life, [they don't] want to doubt their abilities or go through life scared." They want to do well and build strong skills for their mathematical foundation demonstrates their intrinsic willingness to reach their intrinsic outcome. One presenter fell into a Category 1 motivation.

Category 2: intrinsic outcome // extrinsic willingness

There were no presenters who fell into a Category 2 motivation.

Category 3: extrinsic outcome // intrinsic willingness

These presenters wanted "to get out of remediation [developmental math] in one semester" because they expressed that if they "did not pass the course in one semester, [they] would have fallen behind two semesters." Their desired outcome came solely from the course. However, their motivation towards passing the course was intrinsic: they spent "a good solid hour on homework" and "studying two hours for the exams for three to four consecutive days."

Their dedication towards working on their goal came from within and their own personal study habits were manifest. Three presenters fell into a Category 3 motivation.

Category 4: extrinsic outcome // extrinsic willingness

These presenters' ultimate desired outcome "was to pass the entire full year class because [they] really wanted to stay in San José State ... and [they] wanted to get [the class] out of the way." Their outcome came from their academia as well. Then, their willingness to achieve their goal included "staying in San José State University for [their] family." The university and family represented the external forces to motivate them to reach their outcome. Two presenters fell into a Category 4 motivation.

5.5. Workshop Overview

The workshop started with an ice-breaker to create a comfortable setting. Then, presenters shared their own experiences in the course. The participants (current students) spun the "Wheel of Success" which contained questions pertaining to the presenters' course experience. For example, if a participant spun the wheel and it landed on "what study strategies did you use in this course?" the presenters were able to share their own experience with that specific question. The participants initially listened to the presenters speak about their experiences about the course and then engaged in an interactive discussion.

In the discussion, the presenters opened up the floor to the participants to ask any questions they might have about the presenters' stories. The participants also shared their own experiences in the course. Then, the presenters and peer mentors informed the participants about on-campus resources and other student success skills services. In the last five minutes, the participants filled out the Math Motivation Workshop Exit Survey (see Appendix A for a copy of the survey).

6. How Effective was This Approach?

6.1. Workshop Exit Survey Feedback

In all, 87 students provided feedback on the Motivation Workshop Exit Survey. We asked Question 1 (Q1), "Did this workshop change your motivation in this course? (Yes / No)". 80 responded "yes", 3 responded "no", and 4 left the question blank. This result alone, though preliminary, is fairly promising; a future study might investigate how such a workshop might transform student motivation.

To get a sense of how effective the workshop was in reaching its goal, we posed Question 2 (Q2), "How effective was this workshop in changing your motivation in this course? (Extremely effective/Very effective/Moderately effective/Slightly effective/Not at all effective)". Counts of responses to this question are shown in Table 2. Again, we find these responses promising and indicative of the effectiveness of the workshop.

Table 2: Counts of responses to Q2: "How effective was this workshop in changing your motivation in this course?"

Response Choice	Count
Extremely	21
Very	32
Moderately	28
Slightly	2
Not at all Effective	0
Blank Responses	4

The qualitative responses for the remaining questions evoked the experience of the workshop from the students' points of view. The first author highlighted keywords that demonstrated motivation and then summarized the main "types" of responses that emerged to analyze the survey. The main types of responses for Question 3 (Q3) are reported in Table 3. Overall, we are pleased with the concrete ideas that the students generated. We are unaware if each student enacted their ideas, but we also acknowledge that students merely recognizing possible ways in which they could improve their performance in mathematics can have long-term benefits.

Table 3: Counts of responses to Q3: "Do you plan to do things differently in this course? If so, what? Be specific."

Responses	Count
Work on study strategies / studying more	39
Attending office hours/study halls/labs	20
Ask more questions / Ask for help when needed	12
Improve communication with the professor	11
Attend class more	7
Forming study groups / Talking to my peers	7
Putting more time/effort in the class	7
Using Peer Connections / Talk to my peer mentor	5
Do online HW (Edready)	5

The responses to Q3 were varied, but also encouraging. Typical responses centered around changing behavior: "I plan on practicing after the lecture a lot more and asking Ms. Mean if I have any questions. I will not slack off and give up", "I plan on attending office hours and study hall, and also my lab on Tuesdays and Thursdays to get extra help," and "I never really go to office hours so now that I know it can help, I will go." The actions students plan to do suggests a shift in student motivation. The Math Motivation Workshop may have influenced how students felt a change in motivation after attending a workshop.

The most common responses to Question 4 (Q4) are in Table 4. The participants expressed that hearing the presenters' stories were helpful because the participants did not feel alone. Students said "hearing everyone else struggling just like me", "knowing other students feel the same about this course", "finding others in the same position", "I like how the students shared their stories from the class and how they will change their study strategies", and "the way everyone was comfortable speaking was really helpful because it made a safe haven for us to share things." What we take from these responses is that attendees appreciate having peers to talk to about these issues. Many of our students at our institution are first in their families to attend university. This presents a challenge to them: they may not have someone in their lives who they can relate to over their emotions that arise during university.

University students undergo immense personal and social change during their studies and the non-academic experience is seldom discussed. The workshop seemed particularly effective in foregrounding these common experiences.

Table 4: Counts of responses to Q4: "What did you find helpful/useful in this workshop?"

Responses	Count
The presenters sharing their past experiences	35
Didn't feel alone	16
Finding out ways to get help (learning strategies/helpful tips about students success skills)	12
The workshop was motivational/ encouraging	9
The different ways of communicating with professors	8
Getting information about passing the class	6
Create a space to express my feelings	5

Question 5 (Q5) asked "Please provide any other feedback/suggestions about this workshop". The responses were positive and constructive, such as "everything good. More discussion with all students", "I liked this workshop. I don't think there is anything to change"', "if the workshop was hosted in a bigger venue, that would be great!", "have multiple workshops like this throughout the semester", and "very comfortable, feeling we are not alone". The remaining responses included recommendations for having better incentives for attending the workshop, making the workshop longer in duration, promoting it more, adding a visual aid, and providing food/refreshments.

6.2. Workshop Discussion

Overall, the Math Motivation Workshop appeared to have provided a positive and encouraging space for students. Students found the workshop effective and indicated a behavioral change in response: 84 out of 87 students reported on Question 3 of the survey that they planned on doing things differently in the course; this included attending office hours more and forming study groups. At the end of the workshop, a few students independently exchanged phone numbers because they wanted to form study groups together: further anecdotal evidence that the workshop was effective.

7. Test 2 and Test 3 Analysis

7.1. Data Summary for Test 2 and Test 3

A further indicator of the success of this workshop, albeit a proxy measure, could be a change in student performance in the course. To see if we could find such an indication, we compared performance on two tests, Test 2 (before the workshop) and Test 3 (after the workshop). The summary statistics for these tests are presented in Table 5.

Table 5: Data Summary for Test 2 and Test 3.

		Test 2	Test 3
Overall Performance (N=159)	Mean	0.64	0.65
	StDev	0.21	0.20
Attended Workshop (N=75)	Mean	0.62	0.64
	StDev	0.19	0.20
Did not attend Workshop (N=84)	Mean	0.66	0.66
	StDev	0.22	0.20

Overall, there were no significant differences in average Test 2 and 3 performance. We further partitioned this data into that for those who attended the workshop and that for those who did not attend the workshop. There was still no significant difference in test performance for either of these two groups. However, those that attended the workshop had lower Test 2 scores than those that did not attend the workshop. This suggests that the motivation workshop tended to reach those students who could potentially benefit the most from it. This is a positive result. After the workshop, those that attended the workshop appeared to have increased their test averages, and those students who did not attend the workshop had the same test averages. Though this difference in test average is not significant, it suggests that such a workshop has the potential to improve student performance.

7.2. Attendance by Test 2, Test 3, and workshop

Attendance plays a role in students' academic performance so we next considered test attendance. Test 2 and 3 attendance is reported in Table 6. There were only two students that attended the workshop and did not take Test 3.

On the other hand, there were 23 students who did not attend the workshop and did not attend Test 3. Students who attended Test 3 demonstrated some form of motivation since attending the tests assists them in reaching their outcome such as passing the course.

Table 6: The number of students by Test 2, Test 3, and workshop.

Test 2	Total
Students that attended Test 2 and attended the workshop	77
Students that did not attend Test 2 but attended workshop	1
Students that attended Test 2 but did not attend the workshop	93
Students that did not attend Test 2 and did not attend the workshop	14
Test 3	**Total**
Students that attended Test 3 and attended the workshop	76
Students that did not attend Test 3 but attended workshop	2
Students that attended Test 3 but did not attend the workshop	84
Students that did not attend Test 3 and did not attend the workshop	23

One way of interpreting Table 6 is to think about students' attendance through the semester. Students' attendance tends to decrease as the semester progresses; and this might have resulted in lower motivation to attend Test 3. The decrease in attendance during the course of a semester is due to many factors, which can include course design, an increase in workload, midterms in other classes, and students experiencing illnesses. Any one of these factors might lead to students' interest in the course to wane, and similarly, any one of these might have resulted in lower motivation to attend Test 3. From this perspective, even though it might be difficult to discern the precise mechanism that explains everything, it is plausible to suggest that the Motivation Workshop seems to have assisted students in maintaining their motivation to attend the tests and improve their chances of success in the course.

7.3. Summary

In sum, the Math Motivation Workshop did not appear to make any difference on the Test 3 average versus the Test 2 average. However, we still see two good reasons to be optimistic. First, our intention with the Motivation Workshop was to improve student motivation, especially the lower-performing students. Based on the comparison of the Test 2 averages for those who attended the workshop and those who did not, it appears that mostly lower-performing students attended. Secondly, those who attended the workshop were more likely to take Test 3. That is, we appear to have reached our intended audience and these students exhibited greater participation in the course. These are strong indicators of the success and promise of the workshop.

8. Conclusion

It's imperative for instructors to acknowledge students' emotions and to be aware of students' goals; doing so may help in assisting them to reach academic success. Incorporating student peers in the teaching and learning environment is one way an instructor can make their mathematics courses more motivating. This is where peers can play a big role. Instructors may need to be aware of students who put in a strong effort and work needed to achieve high academic performance because those students may influence the students who may struggle with putting in the effort and work. Successful students that understand the importance of academic achievement may influence struggling students and may be better positioned than instructors to help them succeed.

8.1. Future Plans

Though the Math Motivation Workshop was successful in some regards, in particular, in reaching the students who might benefit the most, we recognize ways in which it can improve. In particular, a series of workshops can be provided in the beginning, middle, and end of the semester. The workshop in this study did not contain a continuous theme of motivation for students since there was only one workshop for the semester. Perhaps exposing students to more motivation workshops can offer more consistency for students.

Then, a continuous theme of motivation and continuous support from instructors and educators may improve student academic performance for students. Indeed, motivation is only one affective variable that students might be struggling with. There are others (e.g. anxiety [2]), and having more student-led, student-focused activities that target these are likely to have a strong positive impact.

8.2. Final Thoughts

One could have expected — or at least hoped — that infusing a course with an emphasis on motivation, or other affective factors associated with learning and performance, might manifest as noticeable effects on student performance. In our case, the motivation workshop appeared to have no effect on academic performance. However, we believe that the value in the workshop was that it created a space for students to connect with their peers and discuss issues that are outside of the curriculum, but integral to the university experience. This seems to be what students appreciated most. Our view is that such a workshop would have been less successful if either of us had presented it. Having peers run the workshop made it more authentic, facilitating the association of a much needed human face to learning mathematics.

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A. Math Motivation Workshop Exit Survey

Math 1005B Motivation Workshop Exit Survey

Name: _____ Class Instructor: _____ Class Section: _____

1. Did this workshop change your motivation in this course? Yes / No
2. How effective was this workshop in changing your motivation in this course?

Extremely effective/Very effective/Moderately effective/Slightly effective/Not at all effective

3. Do you plan to do things differently in this course? If so, what? Be specific.
4. What did you find helpful/useful in this workshop? (if any)
5. Please provide any other feedback/suggestions about this workshop.