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# Kagan Cooperative Learning Structures and the Effects on Student Achievement and Engagement

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Abstract

The purpose of this action research project is to determine if there is a correlation between Kagan cooperative learning structures and student achievement and engagement in mathematics. Data was collected using a mixed methods approach. Quantitative data was gathered through three math pre and posttests. Qualitative data was collected through observations and interactions with students. Analysis of the data collected suggests that students are more engaged when working in cooperative teams. Growth was also noted from pretests to the posttest.

*Keywords*: cooperative learning, student engagement, achievement, mathematics

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Todays' classrooms are increasingly diverse and students desire more than the daily routines of a traditional classroom. In a traditional classroom, the teacher leads with minimal interaction between the students. The same students raise their hand to answer questions while others sit passively. This is the ongoing trend within the researchers' school, Liberty Elementary. During Professional Learning Communities (PLC) meetings and at the end of the year reflections teachers and staff expressed a concern for failing test scores and the lack of student engagement and taking ownership of their learning.

Building administration researched a variety of programs that could be implemented in our building to help increase student engagement and achievement. The results of their research was to implement Kagan's cooperative learning structures. Throughout the year, teachers and staff attended five workshops to gradually learn about the program and to implement the structures at a manageable pace for full time teaching.

Kagan Structures are a set of instructional strategies created by Spencer Kagan to be used cooperatively in a team setting in the classroom. His model of cooperative learning is different from the other models. Kagan believes that in order for cooperative learning to be effective students must have the four basic principles he calls PIES. PIES is an acronym that stands for Positive Interdependence, Individual Accountability, Equal Participation, and Simultaneous Interaction. Kagan says in order for cooperative learning to work effectively all students need to be involved at all times. Positive interdependence creates equal support among each other. Individual accountability still holds each student in the team accountable and increases participation and motivation to learn and do well. Equal participation means all students have to

participate equally. It helps eliminate the traditional setting atmosphere where there are always the students who raise their hands and answer questions and those that sit passively. Finally, simultaneous interaction is teaching and student participation working together simultaneously. It increases the amount of participation among students and lets the teacher be more of a facilitator of learning. Students sit in teams of four, but there can be teams of three or five if there is an odd number in the class. Teams of four are ideal. The teams of four are arranged in heterogeneous groups based on the students' academic level: low, low medium, high medium and high. In these groups, students then interact and work on academics and sharpen their social skills using a myriad of structures that help with learning. This action research study was conducted to determine if using Kagan Structures increases student achievement and student engagement in the content area of math.

## Literature Review

Educators have been researching programs and other ways to increase student achievement and interaction in the classroom for decades. Educators realize there is a need to move away from the mentality of a traditional classroom. The traditional classroom consists mainly of teacher-fronted lessons, independent work, and competition where students are expected to work independently and student interaction is discouraged (Kagan, 2008). As a nation, we are also facing challenges and crisis in the classroom. According to Spencer Kagan there are four challenges our schools are facing: the achievement crisis, the achievement gap crisis, the race relations crisis, and the social skills crisis (Kagan, 2008). One instructional program that has been researched for decades and claims to help the challenges schools are facing is cooperative learning.

David Johnson, Roger Johnson, and Spencer Kagan have completed extensive research in the area of cooperative learning. David and Roger Johnson use five elements to define their ideas of cooperative learning. They say in order for cooperative learning to be effective the learning must have positive interdependence, face-to-face promotive interaction, individual and group accountability, interpersonal and small-group skill, and group processing (Dean et al., 2012). Spencer Kagan believes cooperative learning consists of what he defines as PIES. PIES is an acronym that stands for Positive Interdependence, Individual Accountability, Equal Participation, and Simultaneous Interaction (Kagan, 2011). Both can be a viable program to use in the classroom; for the purpose of this action research study the Kagan Cooperative Learning model was used.

An emerging trend is the use of cooperative learning to help students develop communication in mathematics. One study used cooperative learning to aid in math reform and increase math conversations. According to the study, *Cooperative learning can contribute to mathematics education reform by stimulating student conversation* students had a difficult time engaging in math conversations because they lacked the math vocabulary needed to describe their operations (Ross, 1995). Final results state that while cooperative learning does aid in math conversations, it alone does not lead to quality explanations of the operations and methods used (Ross, 1995). Instead, the researcher believes that cooperative learning needs to be accompanied with teacher interventions to model how students should have math conversations (Ross, 1995). A study completed by Roza Leikin and Orit Zaslavsky (1999) on math and communication showed evidence that cooperative learning contributes to a higher level of learning and an increase in active learning. The researchers “attribute this to the increase of mathematical communications, which were defined in general as student-student and student-teacher

interactions related to the learning material. Observations pointing to these communicative interactions took the form of giving an explanation and posing a question or requesting help" (Leiken & Zaslavsky, 199, p. 243).

Another study that was dedicated to math and the use of cooperative learning was conducted with fourth grade students at a Turkish elementary school. According to the study most students have math anxiety caused by personal, societal, environmental, and pedagogical factors (Tarim & Akdeniz, 2008). The results suggest that the use of cooperative learning is a good tool to use to decrease math anxiety and the fear of failure because it encourages students to take risks and play an active role in the learning process (Tarim & Akendiz, 2008).

According to the article titled, *Cooperative Learning in Elementary Classrooms: Teaching Practices and Lesson Characteristics*, written by Edmund T. Emmer and Mary Claire Gerwels (2002), cooperative learning is a viable program to use in the classroom if it is implemented with fidelity. The action research was conducted to gather information on lessons, teacher and student behavior, and the academic tasks (Emmer & Gerwels, 2002). The results also gave indication that "teachers do not follow a specific model for cooperative learning and they varied in the components that they emphasized" (Emmer & Gerwels, 2002, p. 88). Another result was the importance of teachers monitoring. The study noted the importance of teacher monitoring group communications and progress (Emmer & Gerwels, 2002). This allows for feedback and aids in solving problems.

Finally, Alfie Kohn (1993) has done research in cooperative learning. He states that, "the opportunity to collaborate ought to be the default condition in the classroom (p. 215). According to his research, "cooperative learning works with kindergartners and graduate students, with students who struggle to understand and the students who pick things up instantly; it works for

math and science, and language skills and social studies, fine arts and foreign language" (Kohn, 1993, p. 214-215).

## Methods

### Participants

This action research project was conducted in the teacher researcher's third grade general education classroom. There are 28 students, 13 females and 15 males and their ages range from 8-9 years old. The classroom is diverse with students that are predominately Hispanic, African American and Native American and receive free and reduced lunch. Of the 28 students in the class, four students have an IEP and receive special education services and three receive speech and language services. One of the students who has an IEP and receives speech services is also defined as medically fragile and has a one-on-one nurse assigned to him full time. Four students are defined as Talented and Gifted (TAG) and receive enrichment in math from the TAG teacher. One of the students that is TAG is subject advanced in math and receiving instruction in fourth grade math and is exempt from the third grade math curriculum. Six students in the classroom have been diagnosed with ADHD that can affect their behavior and require medication. One of the students is new to the United States and does not speak English.

### Data Collection

The purpose of this action research project is to determine if there are any correlations to the use of Kagan Structures and student achievement and engagement in the content area of math. In order to research all aspects of students' achievement and engagement, a mixed methods approach was used. The researcher kept anecdotal notes for qualitative data. The qualitative data allowed the researcher to observe student's engagement, off task behavior, students' social interactions, interact with the students to aid in facilitating of learning, and

reflect on the use of familiar structures and new structures implemented in the eight-week study. During structures, the researcher was able to circulate among teams and partners to observe their interactions that also provided value feedback to assist with driving instruction. Quantitative data was collected using pre and posttests in math.

Students were placed in new teams for the beginning of the eight-week study using the scores from the end of the 3rd quarter math assessments to determine students' academic levels of low, low-medium, high-medium and high. Once students were placed in their new teams, a Kagan team building structure was used to create a team cheer and team handshake to help students build rapport with their new team members. Team building structures were used twice a week per Kagan recommendations. Students were given three mirrored pretests created by the researcher and three district required posttests in math. The researcher used the Go Math curriculum and district pacing guides during the eight-week study. Each unit was taught approximately 2.5 weeks. The scores from the pretest and posttests were placed in a table and the class average and median were calculated. Individual growth for each student was also calculated.

During the study the researcher used structures that were already in place within the building and classroom such as Round Robins, Rally Coach, Timed Pair Share, Take Off Touch Down, Stand Up Hand Up Pair Up, Fan-N-Pick, Match Mine, and Quiz Quiz Trade to name a few. New structures were implemented as they fit into the content area and as directed through implementation cycles. The math-consulting teacher was used to help model how to use the structures within the classroom and with the content area. Students and the researcher would practice and receive feedback from the consulting teacher before using them in the class without

outside support. New structures implemented during the time were Sage-N-Scribe, Pairs Compare, Showdown, 4 Corners, Passport, Read and Review, Centerpiece and others.

## Findings

### Data Analysis

A substantial amount of researcher bias was included during the data collection period of the research study. The building administration and the consulting teacher maintained the belief that Kagan structures were a positive influence on student achievement and engagement. The teacher researcher's hypothesis and discussions in collaboration in grade level PLCs did not see the positive results administration maintained. In spite of researcher bias, high quality lessons with input from the consulting teacher were planned with the use of structures to maintain the integrity of the study.

Despite the teacher researcher's bias, systems were in place to collect quantitative and qualitative unbiased data in the form of 3 pretests and posttests and anecdotal notes. The mixed methods approach provided valuable information showing the value of the use of Kagan Cooperative learning and the positive effects on student achievement and engagement in mathematics.

**Quantitative data analysis.** The quantitative data was collected through three different units and provided scores for a variety of math standards. The quantitative data collected provided information in mastery of comparing fractions, finding the area and perimeter, and geometry skills.

**Table 1: Math Comparing Fractions Class Average and Median**

| Comparing Fractions Assessment | Pretest | Posttest | Growth |
|---|---|---|---|
| Class Average | 43.22% | 75.25% | 32.03% |
| Class Median | 38% | 79% | 41% |

Table 1 shows a class average of 43.22% on the pretest and 75.25% on the posttest. This shows a growth of 32.03%. The class median results show a 38% on the pretest and a 79% on the posttest. This shows a growth of 41% in the standard of comparing fractions.

**Table 2: Math Comparing Fractions Assessment**

| Student | Pretest Percentage Score | Posttest Percentage Score | Growth from Pretest to Posttest |
|---|---|---|---|
| Student A | 23% | 79% | 56% |
| Student B | 38% | 57% | 19% |
| Student C | 85% | 100% | 15% |
| Student D | 23% | 54% | 31% |
| Student E | 31% | 57% | 26% |
| Student F | 92% | 100% | 8% |
| Student G | 69% | 100% | 31% |
| Student H | 38% | 86% | 48% |
| Student I | 31% | 71% | 40% |
| Student J | 46% | 93% | 47% |
| Student K | 30% | 100% | 70% |
| Student L | 7% | 7% | 0% |
| Student M | NA | NA | NA |
| Student N | 69% | 100% | 31% |
| Student O | 0% | 57% | 57% |
| Student P | 46% | 50% | 4% |
| Student Q | 46% | 100% | 54% |
| Student R | 62% | 93% | 31% |
| Student S | 7% | 36% | 29% |
| Student T | 54% | 71% | 17% |
| Student U | 54% | 100% | 46% |

| | | | |
|---|---|---|---|
| Student V | 54% | 79% | 25% |
| Student W | 31% | 36% | 5% |
| Student X | 62% | 100% | 38% |
| Student Y | 31% | 71% | 40% |
| Student Z | 23% | 64% | 41% |
| Student AA | 38% | 71% | 33% |
| Student BB | 77% | 100% | 23% |

Table 2 shows the individual growth of each student. The quantitative data for comparing fractions show that 96% of students showed growth. The gains ranged from the lowest being 4% and the highest being 70%. Student L, who showed no growth in comparing fractions is an ESL student with minimal English language and has an ESL tutor that offers assistance within the classroom, but is not able to be with him all the time. Student W, who showed minimal growth in comparing fractions, is a special education student who also has autistic spectrum tendencies.

**Table 3: Math Perimeter and Area Class Average and Median**

| Perimeter and Area Assessment | Pretest | Posttest | Growth |
|---|---|---|---|
| Class Average | 65.70% | 76.55% | 10.85% |
| Class Median | 67% | 92% | 25% |

Table 3 shows a class average of 65.70% on the pretest and 76.55% on the posttest. This shows a growth of 10.85%. The class median results show a 67% on the pretest and a 92% on the posttest. This shows a growth of 25% in the standard of perimeter and area.

**Table 4: Math Perimeter and Area Assessment**

| Student | Pretest Percentage Score | Posttest Percentage Score | Growth from pretest to posttest |
|---|---|---|---|
| Student A | 75% | 83% | 8% |

| | | | |
|---|---|---|---|
| Student B | 58% | 100% | 42% |
| Student C | 83% | 100% | 17% |
| Student D | 50% | 50% | 0 % |
| Student E | 33% | 33% | 0% |
| Student F | 67% | 100% | 33% |
| Student G | 83% | 100% | 17% |
| Student H | 50% | 50% | 0% |
| Student I | 50% | 33% | -17% |
| Student J | 83% | 92% | 9% |
| Student K | 50% | 100% | 50% |
| Student L | 67% | 42% | -25% |
| Student M | NA | NA | NA |
| Student N | 92% | 92% | 0% |
| Student O | 58% | 50% | -8% |
| Student P | 50% | 58% | 8% |
| Student Q | 67% | 92% | 25% |
| Student R | 83% | 100% | 17% |
| Student S | 17% | 50% | 33% |
| Student T | 67% | 92% | 25% |
| Student U | 75% | 92% | 17% |
| Student V | 83% | 100% | 17% |
| Student W | 75% | 33% | -42% |
| Student X | 83% | 100% | 17% |
| Student Y | 75% | 58% | -17% |
| Student Z | 50% | 75% | 25% |
| Student AA | 75% | 92% | 17% |
| Student BB | 75% | 100% | 25% |

Table 4 shows the individual growth of each student. The data for perimeter and area show that 67% of students made growth. The gains ranged from the lowest being 8% and the

highest being 50%. Student D, showed no growth in finding the perimeter and area. This score may reflect the qualitative data that shows the student was tardy often and missed the majority of instruction and off task several times during partner structures.

Student E showed no growth in finding perimeter and area. This score reflects the qualitative data (see Appendix A) that shows the student was struggling and required a math intervention with the math interventionist. While the intervention was intended to have a positive impact, the time he was scheduled to go to the math interventionist was during instruction. This interrupted the time he was in whole group instruction with his peers.

Student H showed no growth. This also may be reflected in the qualitative data that shows the student was off task, often tardy, had head on desk, and was not engaged in learning and partner work. Student L showed a substantial loss in his learning. He is in an ESL student with minimal English language and has an ESL tutor that offers assistance within the classroom, but is not able to be with him all the time.

Student W and Y also showed significant loss in their learning. These students are special education students. Student W has tendencies on the autistic spectrum and often times per the qualitative data would put her head on her desk and say, “I’m scared” if she felt threatened when students were attempting to work with her. This required at times for her to go to be escorted to the special education teacher to help her decompress and review social skills in the classroom. Student Y also had compatibility issues with his face partner as detailed in the qualitative data. His partner at times was bossy and did not always take the needed time to coach him.

Student K showed the most improvement between the pre and posttests. While this is a good trend, it is important to note that the qualitative data shows that Student K often times would become bossy and not cooperative with her face partner, Student Y.

**Table 5: Math Geometry Class Average and Median**

| Geometry Assessment | Pretest | Posttest | Growth |
|---|---|---|---|
| Class Average | 58.88% | 79.62% | 20.74% |
| Class Median | 60% | 80% | 20% |

Table 5 is the final data set in the study. Table 5 shows a class average of 58.88% on the pretest and 79.62% on the posttest. This shows a growth of 20.74%. The class median results show a 60% on the pretest and an 80% on the posttest. This shows a growth of 20% in the standard of geometry.

**Table 6: Math Geometry Assessment**

| Student | Pretest Percentage Score | Posttest Percentage Score | Growth from Pretest to Posttest |
|---|---|---|---|
| Student A | 60% | 80% | 20% |
| Student B | 70% | 40% | 30% |
| Student C | 100% | 100% | 0% |
| Student D | 70% | 70% | 0% |
| Student E | 70% | 80% | 10% |
| Student F | 60% | 90% | 30% |
| Student G | 70% | 100% | 30% |
| Student H | 60% | 80% | 20% |
| Student I | 60% | 80% | 20% |
| Student J | 70% | 90% | 20% |
| Student K | 60% | 100% | 40% |
| Student L | 40% | 60% | 20% |
| Student M | NA | NA | NA |
| Student N | 70% | 100% | 30% |
| Student O | 40% | 60% | 20% |

| | | | |
|---|---|---|---|
| Student P | 20% | 70% | 50% |
| Student Q | 70% | 90% | 20% |
| Student R | 60% | 80% | 20% |
| Student S | 50% | 70% | 20% |
| Student T | 50% | 90% | 40% |
| Student U | 80% | 100% | 20% |
| Student V | 50% | 80% | 30% |
| Student W | 40% | 50% | 10% |
| Student X | 70% | 100% | 30% |
| Student Y | 60% | 100% | 40% |
| Student Z | 20% | 30% | 10% |
| Student AA | 50% | 60% | 10% |
| Student BB | 70% | 100% | 30% |

Table 6 shows the individual growth of each student. The data for geometry show that 92% of students made growth. The gains ranged from the lowest being 10% and the highest being 50%. Student C showed no growth. However, he already had mastery at the pretest level. Student D, showed no growth in geometry. This score may reflect the qualitative data that shows the student was tardy often and missed the majority of instruction and off task several times during partner structures.

Student L, is a student who has very limited English language. He has an ESL tutor that is with him a couple times a week during instruction. It is noted that he made a 20% gain. This could be a result in the qualitative data that his face partner would work with him when the ESL teacher was not able to. His face partner can speak Spanish. It is also noted that while Student L

was at ESL he was working hard on learning the basics of the English language and his speaking skills greatly improved by the end of the study.

Student Z showed small growth. His pretest was a 20% and he raised it to a 30%. This may be reflected in the qualitative data. Student Z suffers from ADHD that affects his behavior and attitude. He did not have his prescribed medications for the majority of the unit that made it difficult for him to stay on task and participate in the current learning. He struggled working with his teammates and the class as a whole.

**Qualitative data analysis.** Qualitative data was observed twice a week throughout the action research study. Qualitative data was primarily observation and notetaking, however, informal discussions with students and teams of students also provided valuable data about student engagement, needed interventions in math, and their opinions about Kagan structures (see Appendix A).

## Discussion

### Summary of Major Findings

Throughout this study, the findings concluded that Kagan cooperative learning does have a positive effect on students' engagement and math scores. This was indicated with gains on three different tests ranging from 10.85% to 32.03% with an average gain of all three tests of 21.20%. The teacher researcher's hypothesis was that it would not show a positive correlation with academics due to data and discussions used during PLC's with grade level team members. The study also showed that using cooperative learning and giving the students the ability to communicate and interact with each other through Kagan Structures greatly increases student engagement. Those that were not engaged showed minimal growth or no growth at all in math,

which also shows the more engaged a student is with his or her learning, the more growth in academics.

**Limitations of the Study**

The limitations of the study included only using math as a basis for quantitative data. Different outcomes could have occurred if the study was conducted in reading, science, or social studies. While students did show growth in math, this could have been attributed to the materials used and spiral flow of the curriculum and other math programs used in the classroom. Another area would be to include technology in the study. Students are engaged in learning when using programs for reading and math on the computer; different outcomes may have come from teams working on programs such as Kahoot.

**Further Study**

Further study would be to include other content areas. It also would be beneficial to include a technology component and how it effects student engagement. Would teams still be able to remain engaged with each other and not be distracted by the computer programs? Would technology coupled with Kagan Structures produce higher gains in math? Another area to include for further study would be the implementation of project-based learning projects especially in the area of science and social studies to see how working on group projects and grading would be fair.

## Conclusion

The use of Kagan Cooperative Learning has a positive influence on student engagement. It also proves to be a good program to be used to help solve math problems due to the increase of communication and support from peers. However, as stated in other studies within this action research study, it is important to have teachers who are diligent and dedicated to using the Kagan

Structures with fidelity and to be actively monitoring teams as the students interact and learn with each other. In order to foster positive and appropriate conversations it is important for the teacher to lead and model discussions so students know the expectations and can be effective team coaches. Kagan Cooperative Learning not only is a viable program for student engagement, but it is also beneficial to help increase math scores.

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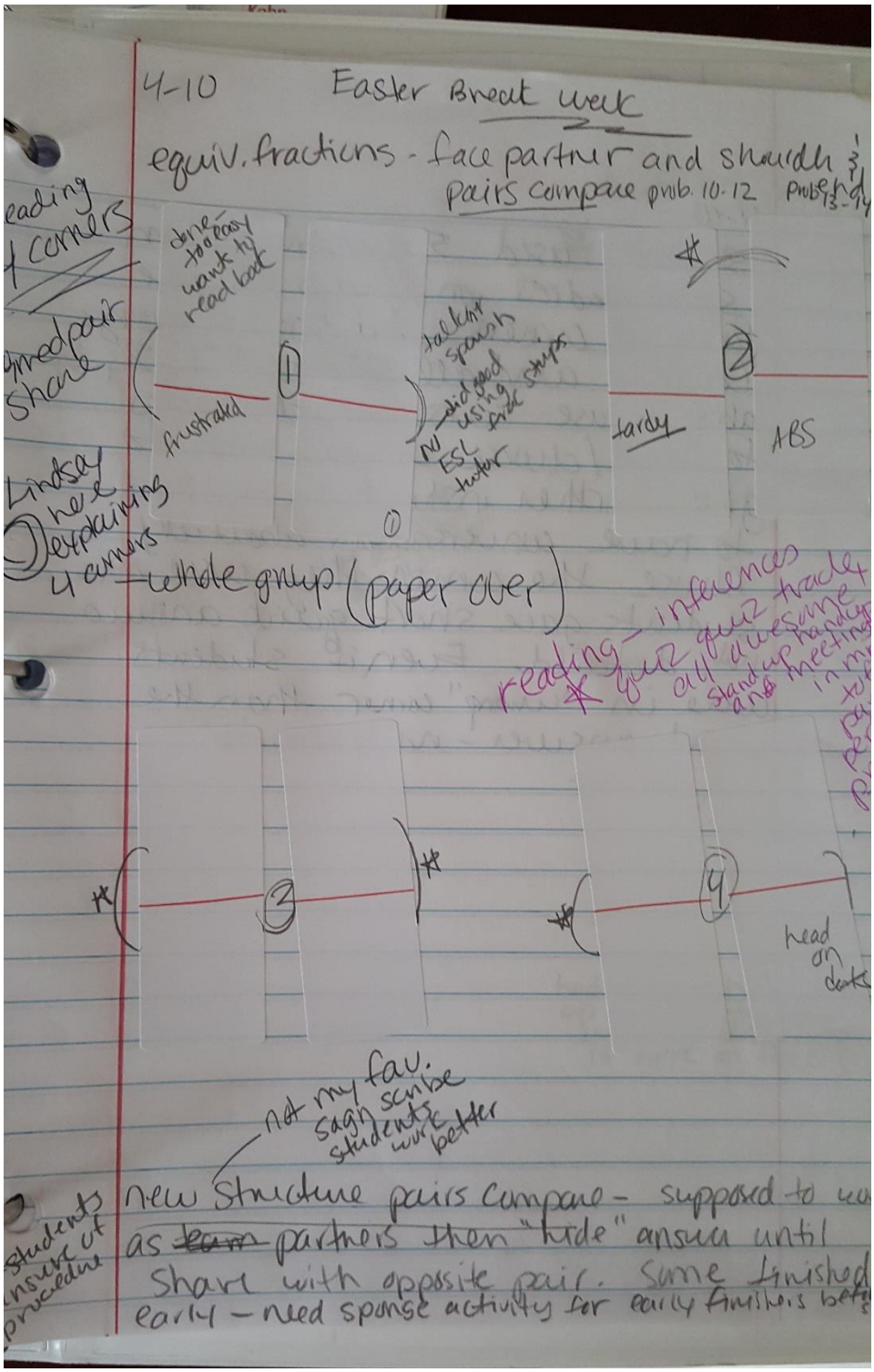
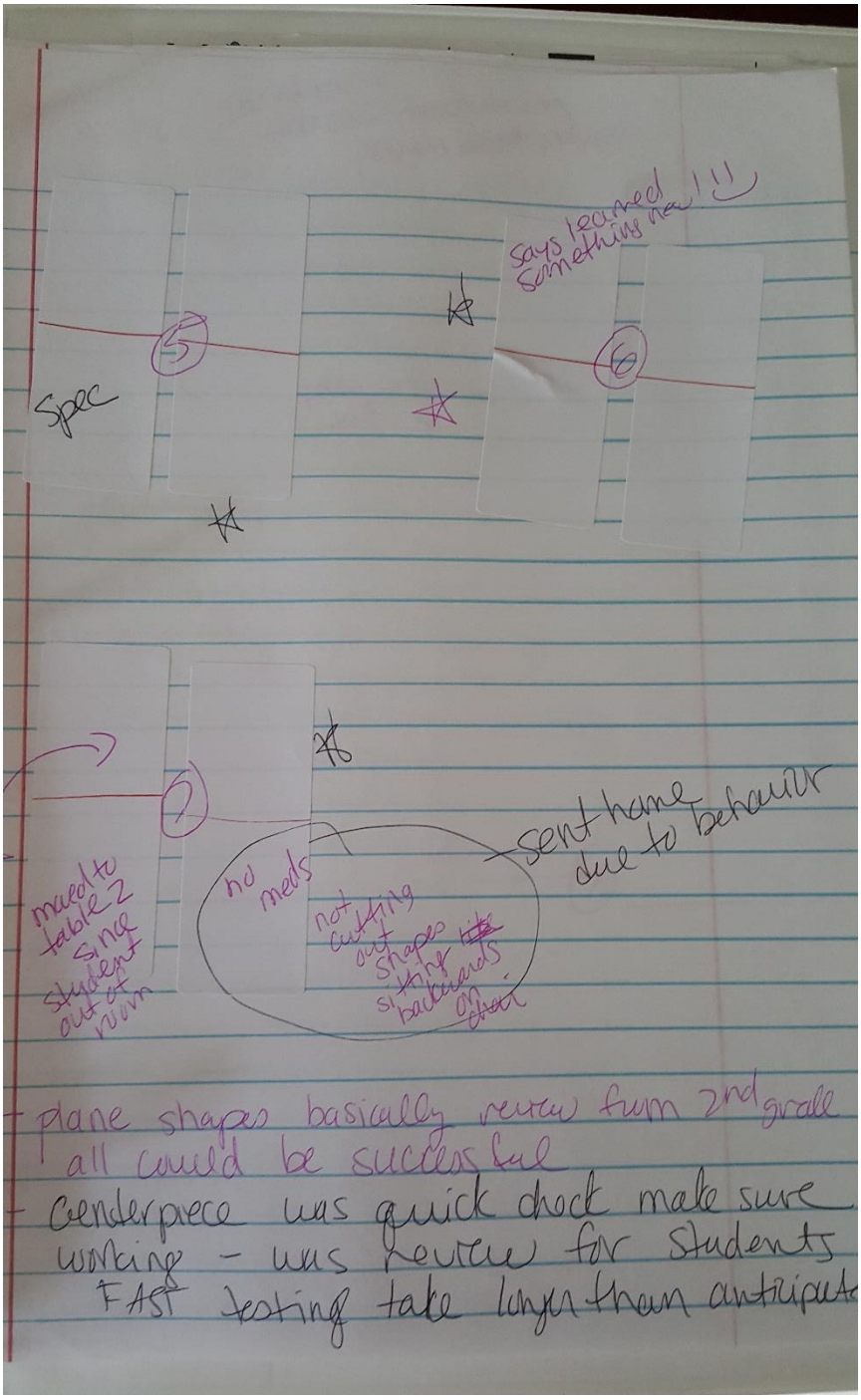
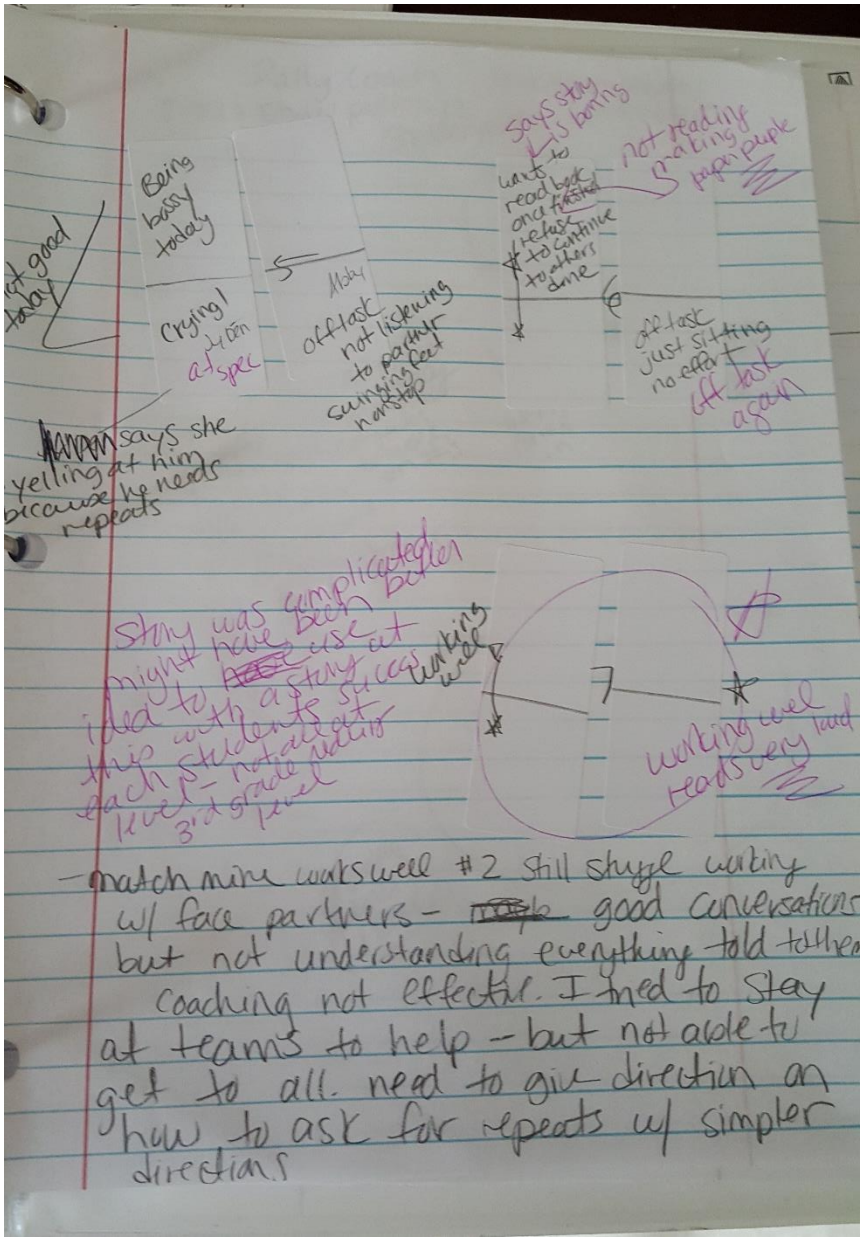
Appendix A

Weekly Anecdotal Notes




Says learned something new!!!
5
6
spec
sent home due to behavior
no meds
not cutting out shapes sitting backwards on chair
moved to table 2 since student out of room
plane shapes basically review from 2nd grade all could be successful
Centerpiece was quick check make sure working - was review for students
FAST testing take longer than anticipate


Being bossy today
Crying! when at spec
Says stay is boring
Wants to read book once finished refuses to continue to others done
not reading eating paper purple
off task not listening to partner swinging feet
off task just sitting no effort off task again
says she yelling at him because he needs repeats
Stay was complicated might have been better idea to use this with a stay at each students at level - not all at 3rd grade reading level
working well
working well reads very loud
- match mine works well #2 still struggle waiting w/ face partners - good conversations but not understanding everything told to them
coaching not effective. I need to stay at teams to help - but not able to get to all. need to give direction on how to ask for repeats w/ simpler directions