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The impact of peer tutoring on elementary students' mathematical education

Kristen Clapp

The Impact of Peer Tutoring on Elementary Students' Mathematical Education

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Kristen Clapp

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Approved:

Kimberly Rombach

EDU 698 Course Instructor

Kim Wieczorek

CECE Department Chair

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Abstract

This action research study utilized a mixed-methods approach to determine the impact peer tutoring can have in mathematical instruction within a fourth-grade classroom. Data was collected using student-surveys, personal journal entries, and student work samples over the course of a four-week time frame. Report findings show both unchanged and positive impacts in students' achievement in math as well as data supporting the idea that students who present high mathematical comprehension prior to the study result in no significant impact in mathematical achievement through peer tutoring. This study also displays how student skill and personalities impact effectiveness and ineffectiveness in mathematical work results.

Overview

When it comes to teaching mathematics, there are many different approaches that can be utilized. However, some teaching strategies are more popular and practiced more commonly than others. Such as whole group mathematical instruction is a commonly seen teaching strategy for math. One method that is becoming more recognized is the use of peer tutoring in the classroom when teaching and learning mathematics. According to Tsuei, "Peer tutoring is one of the most well-studied strategies in mathematical instruction" (2014, p. 2014). Peer tutoring has a multitude of information providing various perspectives on the effectiveness of the strategy. Tsuei (2014) states that peer tutoring can be defined as, "people from similar social groupings who are not professional teachers, helping each other to learn, and learning themselves by teaching" (as cited in Topping & Ehly, 1998, p. 115). In other words, this means that peer tutoring is when students from a similar social group help and teach each other the material in order to increase learning, which in turn helps them learn through teaching. Through a multitude of observations in various classrooms as a prospective teacher, I have noticed that some commonly used mathematical teaching strategies in classrooms are small individual or partner groups and whole instructional groups. In doing this, I have seen students having difficulties with comprehension of a mathematical topic but is unable to get the individual assistance and explanation that is needed to help them be successful and excel in the topic. Within a classroom, there is a large range of students at various points in their learning and by creating more individualized instruction, possibly through peer tutoring, mathematical outcomes may improve. This paper will attempt, through a review of literature, to answer the question: how does peer tutoring promote mathematical achievement in elementary students?

Introduction

As I began my research, I found several studies that have taken place on the topic of peer tutoring effects on mathematical education for elementary students. For the purpose of this review, I chose to emphasize findings found in five specific research studies done on this topic. From reading these five articles, I found three main themes that show exceptions, positives, and additions to peer tutoring in mathematics. The first discussion point that I found is that peer tutoring is effective for mathematics and improves student learning due to the idea that peers prefer asking other peers for help over asking a teacher. Additionally, studies have found peer tutoring to be a particularly beneficial strategy to support students with learning disabilities. A final theme that is present in the articles is exceptions to peer tutoring. There is an argument for peer tutoring being an effective practice for mathematical education when there is an addition with either cognitive load theory, explicit instructional teaching strategies, or with teacher creation of tutor selection, training, roles, and tasks for the tutoring session. A common theme overall for these five articles is that peer tutoring for mathematics in elementary school is an effective method of teaching for students and teachers to implement within their classroom.

Requesting Help

One of the articles that was analyzed supports the idea that students prefer to ask their classmates for assistance when confronted with a problem in mathematics rather than asking their teacher for guidance. Araya and Gormaz state, "…students prefer asking classmates for help three times more than asking their teachers when given the choice" (2021, p. 1). This further supports the idea that students would prefer to utilize their classmate assistance that peer tutoring offers over asking for the teacher for help every time they have a question. Araya and Gormaz (2021) also suggests in their study that students would prefer to ask for help from classmates that are of the same sex and that are seen as higher in academic performance (p. 1). By these results,

it suggests the idea that students have a preference for whom they are paired up with for peer tutoring and feel as those some students may be more beneficial in helping them than others might be. This article also suggests the idea that students should be able to privately select whom they want to ask help from in mathematics (Araya & Gormaz, 2021, p. 13). Thus, this article encourages teachers understand that peer tutoring pairs need to be selective and preplanned to be effective in practice.

Learning Disabilities

Tsuei (2014) studied the impact of a synchronous peer tutoring program for students with various learning disables. From the study, Tsuei's results suggest that "the proposed system was effective to enhance the mathematics learning of students with LD, especially the learning of conceptual and application of math problems" (2014, p. 115). This suggestion shows that peer tutoring can be an effective mathematical learning strategy for all students. However, "they found that students with disabilities showed significantly greater progress than students without disabilities" (Tsuei, 2014, p. 115). According to Tsuei, some reasons that as to why peer tutoring is effective for students with learning disabilities are that peer tutoring fosters a learning environment that ensures active participation and it allows students to receive individual attention and immediate feedback (2014, pp. 115-116). Although these are both reasons as to why students with learning disabilities may thrive in this learning environment, it has also shown to be a positive learning environment for all types of students.

Additions

Three of the five articles reviewed suggest that peer tutoring is an effective learning strategy for students but can be even more effective when accompanied with another theory or practice. Tella (2013) states that a "primary school practicing Mathematics teacher should constantly use

peer-tutoring and explicit teaching instructional strategies in Mathematics classrooms" (pp. 5-6). Tella suggests explicit teaching instructional strategies as a structured and guided approach to create meaningful learning (2013, p. 8). By combining explicit teaching with peer tutoring, Tella suggests that peer tutoring can improve overall achievement in mathematics (2013, p.22). However, Baiduri (2017) advises that teachers should create more strategic and meaningful tutors within peer tutoring to create the most effective use of the peer tutoring strategy. The study recommends that teachers preselect and train their tutors, provide tutors with clear responsibilities, and to prepare materials and tasks to assign students ahead of time (Baiduri, 2017, p. 155). In addition to this, Baiduri also found in the study that "tutors' spoken activities covering: questioning, answering, explaining, discussing, and presenting, were improved" (2017, p. 145). This shows that peer tutoring not only improved comprehension of the topic, but also improves various other skills for students. Overall, Baiduri determined that peer tutoring when chosen and prepared by the teacher brings positive behavioral, social, cognitive, and academic impacts (2017, p. 147). Russo (2018) also agrees that peer tutoring is a beneficial strategy to use when teaching mathematics. Their study argues that peer tutoring's effectiveness can further increase when combined with cognitive load theory. According to Russo, there are three forms of cognitive load: intrinsic, germane, and extraneous. Intrinsic cognition is related to the complexity of a task whereas extraneous cognition refers to mental effort and energy that is wasted by insufficient instructional design. Germane cognition refers to a person's working memory based on the information obtained during task complexity (Russo, 2018, p. 614). Russo suggests that "cognitive load theory implies that teachers should develop instructional tasks and approaches to instruction that minimize extraneous cognitive load, maximize germane cognitive load, and optimize intrinsic cognitive load" (2018, p. 614). This means that teachers should create

mathematical instruction that increases task complexity and working memory while decreasing activities that misuse student mental energy and effort. In general, Russo, Tella, and Baiduri all agree that peer tutoring is an effective strategy to utilize when teaching mathematical education but can be even more effective when combined with another skill or strategy.

Summary

The goal of this literature review was to answer the question, how does peer tutoring promote mathematical achievement in elementary students? The findings in the five articles presented show that peer tutoring does increase mathematical achievement in elementary students. Three main themes that were then discovered in this article were using peers to request help, how peer tutoring benefits students with learning disabilities, and additions that can be made to peer tutoring to increase its effectiveness. The articles also have shown ways peer tutoring can be beneficial in promoting mathematical achievement. Araya and Gormaz (2021) found that students prefer to ask other students for help rather than asking the teacher (p. 1). Through peer tutoring, students can get this form of help. Students can engage with peers to get assistance which improves social abilities and their mathematical comprehension. Tsuei (2014) determined that by peer tutoring, a learning environment is created that ensures active participation and individual and immediate feedback which increases student's progress in math (pp. 115-116). These two studies differed from the remaining three article studies since they did not suggest an additional method to be used in addition to peer tutoring to increase effectiveness. In Baiduri's article (2017), the idea of selecting tutors strategically was suggested. By doing this, tutors learn to question, answer, explain, discuss, and present ideas (p. 145). It also found that since tutors are prepared and chosen, there are positive social, behavioral, cognitive, and academic impacts for students (p. 147). Tella (2013) found that when peer tutoring is combined with explicit teaching

strategies, students engage in meaningful learning which improves math achievements (p. 22). In the final article, Russo (2018) presented findings that show how cognitive load theory, when applied with peer tutoring, creates lessons that are more beneficial to students which then can increase student ability to complete complex tasks and their working memory (p. 614). In conclusion, peer tutoring when used in elementary classrooms can be an effective learning strategy to increase mathematical comprehension for most types of learners. When paired with an additional strategy, peer tutoring's effectiveness can increase. Peer tutoring can promote elementary student's mathematical achievement by fostering a beneficial learning environment for students, increasing student's social, behavioral, cognitive, and academic skills, increasing meaningful learning for students, and improving student's working memory and ability to perform complex tasks.

Methods

Setting

This study took place in a fourth-grade classroom in an intermediate school located in the Central New York region. With a town population of around 3,000 community members, there are many resources offered. People in the community can often be found at the local-owned shops, at the park, or enjoying a walk through the town. Community members have accessible resources to them such as hospitals, fire departments, banks, town centers, and many others. This town is also conveniently located next to a major highway that allows easy access to larger towns and cities nearby.

Out of the 1,832 students within this school district, 354 students are enrolled at the school this study takes place at. Within the district, 3% of students identify as Hispanic or Latino, less that 0% of students identify as Black, 1% identify as Asian, and 3% identify as multiracial. The

remaining 93% of students in this district identify as White. 1% of students are English Language Learners, while another 10% of students have a disability. Another 1% of the students within this district are considered homeless. However, a large percentage, 44%, of students are considered economically disadvantaged. These percentages can then be narrowed down to the individual school that this study took place at. Within the school itself, 1% of students identify as Black and another 1% identify as Asian. 4% identify as Hispanic or Latino, and another 4% identify as multiracial. This leaves 91% of the student population who identify as White. Of this school's student population, 1% of students are English Language Learners, 10% are student with disabilities, and there is 47% of the student body that is considered economically disadvantaged. These statistics can be even further condensed to the classroom population which will be seen in the participants section of this paper.

Participants

The participants of this study were fourteen, fourth-grade students between eight and ten years of age. The mathematic instruction portion of the day occurs for approximately one hour each day and utilizes stations. This study took place under a host teacher for the fourth-grade classroom. This teacher has been teaching for approximately 18 years and holds a Bachelor of Science in elementary education for preK-6th grade, a masters in literacy birth-6th grade, and a C.A.S. in Educational Leadership. The teacher's philosophy of teaching can be described as all kids have the ability to learn, teacher's need to find the best method to help each student learn best. This room also has three additional support staff members including a special education teacher, a teacher aid, and a one-to-one teacher. Students in this classroom are primarily identified as White with .05% being Black and another .05% being Asian descent. Students with disabilities were not included in this study because they were taught math content while in a

separate special education classroom. Approximately half of this school's student population is considered economically disadvantaged. The overall goal for mathematical instruction that is currently not being met is consistency in mastery of mathematical comprehension.

Materials

The three data collection tools that were used in this study were surveys, student work samples, and field notes. Students completed two different surveys throughout the study. Both student surveys are related to student feelings and opinions about how the peer tutoring went. One has an additional section where students write their input on a student that they feel like they work well with and a student that they feel as though they do not work well with. This feedback was used to help alter and adjust the peer tutor groupings. Student work samples were used as formal feedback to determine if students were able to progress in the mathematical content through peer tutoring. Work sample results and field work observation notes was also used to help determine if student's peer tutoring groups was beneficial. This feedback was compared to the student surveys. Student work samples were taken from the independent workstation, which is their formative assessment, and from collaborative work done in peer tutoring to compare if the efforts done in peer tutoring increased students' independent ability to complete the mathematical skill. Students are following the New York State Common Core Mathematics Curriculum and were on module five, which pertains to the topic of fractions.

Procedures

Students were grouped in the teacher led instruction station in a variety of ways throughout this implementation period. Although this research does not include how they performed in their teacher led station, it is important to note the changes that occurred. When I first began this study, students were arranged in small, homogeneous groups by skill level for teacher led

instruction. I found this ineffective for teaching since some of the groups required additional guidance from peers or the teacher which was not attainable due to group arrangements. I rearranged groups from this to allow a heterogeneous grouping student skill levels in each group based on personalities. I found that this limited the student's ability to excel in their collaborative group since peer tutor options were reduced in each group. It also did not allow enough time for students in peer tutoring group to effectively complete their work. Thus, I switched to whole group teacher led instruction while making sure to give students time to practice independently with 1:1 guidance from myself. I provided students with guided instruction, and then independent practice problems. Once their work was checked by me, I allowed those who finished to continue practicing additional questions. This helped students who were ready to move ahead, keep practicing and learning while those who needed extra assistance was able to ask me or a peer nearby for help. Students completed their independent station as an exit ticket to take be used as the formative assessment. Students used peer tutoring in the collaboration station through a preselected grouping, that I determined, for a course of a week. Some specifications that were used to determine the peer tutor groupings were known student personalities, student tendencies, student skill levels, and personal knowledge of previous student collaboration. Student tutoring groupings varied week to week based on student confidence and comprehension level of the materials as well as personalities. Due to this, students were uninformed of having a peer tutor. I found that this lessened the pressure and expectations for the students in collaborative math. Students were reminded daily of expectations within collective math. These expectations including working together, helping your partner if they do not understand, making sure you are reading directions, looking back at the previous lesson for clarification, making sure your group stays focused, and making sure you and your partner and simultaneously working on

the same question. Within the study, I observed and recorded in my observation notes that many times, students were off-task due to peer interactions with students outside of their group member. To combat this, I assigned groups specific seating for each week to reduce distractions. I had two groups work in the hall, two on the carpet, and three at tables facing away from each other. I determined who would work in the hall based on which students work most effectively with a quiet workspace. The groups that worked on the carpet was based on who effectively works with flexible seating options. At the end of collaboration, students were provided a student survey to determine their personal thoughts and feelings about how the peer tutoring session went. They completed this survey away from other students and turned the paper in, face down, to me. Students were informed that the information on survey information was for my eyes only and assured other students would not see their responses.

Type of Research Conducted

In this mixed method study, quantitative information came from the student work samples while the qualitative data was obtained through student surveys and field notes. The qualitative data in the student work samples ensures that peer tutoring groups are progress in mathematical comprehension. The qualitative data from the student surveys and field notes helped to understand the social-emotional status of the students within the peer tutoring group. Social-emotional refers to a student's overall well-being in their classroom peer community and their mental health. Students that do not find that they collaborate well together due to personality differences will most likely not have as much progress in an academic setting as they would if they were paired with a tutor or tutee that they get along with in general.

Timeline

This study took place over the course of approximately eight weeks. Data was collected for about one hour, five times a week. Each week, students were given a different peer tutoring group to assess different grouping effectiveness.

Phases	Description	Dates
One: Collecting Baseline Data	During this time frame, I collected data from current collaborative math groupings through observations notes of groups, student surveys, and student work samples. This data was used to examine current thoughts, feelings, and comprehension level of students in randomized mathematical groups.	February 14th – February 18th
Two: Implementing an Intervention	Students were arranged into peer tutoring groupings ahead of time that get adjusted weekly. After each collaborative math group session, each student went to a secluded section of the room with a student survey to complete.	February 28th – March 16th
Three: Collecting Post Data	After students have completed the student survey, they flipped their survey over and handed it into a designated location in the room.	February 28th – March 16th
Four: Analyzing Data	After all data is collected, I created a chart organizing the information, determining averages of students, and findings trends in individual students and in weeks of data.	February 28th – April 25th

Limitations

There were a few limitations that this study presented. The most significant limitation that was noticed was missed days and absences. In general, students were absent for sickness or medical reasons quite often throughout the data collection time frame. In total, out of the 14 days that were used for collecting data, there were 23 student absences. Because of this, there is the possibility of missing and inconsistent data. If there were an odd number of students that day due to absents, some peer tutoring groups were small groups of three students sharing the role of either the tutor or tutee rather than two students each with their own role. It also means that students that missed multiple days in a row would be significantly behind in their mathematical comprehension. A peer tutor is not responsible for getting a student caught up on missing concepts from days they were absent. This also raises the limitation of the peer tutor within the collaborative group being absent. Within the study, it is found that when the peer tutor was absent, the group's work sample grade notably decreased. Another limitation presented by this study is the timeliness of the math lessons. Students move to a new lesson each day and review the previous days lesson in peer tutoring groups. Due to required curriculum pacing, students did not get ample time to fully comprehend and learn each lesson. This also creates variation in tutor ability. If the tutor did not comprehend the lesson from the day before or was absent, they did not get the ability to be the most effective tutor for the tutee. Another limitation is that when students are having a challenging day emotionally, they are more likely to struggle with academics in general. Refer to appendix C for an example of this limitation. A final limitation found within the study is student truthfulness in answers on their surveys. If students are not honest with how they felt the tutor session was, it can skew the data, this can be seen in appendix D.

Analysis

I used my three tools of data collection to accumulate and analyze data. Throughout the study, the mode data of each day was used to determine the mathematical score that was achieved the most that day. At the end of the study, I began by analyzing the data by sorting the tools into qualitative and quantitative information through charts. I then analyzed the quantitative information based on how the student did in their peer tutoring group compared to in their initial data. Next, I created means, or averages, of each student's scores for each week and the overall class average for each day. I also used this time to look for inconsistencies and abnormalities from known tendencies of students. This was done by using median data in order to provide an idea of if outlier scores. Median scores were able to show me each student's grades in a progression through time which showed my their lowest, highest, and middle scores. I took the averages and placed them in a separate chart to compare data. I used this to determine the students that benefited from peer tutoring, ones that were not impacted, and those that found peer tutoring to be damaging to their comprehension. I examined each of their grades directly with their qualitative data from the surveys to find trends. As I looked through this data, I compared it with field notes to determine if there were any other important factors to note about each group that I wrote down during that day's lesson that should be considered.

Findings

Table 1 shows each student's average grade per week compared with their baseline data. Abnormalities within the data represent students that scored higher or lower than they typically do. For example, student 2 was absent all days during the week of baseline data except for one day of work that he got a 100% on, resulting in a 100% average for baseline data. This is inaccurate to the student's true scores, which are more accurately depicted throughout the rest of the study. This is similar for student 8 and student 10. Alternatively, students 11 and 12 both

show data that is lower than their typical abilities. For example, student 12 was absent the majority of the days during week 3. This created difficulties in math that week due to missing instruction and practice which resulted in a comprehension grade lower than usual.

Table 1

Student Data – All Students

	Baseline	Week 1 Average	Week 2 Average	Week 3 Average
Student 1	0%	47%	61%	31%
Student 2	*100%	55%	51%	57%
Student 3	100%	87%	97%	92%
Student 4	53%	65%	69%	100%
Student 5	62%	83%	90%	86%
Student 6	100%	92%	93%	100%
Student 7	45%	57%	72%	64%
Student 8	*78%	57%	83%	83%
Student 9	63%	77%	84%	–
Student 10	*93%	67%	72%	–
Student 11	84%	*65%	95%	90%
Student 12	67%	89%	92%	*50%
Student 13	71%	77%	78%	95%
Student 14	100%	86%	85%	89%
Overall Average	73%	72%	80%	78%

*Note: * represents an abnormality in student data. – represents no data collected due to student absents.*

Finding 1: Peer Tutors Impact Student Grades

From the collected and analyzed data, I recognize two overall findings. The first is that different peer tutors throughout different weeks does make an impact in student comprehension. This can be seen by all students in both positive and no significant change. These trends are specifically noticed in student 5, student 13, and student 4. Based on table 2 shown below, it shows that through the utilization of peer tutoring throughout different weeks, the student's mathematical comprehension increased steadily over the entire study whereas in table 3 and table 4, both students results were not significantly different from their base score showing that these

students were not impacted by peer tutoring. Qualitative data for students 4, 13, and 3 can be found on appendix E. Qualitative data related to students with no significant impact relates to the second finding and will be analyzed and explained in the discussion and findings section for finding 2.

Table 2

Positive Impact – Student 4

	Baseline Score	Week 1 Average	Week 2 Average	Week 3 Average
Score/100%	53%	65%	69%	100%

Table 3

Positive Impact – Student 13

	Baseline Score	Week 1 Average	Week 2 Average	Week 3 Average
Student 13	71%	77%	78%	95%

Table 4

No Significant Impact – Student 3

	Baseline Score	Week 1 Average	Week 2 Average	Week 3 Average
Score/100%	100%	87%	97%	92%

Finding 2: Students with High Comprehension Results Show No Significant Change

Based on table 5, all students started with high levels of comprehension in mathematical instruction and continued to stay at a high comprehension status throughout the entirety of the study. These students were not impacted enough by their tutoring group to increase their grade or maintain their grade at a 100%. These students were also seen to not be impacted by social-emotional factors of having a partner they did not enjoy. Student 6 is a good example of this claim. Table 6 shows that student 6 was unhappy working with student 10 and student 2 during

collaborative math yet still received a 100% for mathematical comprehension both times. This shows how students who began with a high level of comprehension of mathematics was not impacted by the tutoring group.

Table 5

Selected Student Data – No Significant Change

	Baseline	Week 1 Average	Week 2 Average	Week 3 Average
Student 3	100%	87%	97%	92%
Student 6	100%	92%	93%	100%
Student 11	84%	*65%	95%	90%
Student 14	100%	86%	85%	89%

*Note: * represents an abnormality in student data.*

Table 6

Student 6 Data - February 17

Student: 6	
Partner(s): 10	
Score on work: 100%	
I felt productive with my partner(s) during collaborative math today	
I felt like I understood the math in collaborative that we worked on together	
I felt like I was able to work well with my partner(s)	
My group was able to stay focused and work on our collaborative math the entire time	
I would like to work with this partner again	

March 16

Student: 6	
Partner(s): 2	
Score on work: 100%	
I felt productive with my partner(s) during collaborative math today	
I felt like I understood the math in collaborative that we worked on together	
I felt like I was able to work well with my partner(s)	
My group was able to stay focused and work on our collaborative math the entire time	
I would like to work with this partner again	

Note: Green indicates strong agreeance, blue indicates agreeance with statement, yellow represents no opinion, orange indicates dis-agreeance with the statement, red represents strong dis-agreeance.

Discussion

Finding 1: Peer Tutors Impact Student Grades

Based on information analyzed in literature review, studies have found peer tutoring to be an effective strategy for learning to increase mathematical achievement. Within my literature review, I mention how Tella (2013) states that a "primary school practicing Mathematics teacher should constantly use peer-tutoring and explicit teaching instructional strategies in Mathematics classrooms" (pp. 5-6). However, when looking at the information presented in my study, it shows that students had either a positive reaction to the peer tutoring or no significant impact from the peer tutoring. This finding is important to note because it shows that there was no negative result to student's mathematical comprehension for students who were already identified as high achieving. Each student was able to be successful in some manner throughout peer tutoring. This result is also important because it shows a variety of successful student partnering that can be utilized in different areas of the classroom. Table 7 shows all of the students that had increases in mathematical achievement from their baseline data to the end of the study on week 3. Some students show a small decrease in achievement from week 2 to week 3, such as student 5 and student 7. Since the change in achievement for student 5 during this time is -4, and for student 7 the change is -8.52, the results are not wide enough of a range to contribute the reasoning to peer tutoring. It rather is likely due to differences in topics covered, their emotional standings each day, and the number of days allotted for math that week. Students 1 and 12 did have a large change in achievement from weeks 2 to 3. Both of these students were

absent 1 of the 3 days allotted for mathematical instruction in week 3. Due to the absence, student 12 had significantly lower comprehension on the next day present in math than usual. This was also seen for student 1. In Baiduri's article (2017), the idea of selecting tutors strategically was suggested. By doing this, tutors learn to question, answer, explain, discuss, and present ideas (p. 145). This was also done throughout the study to help create a positive relationship between social-emotional needs and mathematical achievement.

Table 7

Selected Student Data – Beneficial

	Baseline	Week 1 Average	Week 2 Average	Week 3 Average
Student 1	0%	47%	61%	31%
Student 2	*100%	55%	51%	57%
Student 4	53%	65%	69%	100%
Student 5	62%	83%	90%	86%
Student 7	45%	57%	72%	64%
Student 8	*78%	57%	83%	83%
Student 9	63%	77%	84%	–
Student 10	*93%	67%	72%	–
Student 12	67%	89%	92%	*50%
Student 13	71%	77%	78%	95%

*Note: * represents an abnormality in student data. – represents no data collected due to student absents.*

This finding is also important because of the social-emotional standings that helped students to be successful in their peer tutoring groups. Not only does this data show us students that are beneficial as partners, but it also shows us the students who do not work well together. For example, when comparing student 4's qualitative baseline data (Table 8) with week 2's data (Table 9), it is clear that there is a social-emotional factor to student's mathematical achievement. When student 4 is working with student 5, student 4 feels very displeased with their overall ability as collaborative partners. This reflects in the score of student work on both

days of math during this time. However, when student 4 works with student 13 on week 2, the survey responses are much more positive and thus the achievement on the work in greater. This can also be seen in table 10, which contains journal entries related to student 4's input on the pairing.

Table 8

Student Data – Baseline

Student: 4		
Partner(s): 5		
Date:	15 – Feb.	17 – Feb.
Score on work:	50%	57%
I felt productive with my partner(s) during collaborative math today		
I felt like I understood the math in collaborative that we worked on together		
I felt like I was able to work well with my partner(s)		
My group was able to stay focused and work on our collaborative math the entire time		
I would like to work with this partner again		

Note: Green indicates strong agreeance, blue indicates agreeance with statement, yellow represents no opinion, orange indicates dis-agreeance with the statement, red represents strong dis-agreeance.

Table 9

Student Data – Week 2

Student: 4		
Partner(s): 13		
Date:	7 – Mar.	10 – Mar.
Score on work:	80%	71%
I felt productive with my partner(s) during collaborative math today		

I felt like I understood the math in collaborative that we worked on together		
I felt like I was able to work well with my partner(s)		
My group was able to stay focused and work on our collaborative math the entire time		
I would like to work with this partner again		

Note: Green indicates strong agreeance, blue indicates agreeance with statement, yellow represents no opinion, orange indicates dis-agreeance with the statement, red represents strong dis-agreeance.

Table 10

2/15 – Student 4 does not like working with student 5, results are also showing that they do not work well together.

3/3 – Student 4 came up to me today after math and told me that she enjoys working with student 3 but does not like working with student 5.

3/7 – Students got new assigned seats today for the classroom in general. Student 4 came up to me and asked why she was placed next to student 5 and stated, “If I don’t want to work with him in math, why would I want to sit next to him?”.

Finding 2: Students with High Comprehension Results Show No Significant Change

As seen in the previous finding, many students’ mathematical achievement increased through the utilization of peer tutoring. However, there were a few students who did not have a significant change in achievement throughout the study. This finding is important to note because it may indicate that peer tutoring was not beneficial for all students. Although it was not

harmful for students with high mathematical knowledge, it was not necessarily beneficial for them either. Some students, regardless of baseline comprehension levels, were significantly impacted by their peer tutor partner. For example, student 13 had a large impact in mathematical achievement based on who their partner was, and how they felt about them emotionally. When looking at table 14, it shows that student 13 had a negative experience working with student 7, which contributed to a 40% that day. However, when the partnering is switched to student 13 and student 4, the feeling of successfulness increases, and the student achieved a 100% that day. Table 5 shows the few students who did not demonstrate significant change throughout the study. Students 3, 6, 11, and 14 are all students who are considered high level students in mathematical comprehension. Although each student did not stay consistent with their baseline score, it is also unrealistic to expect these students to obtain 100% every week. For example, when looking singularly at student 6's data, all of these averages are still incredibly high even though two of them are below the baseline score.

Table 11

Selected Student Data – No Significant Change

	Baseline	Week 1 Average	Week 2 Average	Week 3 Average
Student 6	100%	92%	93%	100%

Additionally, some of the higher-level students did not emotionally enjoy their tutoring partner yet were still highly successful in their work. This shows that even though they were unhappy with their partner, they still have full comprehension of then material and their partner does not impact that ability. It also shows that placing a higher-level student with a lower-level student for peer tutoring is not always beneficial for both students. This relates to the social-emotional aspect of collaborative work. It requires the higher-level peer tutor to have a high level of patience for the tutee in order to be helpful. This also is an unfair expectation to have for high-

level students. Table 12 shows student 6, a high comprehension student, partnered with student 2, a lower comprehension student. Although social-emotionally the pairing worked, student 6 still had high achievement while student 2 did not meaning the pairing was not beneficial for learning. Table 13 is an example of a high comprehension student paired with a lower comprehension student. Social-emotionally, student 3 did not enjoy working with student 7. Even with those feelings, student 3 still had high achievement for that week.

Table 12

Student Data – Week 2

Student: 6		
Partner(s): 2		
Date:	9 – Mar.	10 – Mar.
Score on work:	80%	100%
I felt productive with my partner(s) during collaborative math today		
I felt like I understood the math in collaborative that we worked on together		
I felt like I was able to work well with my partner(s)		
My group was able to stay focused and work on our collaborative math the entire time		
I would like to work with this partner again		

Student: 2		
Partner(s): 6		
Date:	9 – Mar.	10 – Mar.
Score on work:	30%	71%
I felt productive with my partner(s) during collaborative math today		

I felt like I understood the math in collaborative that we worked on together		
I felt like I was able to work well with my partner(s)		
My group was able to stay focused and work on our collaborative math the entire time		
I would like to work with this partner again		

Note: Green indicates strong agreeance, blue indicates agreeance with statement, yellow represents no opinion, orange indicates dis-agreeance with the statement, red represents strong dis-agreeance.

Table 13

Student Data – Week 3

Student: 3		
Partner(s): 7		
Date:	15 – Mar.	16 – Mar.
Score on work:	83%	100%
I felt productive with my partner(s) during collaborative math today		
I felt like I understood the math in collaborative that we worked on together		
I felt like I was able to work well with my partner(s)		
My group was able to stay focused and work on our collaborative math the entire time		
I would like to work with this partner again		

Note: Green indicates strong agreeance, blue indicates agreeance with statement, yellow represents no opinion, orange indicates dis-agreeance with the statement, red represents strong dis-agreeance.

Table 14

Student Data – Week 1 & 2

Student: 13		
Partner(s):	7	4
Date:	28 – Feb.	10 – Mar.
Score on work:	40%	100%
I felt productive with my partner(s) during collaborative math today		
I felt like I understood the math in collaborative that we worked on together		
I felt like I was able to work well with my partner(s)		
My group was able to stay focused and work on our collaborative math the entire time		
I would like to work with this partner again		

Note: Green indicates strong agreeance, blue indicates agreeance with statement, yellow represents no opinion, orange indicates dis-agreeance with the statement, red represents strong dis-agreeance.

Conclusion

Based on the research and data found throughout this study, it can be determined that peer tutoring is an effective method of mathematical instruction to promote mathematical achievement. It is most effective for students who range in average mathematical scores of 75% and below. Although it can be utilized for higher level students, they should be placed with average comprehension students for best productivity and achievement. This results in average achievement students being placed with lower achievement students. Although this may not seem ideal, I found that this pairing is the most beneficial for student's social-emotional needs. In this study, peer tutoring occurred in a more collaborative student partnering method which I found to be beneficial to maintain a healthy classroom community. Students also required peer

tutoring groupings to be switched on a weekly basis to maintain positive social-emotional standings. I found through this study, that those who partnered with the same student for longer than a week were more displeased with their partner than they were during the first week which impacted their ability to achieve in math. Overall, peer tutoring can be utilized during mathematical instruction as a beneficial method of instruction for achievement.

References

Araya, R., & Gormaz, R. (2021). Revealed preferences of fourth graders when requesting face-to-face help while doing math exercises online. *Education Sciences, 11*(8), 429. https://doi-org.libproxy.cortland.edu/10.3390/educsci11080429

Baiduri. (2017). Elementary school students' spoken activities and their responses in math learning by peer-tutoring. *International Journal of Instruction, 10*(2), 145-160. https://www.e-iji.net/dosyalar/iji_2017_2_10.pdf

Tsuei, M. (2014). Mathematics synchronous peer tutoring system for students with learning disabilities. *Educational Technology & Society, 17* (1), 115–127.

Russo, J. A. (2018). Peer tutoring in the elementary classroom: Putting (A) theory into practice. *McGill Journal of Education, 53*(3), 612-619. https://doi-org.libproxy.cortland.edu/10.7202/1058419ar

Tella, A. (2013). The effect of peer tutoring and explicit instructional strategies on primary school pupils learning outcomes in mathematics. *Bulgarian Journal of Science & Education Policy, 7*(2), 5–25.

Appendix A

Student Peer-Tutoring Survey:

Name: _____

Directions: Answer the questions below using the rating scale. Circle the face to the right of the statement that you agree with the most.

- Strongly Disagree

- Disagree

- No Opinion

- Agree

- Strongly Agree

I felt productive with my partner(s) during collaborative math today

I felt like I understood the math in collaborative that we worked on together

I felt like I was able to work well with my partner(s)

My group was able to stay focused and work on our collaborative math the entire time

I would like to work with this partner again

Appendix B

Student Peer-Tutoring Survey:

Name: _____

Directions: Answer the questions below using the rating scale. Circle the face to the right of the statement that you agree with the most.

- Strongly Disagree

- Disagree

- No Opinion

- Agree

- Strongly Agree

I felt like I understood the math in collaborative that we worked on together

I felt like I was able to work well with my partner(s)

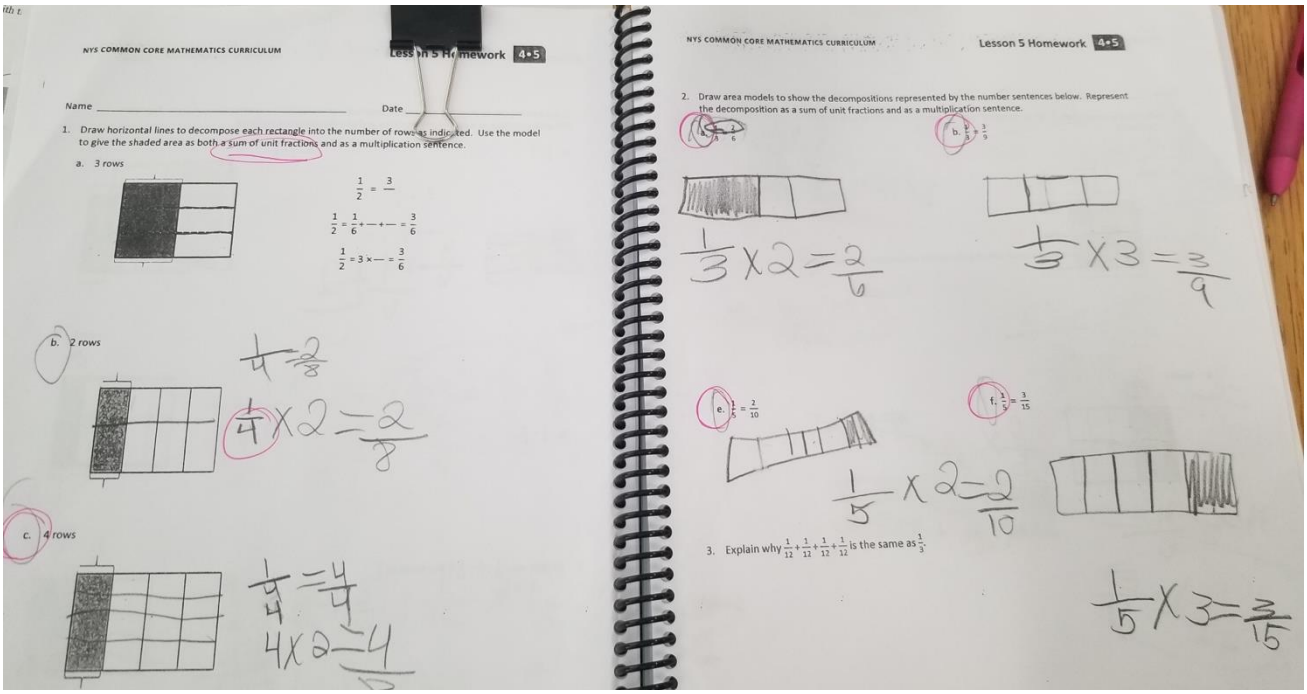
My group was able to stay focused and work on our collaborative math the entire time

I would like to work with this partner again

One person that I think I work well with is: _____

One person that I don't think I work well with is: _____

Appendix C



NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 5 Homework 4•5

Name _____ Date _____

1. Draw horizontal lines to decompose each rectangle into the number of rows as indicated. Use the model to give the shaded area as both a sum of unit fractions and as a multiplication sentence.

a. 3 rows

$\frac{1}{2} = \frac{3}{\_}$

$\frac{1}{2} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{3}{6}$

$\frac{1}{2} = 3 \times \frac{1}{6} = \frac{3}{6}$

b. 2 rows

$\frac{1}{4} = \frac{2}{8}$

$\frac{1}{4} \times 2 = \frac{2}{8}$

c. 4 rows

$\frac{1}{4} = \frac{4}{\_}$

$4 \times 2 = 4$

NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 5 Homework 4•5

2. Draw area models to show the decompositions represented by the number sentences below. Represent the decomposition as a sum of unit fractions and as a multiplication sentence.

a. $\frac{2}{6} = \frac{1}{6} + \frac{1}{6}$

b. $\frac{3}{9} = \frac{1}{9} + \frac{1}{9} + \frac{1}{9}$

$\frac{1}{3} \times 2 = \frac{2}{6}$

$\frac{1}{3} \times 3 = \frac{3}{9}$

e. $\frac{2}{10} = \frac{1}{5} + \frac{1}{5}$

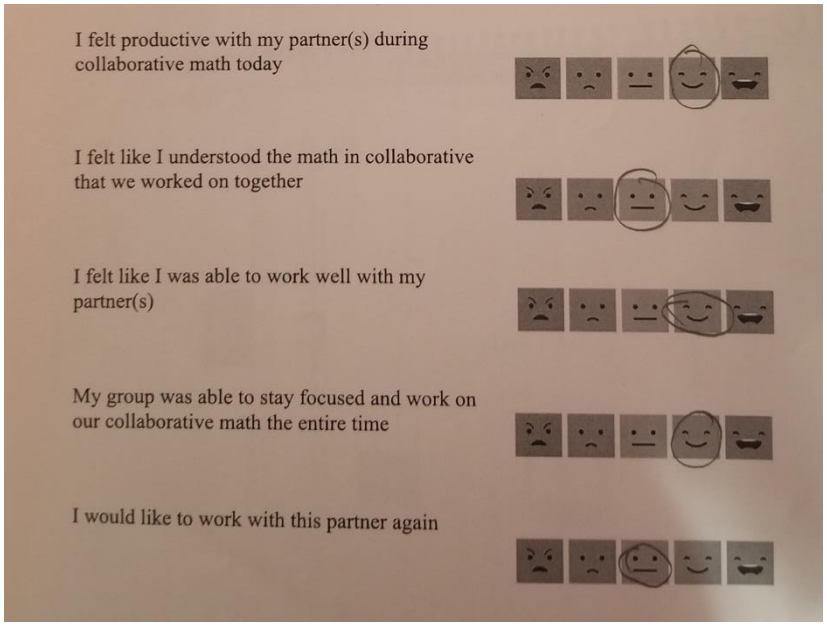
f. $\frac{3}{15} = \frac{1}{5} + \frac{1}{5} + \frac{1}{5}$

$\frac{1}{5} \times 2 = \frac{2}{10}$

$\frac{1}{5} \times 3 = \frac{3}{15}$

3. Explain why $\frac{1}{12} + \frac{1}{12} + \frac{1}{12} + \frac{1}{12}$ is the same as $\frac{1}{3}$.

2/15 – Student 12 had a day of feeling frustrated in math which reflects her ability in math. She begins giving up and acting like she knows less that what she actually does. She is a very bright student. When guiding her in the material, she will refuse to apply what she already knows to the work. I know she is capable of some of them steps in the problem since she has demonstrated several times prior that she understands the majority of the concept.



I felt productive with my partner(s) during collaborative math today

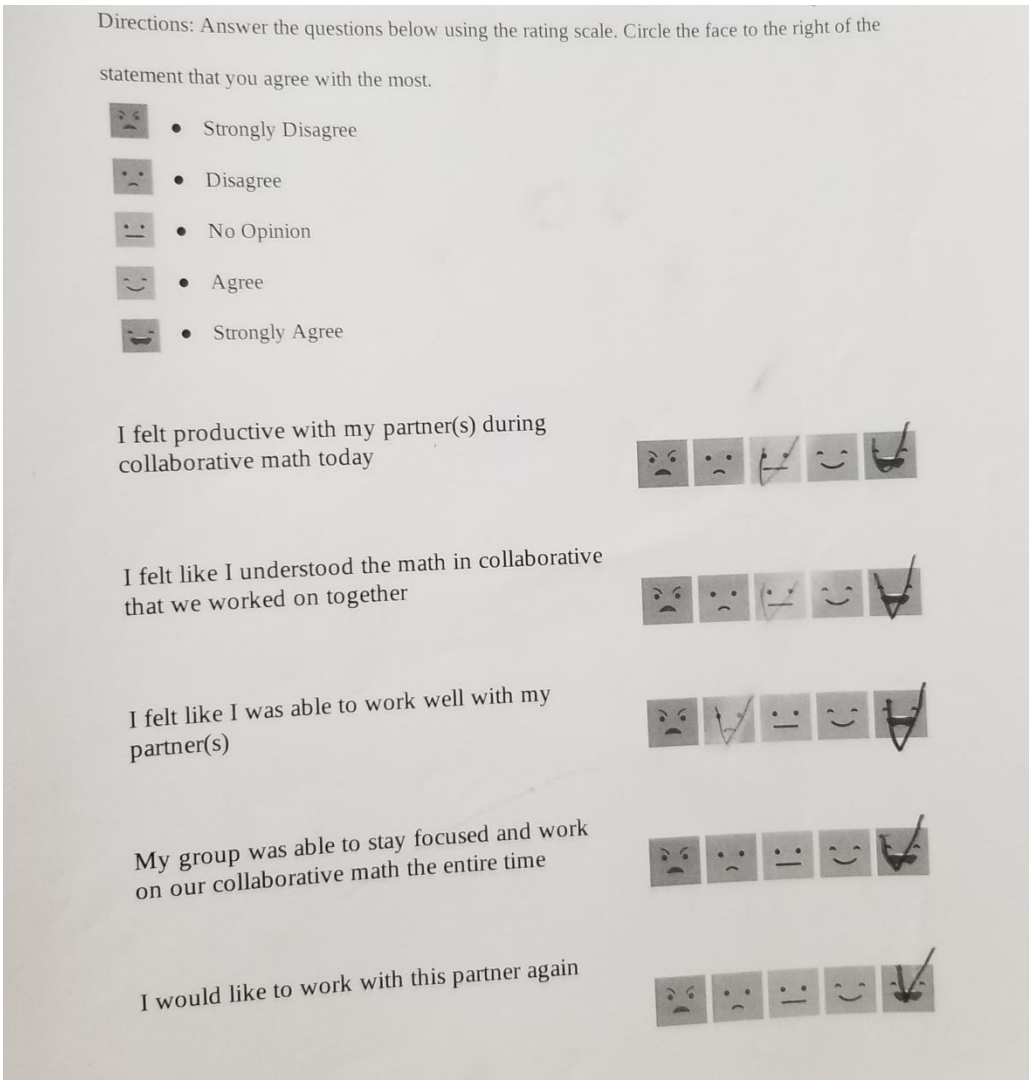
I felt like I understood the math in collaborative that we worked on together

I felt like I was able to work well with my partner(s)

My group was able to stay focused and work on our collaborative math the entire time

I would like to work with this partner again

Appendix D



Directions: Answer the questions below using the rating scale. Circle the face to the right of the statement that you agree with the most.

- Strongly Disagree
- Disagree
- No Opinion
- Agree
- Strongly Agree

I felt productive with my partner(s) during collaborative math today

I felt like I understood the math in collaborative that we worked on together

I felt like I was able to work well with my partner(s)

My group was able to stay focused and work on our collaborative math the entire time

I would like to work with this partner again

Appendix E

	Date:			
	Student:	Student 1 (A)	Student 3	Student 4
	Partner(s):		Student 8	Student 5
Question:	Score on work:		100.00%	50.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				
	Date:			
	Student:	Student 1 (A)	Student 3 (A)	Student 4 (A)
	Partner(s):			
Question:	Score on work:			
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				
	Date:			
	Student:	Student 1	Student 3 (A)	Student 4
	Partner(s):	Student 13	Student 8	Student 5
Question:	Score on work:	0.00%	100.00%	57.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				
	Date:			
	Student:	Student 1	Student 3	Student 4
	Partner(s):	Student 11 (A) & Student 9	Student 5 & Student 4	Student 5 & Student 3
Question:	Score on work:	50.00%	90.00%	60.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				
	Date:			
	Student:	Student 1	Student 3	Student 4
	Partner(s):	Student 11 & Student 9	Student 5 & Student 4	Student 5 & Student 3
Question:	Score on work:	50.00%	100.00%	81.00%
I felt like I understood the math in collaborative that we worked on together		NA		
I felt like I was able to work well with my partner(s)		NA		
My group was able to stay focused and work on our collaborative math the entire time		NA		
I would like to work with this partner again		NA		
One person that I think I work well with is		Student 4	Student 6	Student 1
One person that I don't think I work well with is		Student 5	Student 1	Student 5

	Date:			
	Student:	Student 1	Student 3	Student 4
	Partner(s):	Student 11 & Student 9	Student 5 & Student 4	Student 5 & Student 3
Question:	Score on work:	14.00%	43.00%	43.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				
	Date:			
	Student:	Student 1	Student 3	Student 4
	Partner(s):	Student 11 & Student 9	Student 5 & Student 4	Student 5 & Student 3
Question:	Score on work:	50.00%	100.00%	100.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				
	Date:			
	Student:	Student 1	Student 3	Student 4
	Partner(s):	Student 11 / Student 9	Student 5 / Student 4	Student 5 / Student 3
Question:	Score on work:	70.00%	100.00%	40.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				
	Date:			
	Student:	Student 1	Student 3	Student 4
	Partner(s):	Student 3	Student 1	Student 13
Question:	Score on work:	70.00%	90.00%	80.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				
	Date:			
	Student:	Student 1	Student 3	Student 4
	Partner(s):	Student 3	Student 1	Student 13
Question:	Score on work:	70.00%	100.00%	56.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				

	Date:			
	Student:	Student 1	Student 3	Student 4
	Partner(s):	Student 3	Student 1	Student 13
Question:	Score on work:	43.00%	100.00%	71.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				

	Date:			
	Student:	Student 1	Student 3 (A)	Student 4 (A)
	Partner(s):	Student 6		
Question:	Score on work:	29.00%		
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				

	Date:			
	Student:	Student 1 (A)	Student 3	Student 4 (A)
	Partner(s):		Student 7	
Question:	Score on work:		83.00%	
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				

	Date:			
	Student:	Student 1	Student 3	Student 4 (Typically Student 9)
	Partner(s):	Student 6	Student 7	Student 13
Question:	Score on work:	33.00%	100.00%	100.00%
I felt productive with my partner(s) during collaborative math today				
I felt like I understood the math in collaborative that we worked on together				
I felt like I was able to work well with my partner(s)				
My group was able to stay focused and work on our collaborative math the entire time				
I would like to work with this partner again				