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A Self-Study of Purposeful Grouping for Collaborative Learning

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A SELF-STUDY OF PURPOSEFUL GROUPING FOR COLLABORATIVE LEARNING

by

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ABSTRACT

ALLIE CAMERON ROBERSON: A Self-Study of Purposeful Grouping for Collaborative Learning
(Under the direction of Dr. Allan Bellman)

Groups are commonly seen and used in mathematics classrooms. During my time student teaching, I have used what I call, "timely, flexible, dynamic, purposeful" groups. I call groups "purposeful" when there is a defined purpose for using them, there is an ability to change groups when needed, and the groups are formed from a timely assessment. During my self-study, I have looked at how I used these purposeful groups in my classroom, and how it differs from common group-types. I give an example of a specific class period, how I used the data from the opener to form purposeful groups, and how those groups worked together during the class period. Overall, I have seen that grouping methods are dependent on how you select the students. Without the use of timely data and a purpose, the groups could fall apart, and students will not be able to successfully complete the day's lesson.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TERMS

Clinical instructor: the teacher from the assigned school whose focus class the student teacher is teaching.

Closer: daily assessment piece at the end of the lesson that contains three types of problems that informs both the teacher and the student of their success with the lesson (Knapp, 2016).

Flexible grouping: groups that can change multiple times throughout one class period based on the students' understanding (Valentino, 2000).

Focus class: the full-year class a student teacher is assigned in the student teacher practicum. The student-teacher takes over this class as the teacher and the daily routine of assessing, grouping, teaching, and grading.

Opener: daily assessment piece at the beginning of a class that students complete independently in order to activate and assess knowledge necessary for the day's lesson (Knapp, 2016).

Purposeful grouping: a) using groups for a specific purpose and b) each person in the group is there because of a specific purpose (Bogert, 2010).

Timely Data: data that is taken from an assessment in that day's class (compared to *untimely data* that would be taken from an old assessment).

INTRODUCTION

Background

Reflecting on my education as a child, I spent a good amount of time in the classroom in groups. However, when thinking about all those memories, I cannot remember one time where my teacher explained to me why we were getting in groups or how those groups were supposed to help us. Frequently, my teachers just told the class to partner or group up with people around you to work on a problem. Another common practice was when the class was told to number ourselves off and get in groups based on the number we said aloud. I recall teachers that had us pick a color candy or sheet of paper as we walked in the classroom door. Then, we would sit with our peers that chose the same color. Regardless of the methods my teachers used, I did not know if there was any purpose to the grouping.

Through one of my education classes, I started to grow interested in inquiry learning using technology.That idea than grew specifically into how groups can be used for activities such as the inquiry activities and, in fact, for any class day. Now in my student teaching practicum, I am starting to use groups myself. I have seen groups used in different manners during my own personal education. Even now through student teaching, I have seen my clinical instructors and other teachers at the school tell their students to get in groups without any reason behind them. Most of the times, the students sit in the groups they want to be in. They come into the classroom and sit by their friends.

The students have no regard for how working in a group may help them. They just tend to want to socialize and be with the people they are comfortable with. However, the more I see of those groups of just friends together, the less productive those groups are becoming. That is why I have been doing something different in the classes I am teaching now in an attempt to determine what works best for my students.

Purpose of Study

As a young person getting ready to teach, there are always questions about the decisions that have to be made to form groups with a purpose, which I will call purposeful groups for this paper. Through my own experience during my practicum, I have been able to make my own decisions for the groups I use in my classes. Through this I have been able to start formalizing ideas and reflecting on how I make decisions in order to form flexible, timely, purposeful groups where every student is critical to the success of the group.

"Flexible" means that groups can be changed, whether that is different types of groups for each class period, or even students moving into groups multiple times throughout the same class period in order for the students to fully succeed. "Timely" means that the data I am using to make grouping decisions is not from a previous day's assessment, but instead from an assessment immediately before the grouping is formed. Overall, I form and use "purposeful" groups for a specific purpose with each person in a group for a purpose.

Through this paper, I am exploring how and why I make timely, purposeful groups in my classroom, what decisions went into making those groups, developing those

ideas, and discussing why I think this works. I did not find this method of forming purposeful groups through research or instruction in my general college education classes nor experience in my personal education as a child, and so through this study of my own decision making, I want to make better sense of how these "purposeful" groups are formed and if they make a difference.

Experience with Groups

In the fall (2018) of my student teaching experience, I had two Algebra II focus classes in the morning for which I was responsible to teach. A focus class is one that student teachers are assigned to teach where they take part in planning lessons and teaching instruction on a daily basis with assistance from the clinical instructor, who is the teacher from the assigned school. It is their classroom that the student teachers work in and their students that the student teacher works with.

In January of this year (2019), I began my full school day student teaching experience, and with the addition of the afternoon for my practicum, I added a geometry class as another focus class in which I would get to plan, teach, and learn from a second clinical instructor. The geometry class had already been meeting for a full semester; so when I joined the class as a student teacher, the norms, procedures, and routines that the students were used to had been set by my clinical instructor before I arrived. On my second day of student teaching in this geometry class, the students came into the classroom and sat where notecards with their names were placed. The desks were situated in groups of four. The students' groups were decided before they came in the room, just based on how the teacher placed the notecards on

the desks. There was no specific reasoning or purpose for how the groups were formed (an example of a "random" group as shown later in the "Review of Literature"). When the bell rang for class to begin, the students began with an "opener."

An "opener" is an activity or problem that the students begin as soon as they come in the room and are in their seat. The "opener" may use technology, be written on a piece of paper, or on a personal whiteboard just as long as there is a quick way for a teacher to compile and assess what the students do and do not know for the upcoming lesson. In general, the problems in the "opener" contain skills, procedures, and concepts that will be necessary for the lesson. Some questions will activate the knowledge students should know from previous lessons or classes, while the other questions assess the skills the students will need to be successful with the upcoming lesson. The "opener" is designed for the students to complete on their own so the teacher can see what the individual student knows. Students who do not know how to answer a question are told not to guess so that when looking at the results, the teacher has an accurate representation of what is actually known rather than what they guessed correctly. From this data, the teacher decides how to proceed with the lesson. In this particular "opener," the students were being assessed on if they remembered how to simplify radicals and if they could solve for a missing side-length in a triangle using the Pythagorean Theorem.

Once students were finished with the "opener," my clinical instructor moved to the front of the room and walked the students through the Pythagorean Theorem proof without changing any of the groups. Another student teacher and I wanted to spend time watching the clinical instructor with the students and get an understanding of how

her classroom worked before we stepped in to teach. In observing the class as the clinical instructor worked, I noticed how many students were struggling and how many students were not participating during that activity. The groups were chaotic and had no one in particular to lead them in the right direction. There did appear to be two groups where all the group members seemed to already know what they needed to do. So, it was possible that there were enough people who knew what was needed for the lesson so each could be placed in a different group (an example of heterogeneous grouping), and all groups could successfully work the new lesson's material. However, in this case those people were not distributed equally across the classroom since the groups were never changed to reflect what the "opener" uncovered about student readiness. Thus, there was no opportunity for the groups without a knowledgeable student to develop the information that was needed to succeed with this lesson.

Ultimately there was no way for us to see if the groups were successful due to the chaos and lack of purposeful groups. Looking back at the lesson, the "opener" was assessing student knowledge of some material, but nothing was included in the "opener" to see whether students would recognize perfect squares and know how to proceed with the information. The students would have needed to be able to recognize perfect squares later in the lesson in order to be able to develop the Pythagorean Theorem and determine the relationship that 45°-45°-90° special right triangles contain between the legs and hypotenuse (see Appendix A). There was an assumption made that since the students had seen the perfect square material in Algebra I, they could do it that day in class without having any sort of problem on the "opener" to activate that knowledge. Also, students were not understanding how to decompose figures to find

area. Without an "opener" that activated that knowledge or thinking, there was no way to see if the students had the necessary knowledge on area and decomposing figures to be successful before embarking on this activity.

I propose that if both those things had been in the "opener," and the data from the opener was used to form groups with at least one member having the needed knowledge, the class would have been more successful. It would have informed the teacher whether she needed to include a short lesson at the beginning of class on those needed topics or if she could have changed the groups in a purposeful manner so each group could succeed. The strength of collaboration in this case fell short because the clinical instructor, as well as me, did not know who could lead their group or work together successfully as the lesson progressed. Sitting together as a group, in this case, did not make a difference. We are not sure what they really knew without the proper assessment and activation of knowledge in the "opener."

The lesson did not contain a "closer" either. A "closer" is typically a short assessment at the end of class that contains three types of problems that inform both the students and teacher of the success with the lesson. The "closer" should have a "one-step away" problem, which is a problem that a student who has not quite reached the lesson goal for the day would be able to solve. Then, there is a "target" problem for the goal of the lesson. This problem represents the minimum acceptable level of work that will allow the student to successfully continue the next day. Finally, on the "closer," there is a "challenge" problem, which is for those who exceed the minimum. This problem may sometimes ask the students something in order to keep them thinking about the next day's lesson.

Without an “opener” and “closer” during almost every class period, a teacher does not know what to expect from their students at the beginning of class, and he or she does not know what the students do not understand or know from that day’s lesson. This takes me to “purposeful” grouping and knowing where the students are with respect to the day’s material in order for every student to succeed in moving forward. Groups need to be flexible and not just one set type or else students are not going to gain from their time in their groups and in the classroom. The data must be timely, meaning it should be from that day’s “opener” or from the previous day’s “closer,” in order for the groups to truly be “purposeful.”

CHAPTER ONE: REVIEW OF LITERATURE

Lev Vygotsky, a Russian psychologist who lived from 1896-1934, conducted research into child developmental psychology. However, it was not until the 1970's that his research was widely recognized as showing that "groups" are "key to the learning process" (Frey, Fisher, & Everlove, 2009). Most importantly he stated that "collaboration" was very important for a child's development and proposed that "every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people…and then inside the child" (Vygotsky, 1978). In other words, as Frey, Fisher, and Everlove put it, "learning is social" and "collaboration with peers becomes a necessary part of a child's development. Productive group work is an essential stepping stone to learning and mastery" (Frey, Fisher, & Everlove, 2009).

Collaborative Learning

Collaborative learning (CL) is "an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product" (Laal & Laal, 2012). Jeanne Gerlach further defined CL as being "based on the idea that learning is a naturally social act in which the participants talk among themselves. It is through the talk that learning occurs" (Gerlach, 1994). Further, it is this communication that is important as she noted that "we must reject the idea that learning

occurs only in silent classrooms. Rather, learning is enhanced in informal settings with peers. Listening to different points of view about how to solve problems" or to have "different perspectives on issues helps students to reach deeper levels of understanding about their subjects" (Gerlach, 1994). Similar research states that "there is persuasive evidence that cooperative teams achieve at higher levels of thought and retain information longer than learners who work quietly as individuals" (Srinivas, 2011). In addition to improving learning, this social interaction between participants benefits them in other ways such as leading "to advanced cognitive development and promoting higher academic achievement than individualistic learning activities" (Gerlach, 1994). CL gives students the "opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers" (Srinivas, 2011). This concept is so important that the National Council on Teachers of Mathematics (NCTM) included it in the "Standards for Mathematical Practice" section of the *Common Core State Standard for Mathematics* as "Mathematical Practice 3", which is "Construct viable arguments, and critique the reasoning of others" (Mathematics, 2017). This "Practice" can be put into action through CL by students working in a group setting to come up with "approaches and solutions to problems" which leads the teacher to further encourage them "to provide arguments for why particular strategies work, to listen and respond to the reasoning of others, and to ask questions to prompt discussions" (Zimmerman, Carter, Kanold, & Toncheff, 2012).

Gerlach notes that "there is no single, right way of using collaborative learning" (Gerlach, 1994), but according to The Global Development Research Center (GDRC) there are four approaches that can be used:

(1) Think-Pair-Share: Teachers give students a question or problem to solve and gives them a minute to "think about it" and individually come up with a response, which could be in writing. Next, these students "turn to a partner and share their responses." Finally, responses from the pairs can be shared within larger groups or with the entire class during a follow-up discussion. GDRC states that "the caliber of discussion is enhanced by this technique, and all students have an opportunity to learn by reflection and by verbalization" (Srinivas, 2011).

(2) Three-step Interview: This is commonly used as "an ice-breaker or a team-building exercise" but can also be used "to share information such as coming up with a hypothesis or reaction to a film or article" (Srinivas, 2011). Students form "dyads" or groups of two, where each student interviews the other. This dyad then links with a second dyad to form a group of four members, who then discuss "the information or insights gleaned from the initial paired interviews" (Srinivas, 2011).

(3) Simple Jigsaw: The teacher forms "learning teams" of four students and divides an assignment or topic into four parts with one student from each learning team volunteering to becoming "experts" on one of the four parts. Students from the learning teams with the same topics then group together to form "expert" teams that "work together to master their fourth of the material and also to discover the best way to help others learn it" (Srinivas, 2011). All "experts" then get back together into their "learning teams" where they teach the other group members (Srinivas, 2011).

(4) Numbered Heads Together: Teachers form "learning teams" of four students, who each count off: 1, 2, 3, or 4. The teacher then "asks a question to the entire class, usually factual in nature, but requiring some higher order thinking skills. Students

> discuss the question, making certain that every group member knows the agreed upon answer" (Srinivas, 2011). The teacher then "calls a specific number and the team members originally designated that number during the count off respond as group spokespersons. Because no one knows which number the teacher will call, all team members have a vested interest in understanding the appropriate response" (Srinivas, 2011). Students "benefit from the verbalization, and the peer coaching helps both the high and the low achievers. Class time is usually better spent because less time is wasted on inappropriate responses and because all students become actively involved with the material" (Srinivas, 2011).

There are several other CL techniques that can also be used such as "Three-Step Interview," "Roundtable," "Focused Listing," "Structured Problem Solving," "One Minute Papers," "Paired Annotations," and "Send A Problem" (Srinivas, 2011) that could be used for the groups to complete, once the groups have been created.

Grouping Techniques Research

To better understand how different grouping methods of students in learning environments has been implemented, several studies conducted by educators and researchers were analyzed for effectiveness. I have analyzed four major grouping methods: "Random," "Homogenous," "Heterogeneous," and "Alternative Method".

Random Grouping

The first grouping approach was the idea of "random" grouping, or putting students into classroom learning groups randomly. In the chapter, "The Affordances of

Using Visibly Random Groups in a Mathematics Classroom," Peter Lijedahl, a Professor of Mathematics Education at Simon Frasier University, lays out the framework and results of a six-year study into the daily use of randomly assigned groups in the mathematics classroom. The methods that teachers used in achieving the randomness in the study were students drawing playing cards (grouping based upon rank of the card that was drawn), drawing numbered popsicle sticks from a jar (grouping based on getting the same number), using numbered "grids" of groups generated randomly either by the teacher or electronically (students previously assigned a permanent number), and using laminated student photographs shuffled and drawn into groups. A key point that he made was that not only were the groupings random, but they were "visibly random" so that the students knew up front that the outcome of the group they were put in was not (and could not be) controlled by the teacher or them. Although there was often initial student resistance at the onset of this strategy, after several weeks of daily implementation there were several key consistent benefits that Lijedahl noted such as "students becoming agreeable to work in any group that they are put in," the "elimination of social barriers within the classroom", and overall, "students become more enthusiastic about math class" (Liljedahl, 2014).

Liljedahl's research showed different reasons that students became accepting of the visible random grouping methods after some initial resistance (2014). The first reason was the fact students soon discovered after a few days of grouping that they probably would not be with the same people on a consistent basis, and it was the "luck of the draw" as to which group they ended in (Liljedahl, 2014). For example, one day they might be in a group with a person they did not like or get along with, while the next day

they could be with their best friend. This randomness just became the norm and since the teacher followed the groupings process no matter what, the students gradually accepted the process and the outcomes knowing that it would change the next day (Liljedahl, 2014).

A second reason for acceptance was the "short-term" commitment to it. Since this was the only class using this method, the students knew that they would only have to worry about which group they were in for this one class, and so order would always change again for the next class day (Liljedahl, 2014). This was in contrast to some other classes in the school where seating assignments were changed once per month, which meant that after a change was announced and you happened to be seated next to someone you did not like, it would last at least a month until it could change (Liljedahl, 2014). There was also student resentment in that method because the students were not part of the seating process and it was not conducted in front of all the students using a truly random method, which meant the teacher would group the students however he/she wanted to without student involvement (Liljedahl, 2014).

A third reason for acceptance was the gradual resignation by students a few weeks after implementation that this process was the "new classroom norm." The longer time passed, the more used to the process they became, it's here to stay" as one student who was interviewed put it, a thought according to Lijedahl that was likely shared among their peers (Liljedahl, 2014).

Lijedahl's study also noted that one key benefit from random grouping was the "elimination of social barriers within the classroom" (Liljedahl, 2014). It was noted before the study that the students came from many different cultures, but the vast

majority, over 90%, were either Caucasian, students' families had lived in the area for many generations, or from China, students' families were 1st or 2nd generation immigrants. Since both groups were almost equally split, a bimodal distribution of these two groups was established. He also noted that these groups did not necessarily have racial tensions between them, but were different enough not to associate socially on a regular basis (Liljedahl, 2014).

However, after the visibly random grouping study began and was conducted daily for a few weeks, both Lijedahl and the teacher noted how much these groups began to notice each other as they worked together (Liljedahl, 2014). For example, when asked about the other Chinese students in her group, a Caucasian student stated that she noticed how smart one of these students was, and so "it was a good idea to listen to her" (Liljedahl, 2014). She also became aware that this Chinese student was in another class with her as well as having a sibling that was in another class with her, facts she did not pay attention to before the groupings (Liljedahl, 2014).

Another example of social barrier elimination was related to the social hierarchy that exists in all schools: kids that seem to be "popular" (or being "in" as Lijedahl put it) tend to socialize with each other while leaving other "not popular" kids out (Liljedahl, 2014). When the study started, one such "popular" student initially tried to reject the idea of random grouping and wanted to be paired with her friends (something she always did), but after realizing the groups did not last long, she did not have a problem. Another "popular" student noted that she sometimes did get paired with her friends, but when this occurred also mentioned the name of another "not popular" student who was also in the group. What was striking was that this student knew the name of this individual after

working in this group, something that she probably would not have noticed before the random groupings (Liljedahl, 2014). Overall according to Lijedahl, this segregation of different races and awareness of popularity that was present before the random groupings, did not seem to exist after random groupings, which meant that social barriers could have been impeding student learning before this study was conducted (Liljedahl, 2014).

A final benefit in his study noted from the random grouping pairings was that students were actually becoming more enthusiastic about learning mathematics than ever before. One such student, who was regularly late to class before the random groupings, began coming to class every day on time and was not late once after the groupings started. Some students stated that math was now their "favorite" subject and that they "loved this class." As Lijedahl put it, a student may have not liked "mathematics the subject," but loved "mathematics the class" (Liljedahl, 2014).

Homogenous Grouping

The education resource website *ThoughtCo* defines "homogenous" groups as "groups of students organized so that students of similar instructional levels are placed together, working on materials suited to their particular level, as determined through assessments" (Lewis, 2018). Homogenous can also mean that students are grouped together for any classification that is the same or for any area where they agree. For example, students may be all using the same method to solve a particular problem or students may share a similar interest. Another term used to describe them is "ability" groups, because the students are grouped together based upon their ability to succeed in

whatever task is given to them. For example, in a classroom, there could be three homogeneous groups put together for a learning activity: one for students that would be classified as "high ability," one for students that are "low ability," and one for students that are "medium ability" (Lewis, 2018).

Advantages of homogenous groups are that they allow the teacher to make lesson plans based on the ability of each group (Lewis, 2018). Therefore, more advanced students would be challenged more and not be held back by other students that are not as advanced. Similarly, less advanced students that are slower to learn would not feel as much pressure or get discouraged as easily if they were put into groups of students with similar abilities. Groups with similar abilities allow the teacher a chance to scaffold material to fit the needs of the students in that group and to provide needed differentiation that better meets student needs on some occasions. Teachers can have a chance to work with the lower students in a small group, while the other students are challenged in the higher achieving groups (Frey, Fisher, & Everlove, 2009).

One disadvantage of homogenous grouping is the possibility that students could be put into the wrong group, which could mean that that they are either challenged too much or too little. Another disadvantage, as pointed out by *ThoughtCo,* is the "stigmatization of groups of students of lesser learning ability, emotional needs, or physical needs," which leads to reduced expectations and learning than if they were in a heterogeneous group (Lewis, 2018).

Even though there are some controversies around grouping by ability, it seems as if the practice is gaining traction again in classrooms throughout the U.S. In 2013, an article published in the New York Times about the resurgence of homogenous grouping

found that over 71% of fourth-grade teachers surveyed by the U.S. Government's *National Assessment of Education Progress* were currently grouping students by their ability to read, a dramatic increase from 1998 when only 28% of teachers grouped in this manner (Yee, 2013). One teacher quoted in the article noted that when she started teaching several years ago, her "instruction was aimed at the middle of class," which "was leaving out approximately two-thirds of my learners" (Yee, 2013). However, after she started grouping her students by their abilities, she found that learning was improved. In this grouping, she still taught the same material to all of her students but set their activities in the groups to fit their capabilities. Another teacher regularly using ability grouping found that by giving tests before each new math unit, she could make sure that students "do not remain in groups that are too advanced or too slow for them" (Yee, 2013).

In the article, Yee discusses how an example in which a teacher used initial assessments at the beginning of a new unit to make groups. After observing the students in those groups, the teacher made changes as often as needed, which sometimes happened every day (Yee, 2013). Teachers may change groups based on what they see happening in the classroom. Many start out with new groups after a unit assessment. If there is progress made or if students need extra help with a particular concept in the new unit, the student can be moved to whatever best helps them succeed.

Teachers may use student interests for homogenous grouping purposes. In the book, *Productive group work: How to engage students, build teamwork, and promote understanding*, Nancy Frey, Douglas Fisher, and Sandi Everlove state that allowing students to form their own groups based on common interests, "can be a way to increase

student engagement in a task" (2009). Students have a variety of interests, and a teacher should get to know their students' interests and hobbies and use that information in the classroom for tasks that allow students with the same interest to work together and relate the material from class to an idea they enjoy, which creates a better chance of student engagement with the content.

Overall even though it is occurring more in schools, the practice of homogenous or grouping by ability still has mixed results in studies conducted by researchers (Yee, 2013). Some of the studies have results that indicate that ability grouping "can damage advanced students' self-esteem" by including them in lower-level groups. Other studies state that this type of grouping ensures that "more advanced students do not make their less advanced peers feel inadequate" (Yee, 2013). Still other studies show test scores rising after homogenous grouping, while others do not see that effect (Yee, 2013).

Heterogeneous Grouping

Contrary to homogeneous grouping where similar-ability students are put together for learning, heterogeneous grouping involves the mixing of similar-age students with a wide range of abilities into classrooms with the goal of creating an even distribution of abilities across all classrooms (Bainbridge, 2018). For example, instead of gifted children being put together in one group or classroom, they would be mixed throughout several groups or classrooms (Bainbridge, 2018). The same would be true for students with lower abilities.

There are both advantages and disadvantages of heterogeneous grouping. One benefit would be that students would be less-likely to feel traumatized or bullied if they

had to go to a "special-class" or group every day. Another benefit would be for students with learning disabilities or lacking good social skills to have the opportunity to interact and improve those skills with other higher-ability students (Bainbridge, 2018).

A main disadvantage of heterogeneous grouping is that it can hold back gifted students from being stimulated and challenged in the classroom (Bainbridge, 2018). They may be bored with instruction geared towards the "average" student, which could lead to indifference towards assignments or disruption in the classroom. In addition, they may feel pressure to believe that they have to help out their fellow students almost like a "second teacher" (Bainbridge, 2018). If they do not want to help their fellow students learn to do the work themselves, they may feel that they have to "carry the group," which means being the group leader, coming up with the tasks that need to be done, and doing most or even all of the work (Johnson, 2011). When this occurs the other students in these groups, who may have leadership potential, may be afraid to or not even have the opportunity to exhibit it because they are not as "good" as the gifted student at the tasks to be accomplished.

Teachers that have successfully used heterogeneous grouping in their classrooms take the disadvantages and turn them into advantages. For example, although a gifted student may feel like a "second teacher" in a group, with guidance from the teacher that student can be motivated to show how important his or her role is. In addition, handing out "roles" during group assignments helps to ensure that everyone is participating and responsible for getting the work done (Cohen & Lotan, 2014). For example, in a math exercise working with the equation for a line, one student in the group is the "facilitator" responsible for making sure that everyone is working on a task, the group finishes within

the time limit, and also for any communication or help needed from the teacher during the exercise. Another student is responsible for finding the y-intercept and slope from the given equation. A third student's task is to complete the graph of the line equation. All of the students are involved in making sure that they agree that the graph output handed to the teacher at the end of the 20 minute period is correct (Cohen & Lotan, 2014).

Alternative Grouping Method

The Alternative Grouping Method is a specific form of mixed-ability grouping. In the book, *Productive group work: How to engage students, build teamwork, and promote understanding*, Frey, Fisher, and Everlove, discuss how to form these alternate groups using a list of students ranked from highest to lowest based on collected assessment data (Frey, Fisher, & Everlove, 2009). Using this method, two higher ability students from the top of the list are paired with the two students from the second half of the list. This alternative grouping method "gives you partners who are heterogeneous yet not so far apart that they are likely to have difficulty bridging the divide" (Frey, Fisher, & Everlove, 2009).

For example, if there were sixteen students in a class ranked from 1 to 16, then students 1-8 would be on the first half of the list and students 9-16 on the second half of the list. The teacher would pair students 1 and 2 with students 9 and 10 to form a group of four. Then, students 3 and 4 would be grouped with students 11 and 12. Students would continually be grouped until all students were in a group of four.

Since group size is an important factor to consider, "groups of four are great because they provide differing viewpoints, a wider breadth of skills, and enough social

cushioning to allow for high-quality projects" (Cohen & Lotan, 2014). Of course, classes are not always going to be able to be grouped perfectly into fours. Adjustments can be made to this grouping to allow for groups of three or five. In terms of a timeline for the group, Frey, Fisher, and Everlove, say that the answer depends on the task the groups are trying to complete (Frey, Fisher, & Everlove, 2009). Some groups should be regrouped as soon as they finish the task given, while other groups tend to be together for about six-weeks for projects that require specific communication patterns that are established over time (Frey, Fisher, & Everlove, 2009).

CHAPTER TWO: PURPOSEFUL, FLEXIBLE, DYNAMIC GROUPS IN MY CLASSROOM

As shown from research in the "Review of Literature," when done in the correct way, the collaborative learning method of using groups can influence a class. Groups can allow students to work together and motivate one another (collaborative learning), develop some social skills (Vygotsky, 1978), and ultimately learn math. There are different ways to form groups, each having advantages and disadvantages. It is my view, and the research supports it, that groups should never be used just to have groups, but teachers should make purposeful groups using timely data in order to make the classroom more successful.

"Timely" means using same-day student performance data immediately before forming the group. "Purposeful" for groups has two meanings: (1) a purpose for why there are groups and (2) a purpose for why the students are in a specific group. In addition, groups should be "flexible" and "dynamic," or in other words always changing. "Flexible" means that when the groups may not be meeting the purpose they were set up for, they should be changed again to make sure everyone fits a new role. Also, sometimes groups are changed because teachers want students to go from doing assignments the same ways to different ways. In other times, the teacher may want to build up the social confidence of less confident group members, and so having flexible groups allows that. "Dynamic" means that students actually have to get up and move. Research from David

Sousa, an expert in neuroscience, has shown that frequent movement is important for the brain as sitting for more than 20 minutes causes "blood to pool in the brain in our feet and in our seat" (Sousa, 2015). "Movement causes the blood to pump faster around the body which allows more oxygen to reach the brain. Without good oxygen supply the brain becomes sluggish and maintaining concentration becomes harder" (Harte, 2016). In a classroom, movement could take the form of groups changing every twenty minutes.

Research in the "Review of Literature" shows that to give the best chance for all types of students to succeed, different forms of groups are necessary. I would use "purposeful" groups so that students can work together to develop and practice math. Instead of teachers giving students the answers, we give them the pieces, so they can put the puzzle together for themselves. If the students are having difficulty, the groups are a way for them to work it out together. Depending on the activity, group work may take more time during the class. So, groups are definitely something I believe that teachers need to plan for. Even with groups, teachers need to follow Smith and Stein's *Five Practices for Orchestrating Productive Mathematical Discussion* and anticipate what groups may come up with or what they have trouble with (Smith & Stein, 2018).When monitoring, teachers may notice some groups struggling or others succeeding. Teachers can then use this to their advantage by asking the group who understands to help the group who is struggling.

Some students may feel better contributing to just a partner, while others may love to lead a larger group. So, the first thing a teacher must do is determine how many students should be in the group. There are a variety of ways to divide students into groups (Frey, Fisher, & Everlove, 2009) with some activities better suited for smaller groups of

2-3 students and others needing 4-5 students. Sometimes during a lesson, teachers need students to quickly pair or group up to discuss a topic. In this case, the groups are divided by proximity, but it may not be something that should happen every time, because it may not create the best groups. These quick groups are better for a "think, pair, and share" type activity. For some tasks, diverse groups are important (see "Heterogeneous" research). Allowing students with different abilities to be together in cooperative groups allows for a variety of answers, ideas, and thought processes when working through problems or activities. They have to work together to accomplish the learning tasks.

Another type of group would be one based on similar academic abilities. With any of these kinds of groups, students can be moved around as the activity progresses. For those that may understand or do not understand, they can be moved so that they can get help or help others. However, I have to be careful when using this type of homogenous grouping and do not want use it repeatedly so that I do not possibly "type cast" these students based on academics.

I believe that groups should mainly be formed based on the results from an "opener" or "pre-assessment." I would not pair students who got the same questions wrong unless they were put in a group with students that understood that material or if they were completing a lesson with me. The groups or pairs should include students who see the lesson the same way and who have strengths in different places so one student can help another.

Ultimately, I think "purposeful and timely" groups could be used every day. They may only be used for a short period of time as for discussion purposes, or they can be used for an entire class period to work on an activity. I think it is good to use these groups

as often as appropriate based on the needs of the class both as a whole and the individuals in it, so that students can learn and work together, rather than the teacher just telling the class what they should know (Vygotsky, 1978).

Group Norms

Through my two semesters of student teaching, I have seen just how important it is to establish group norms in the classroom. Particularly, I have learned how important it is to start from the first day with those group norms. According to research by Carl Wiemen, establishing norms for groups are "an important step in making collaborative learning in the classroom go well" and should be "done on the first day of class" (Wieman, 2017). He also outlined a first-day classroom group exercise that if done "is something where everyone feels equally qualified to contribute, and "most importantly, has the class establish norms for behavior in group work" (Wieman, 2017). He believes that this approach is better than "me giving them a bunch of rules to follow, because they think more about the issue and internalize it, and they are setting the standards themselves, rather than it being my rules" (Wieman, 2017).

For my first teaching assignment on the first day of school in August 2018, I began to establish my group norms with my Honors Algebra II class. The first thing we did after introductions was have the students tape a notecard on their backs. They did not know what the notecard said, but on each notecard was a question. The students walked around and read each other's cards, then told the student the answer to the question on their card without revealing any part of the question itself. Then, the students had to guess what their question was based on the number(s) given to them by their peers. Once

everyone had an idea of what their question might be, we had the students sit in groups based on the category of their question. This type of grouping would be an example of random grouping. The students then worked in groups using Desmos, a software program used to tabulate data and graph mathematical equations, to create a table that showed the responses they received from their peers. Automatically on the first day, I had the students talking with one another, or in this case, answering questions. This was important on that first day because it laid the ground work for establishing group norms in our classroom, which I wanted to use the entire school year. These group norms established were that the students were expected (1) to discuss and talk with one another and (2) to work together. The students should know that when they raise their hand to ask the teacher a question, that means that the entire group has discussed and given up on reaching an agreement. This is why a teacher needs to monitor as students work. Those may sound predictable, but establishing with the students what you expect from them and having them practice doing that is the only way to get the norms in place. In this activity, if students did not talk to one another, there would not have been a way to figure out what their individual notecards said and they would not have had the data to put in a table with their groups. Overall, even though the students did not realize it, this activity was a good example of showing the students how important it was for each member of the group to work together to be successful in completing the assignment.

For my second semester teaching in January 2019, I was assigned a Geometry class that had started in August 2018. I saw just how important it was to establish group norms early as this class did not have any established; so when I came in as a student teacher and started using groups every day, it took a while for me to get the students to

understand what I expected from them during group activities. In doing that it was important to form the groups transparently in front of the students, but not let them know all of the reasoning behind the selections so that regardless of where they ended up, they could see how important each person is to the group.

According to Gary Borich, Professor of Educational Psychology at The University of Texas at Austin, norms are "an agreement among members of a classroom or school about how they will treat one another" (Finley, 2014), but they are also "an important component to teaching" and help students become "problem solvers" leading them to "mastering classroom procedures" and empowering them to "take more responsibility and ownership of their education" (Nkielo, 2019). For example, when my students come into my class, I expect them to get started on the questions that I have on the board. They also know that I expect them to complete those problems on their own and if they cannot complete them, they should skip over them, which lets me know their readiness level for the lesson. That is an important expectation and norm, because if a student guesses or gets help from a friend and gets the question correct, then I may assume they know the material and I can move on without addressing it. So, if students are using one another to answer a question or guessing, then the data is not an accurate representation of what the students truly know and understand going into that day's lesson. Also, it is important for me to know how *many* students cannot complete the problems so that I know if and how to adjust my lesson and purposeful group plans for the day.

Another group norm that should be established is that the students are going to move into some sort of group almost every day and not with the same people. Therefore,

as stated earlier from the Sousa research, it is important that students move, and they should expect to be moved (the more you do it with them, the less likely they are to complain) (Sousa, 2015)

Also explaining to the students why and how they are being grouped can keep them from complaining. I also initially explained to my students that the groups I created for them had some sort of purpose to them. This purpose could change depending on the task and the data I got from the "opener." I take the "opener" that assesses pre-requisite skills and activates the knowledge my students need for that day's lesson and try to make decisions as to if the whole class needs to review the concept or skills needed to be successful in the lesson. If the class as a whole does not need a review before the lesson, the "opener" could also inform me if some students might need remediation while others need to be challenged. Overall, I can use the "opener" to help me determine the make-up of the individual groups for the day's particular lesson and also make sure the students in them know that everyone in each group has something meaningful to contribute.

Other norms should include who communicates, how you communicate, and what you communicate. If students are in groups, the assumption is that the students should not always need the teacher, so there should be norms in place so that the students know to ask one another for guidance or help, if needed. This is a an example of following the first standard within the "Standards for Mathematical Practice" established by the National Council on Teachers of Mathematics (NCTM), which is "Make sense of problems and persevere in solving them" (Mathematics, 2017) as it encourages students to "discuss problem pathways and solutions with peers" (Zimmerman, Carter, Kanold, & Toncheff, 2012). Everyone should stay together as they work through problems as well as

participating, talking, and completing activities at the same pace. I think these norms will make the group working portions of class more efficient and beneficial. I want the students to not just learn the material but to understand the concept behind it, and in order for them to be able to achieve that, they must work with one another to dive into what they are learning (Gerlach, 1994).

Ways to Use Purposeful Grouping

Just watching the students in classes throughout my student teaching practicum, half are not paying attention and not really involved in discussion even if they are paying attention. That is until they are in well-functioning groups. Students are motivated to talk in groups, where they can discuss ideas and help one another when they feel they have significant information to add to the conversation (Gerlach, 1994). Students who typically may not be recognized or comfortable speaking in front of the entire class have a chance to lead a discussion and feel as if they have something to contribute, which can raise their confidence and their status in the classroom like I discussed earlier. According to Geoerge, one means of achieving this is to purposefully form a discussion group "with only quiet students so talkative students do not dominate the conversation. Quiet students may be more willing to get involved in a small group discussion than in large-group situations. Creating groups with reluctant conversationalists pushes them to step out of their comfort zones to talk to one another - and prevents the more extroverted students from monopolizing the conversation" (George, 2015).

Purposeful grouping is when a teacher makes a conscious decision into how students are put together. The groups are flexible and dynamic and are assembled based

on what each individual student needs that day in order to succeed in the lesson. The purpose for the groups can change based on the unit being studied or the activity that is planned for a particular day.

On a typical assignment day, as opposed to lecturing, I tend to allow my students to work collaboratively together. By grouping students together in purposefully formed groups, different students could rise up and be the leader for the questions that they understand. In some cases, purposeful groups are put together so that the students in them have all the knowledge needed to complete the activity for the day.

Another lesson may call for purposefully grouped students that all worked an "opener" problem using the same procedure. The students know how they want to complete it with all solving it the same way, and so they are first grouped together. These students can then purposefully break apart and form new groups where each different way of working the problem is represented in the new group. So, all the students discuss the multiple solution methods and can see how their peers worked the problem. The purpose in those groups would not be to get an answer or not even to understand the problem itself, but would be to have the students see 3-4 different methods to solve it.

An interesting way to purposefully group is to "group by motivation." Students need problems that make them interested in the math needed to solve them. Teachers may make assumptions that all students like sports, so they use football or basketball problems for all of the students, not realizing the some of the students may not have that interest. Therefore, teachers can improve their approach by finding out what their students like and trying to group based upon those interests. For example, a teacher may group students who like basketball together into a group and give them a "March Madness™"

basketball problem. For the students who do not like basketball, there may be a problem involving the students' favorite TV show or video game. If students have other hobbies or activities they are involved in, those can be incorporated into the classroom tasks and into the groups the students are purposefully placed in.

In some cases, a class may not have the background needed to be successful or there may not be enough students in the room who do have the background knowledge to help out a group. In those situations, I can take those few students who understand and give them challenging problems to work on together (an example of homogeneous grouping). Then, I can have a lecture or activity for the rest of the class to complete with me. On the other hand, when the majority of students understand the material in the "opener" and only a handful do not, the teacher may group the students who understand it and can work together through an activity together without the teacher. Those who need the support get it in a small group with the teacher or with a peer tutor to go over the material that is needed for them to learn it. The support is there in a group, rather than a lecture where some students might not be getting what they need to learn it. In a lecture approach, students are usually not allowed to comment and join the discussion on new material. The teacher stands at the front and delivers the information, while students sit quietly and take notes. However, since learning math is a social endeavor that allows for students to discuss, critique, and examine their own work as well as the work of their peers, using groups (as shown through research) is beneficial to helping them improve the learning experience and their success in mastering the skills they need to succeed.

In some classrooms, social status and group dynamics may have to be considered when grouping (Ward, 1987). There may be a case where certain students cannot work

together effectively, and in order for the group dynamics to work, a teacher has to make sure that members in the groups that are formed can work together. One of the biggest things that has to happen in order to make good social groups is that the teacher has to know each and every student (Nilson, 2010). If the teacher does not have a relationship with the student and does not understand how they learn, who they get along with, and what they like, these groups will not work. I never want to set my students up for failure, so I make notes when groups are working or not working, when someone works well with a specific peer, and so on. I can keep those things in mind and use those notes when needed for the next day.

Another case for social status is when a student may be considered "lower-performing" and has the ability to lead in the group. In the data shown in the "Data Collection" section (see **Table 2**), I list an example of a student who might be considered "low-performing" based on the Unit 1 test score. This student, known as Es, was placed into a group with another student, Wo, who had the highest score on the Unit 1 test. On this particular day, Es had a piece of the concept needed for the lesson that Wo did not. Teachers may expect the kids who perform well to lead the group. In this case, Es was able to explain a problem to Wo, erasing the need for social status. There are times where students who are not expected to do well can take charge and lead a group, while those who are expected to lead do not have all the necessary knowledge to help the rest of the group. Thus, that is why it is so important for the teacher to be looking at timely data that represents a student's level at that moment and using that data to form the purposeful group.

CHAPTER THREE: RESEARCH METHODOLOGY - DATA COLLECTION

A Purposefully Grouped Lesson's Data

In September 2018, I planned a lesson in Honors Algebra II for the Unit 2 concept of complex conjugates. I had students complete an "opener," "inquiry activity," and "closer" during the 48-minute class period. For my "opener," I used the website, "Go Formative" (https://goformative.com/).

"Go Formative" is an online assessment and monitoring tool for teachers where I can create my class and add my students along with their email addresses. Then when these students log in, I can assign formatives that I have created. The question types range from "audio response," "categorize," "essay," "graphing," "multiple choice," "multiple selection," "numeric," "re-sequence," "short answer," "show your work," and "true or false". The majority of the question types allow me to input the correct answer, which then displays an instant view of the students' responses and whether they are correct (green) or incorrect (red). There can also be a "partial" match, which may show as a yellow, orange, or pink color depending on the answer. Essay questions or short answer responses will show up as gray. These questions can easily be graded by the teacher, as they can look through each student's individual work or look at it in a whole class view. The teacher can also see the overall results for all the questions listed alphabetically, by points, or randomly. The teacher has the ability to anonymize responses so that they can be talked about in a whole class discussion. Teachers can also add documents, PDF's,

and pictures into "Go Formative" as questions as well as embed other website materials, videos, images, and audio. I was introduced to "Go Formative" in a technology class my junior year of college. My students have individual laptops, making "Go Formative" a quick and easy tool to use for both the students and myself.

The "opener" for this lesson on "Go Formative" was assessing students' knowledge on the properties of imaginary numbers and complex roots. The "opener" also contained a few questions that had the students activating their knowledge of what conjugates actually are so that they could use that in the lesson (shown below in **Figure 1**). My goal for the lesson was that the student would be able to use complex conjugates and also to simplify when multiplying and dividing complex numbers. The "closer" of my lesson had my "One-step away," "Target," and "Challenge" problems for the day (see **Appendix B**).

9/27 "Opener" Questions:

1. Express the number in terms of *i*: $\sqrt{-96}$
2. Express the number in terms of *i:* $2\sqrt{-36}$
3. Find the zeros of the function: $x^2 + 4x + 12$
4. Simplify: $(42 + i) - (9 - 10i)$
5. Find the product: $(2 + \sqrt{2})(3 - \sqrt{2})$
6. What is a conjugate? Show me an example.

Figure 1: 9/27/18 "Opener" Questions

The "opener" results from the "Go Formative" (**Figure 2**) gives an example of what the teacher sees as students complete the assignment. Since the results are live, a teacher can see where each student is progressing towards completion of the assignment

while they are working. If the answer is correct, but typed it in a different way, teachers have the ability to change the color from red to green. The results on "Go Formative" show me how many overall points each student earned out of the 5 possible points. In addition, group results are shown for each specific question so that I can see who got the question correct and who answered incorrectly. In this data, I saw that the majority of students missed Question #5 as only six students answered it correctly. However for Question #2, only four students missed the question. Paying attention to this data and realizing what content the question covers, allows for me to begin to make decisions of how I want to group while my students work.

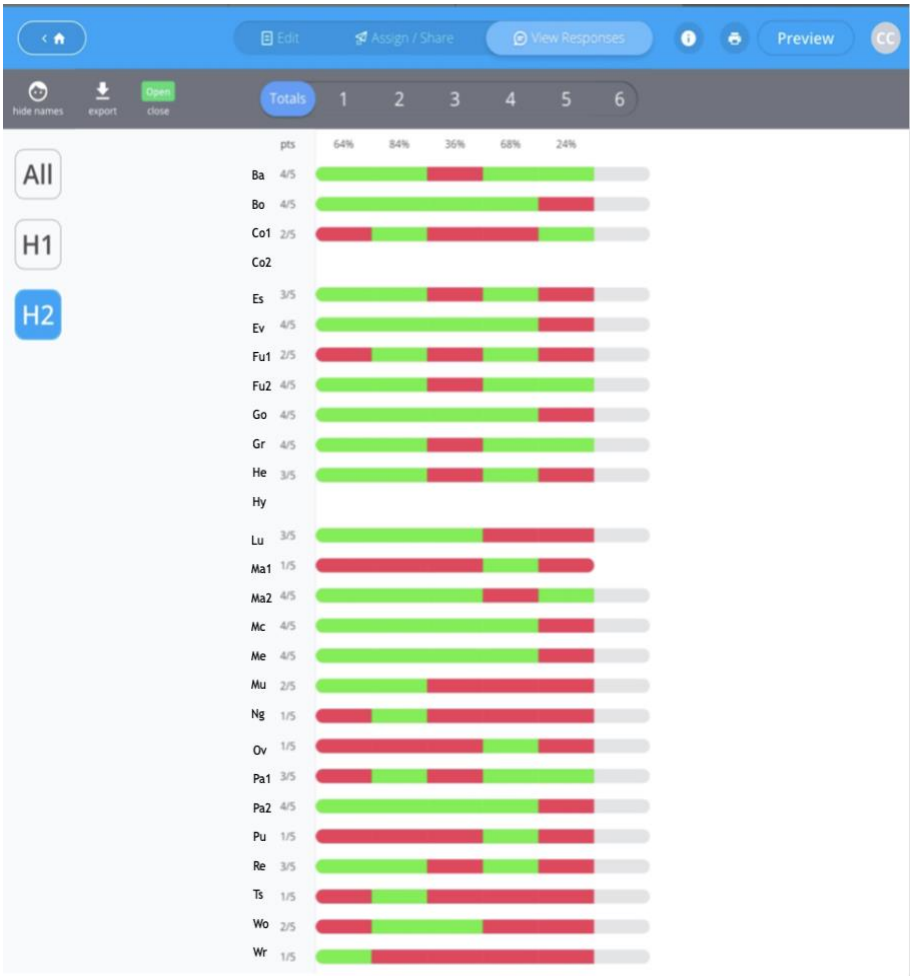


Figure 2: "Opener" Results from "Go Formative"

These results from "Go Formative" can also be exported into a spreadsheet. Since my 6th question was an open response question, I exported my results for the first five questions so that I could more easily compare the results of the "opener", which is shown in **Table 1**.

"Opener" Results According to Last Name						
Name	**Score**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**
Ba	4	1	1	0	1	1
Bo	4	1	1	1	1	0
Coh	2	0	1	0	0	1
Cor	0					
Es	3	1	1	0	1	0
Ev	4	1	1	1	1	0
Fu1	2	0	1	0	1	0
Fu2	4	1	1	0	1	1
Go	4	1	1	1	1	0
Gr	4	1	1	0	1	1
He	3	1	1	0	1	0
Hy	0					
Lu	3	1	1	1	0	0
Ma1	1	0	0	0	1	0
Ma2	4	1	1	1	0	1
Mc	4	1	1	1	1	0
Me	4	1	1	1	1	0
Mu	2	1	1	0	0	0
Ng	1	0	1	0	0	0
Ov	1	0	0	0	1	0
Pa1	3	'0	1	0	1	1
Pa2	4	1	1	1	1	0
Pu	1	0	0	0	1	0
Re	3	1	1	0	1	0
Ts	1	0	1	0	0	0
Wo	2	0	1	1	0	0
Wr	1	1	0	0	0	0

Table 1: "Opener" Results According to Last Name

In the first column of **Table 1**, I ordered my students by last name. The second column shows the score out of 5 points of how many the students answered correctly. The remaining columns show each of the five questions that I wanted to compare data and whether or not the student received credit for the correct answer (1 point) or incorrect answer (0 points) by appearing either green or red.

The results from this lesson's "opener" show that no one student got every question correct. Therefore, no one by themselves could be successful with that day's lesson material. From that point, I had to decide whether I wanted to go forward with my planned inquiry activity or teach a mini-lesson to my students on the concepts they were missing. I made the decision to move forward with grouping my students rather than teach a mini-lesson. With purposeful groups, I felt that students, when strategically placed together, could have the background needed for success with the activity without needing any involvement from me.

Purposefully Grouped vs. Other Grouping Types

As shown earlier, there are many different formations of collaborative groups as I compared homogenous, heterogeneous, alternative method, random, and purposeful groups with data from an "opener." If the grouping type chosen was random, these groups always need to be truly random (see research in "Review of Literature"). For example, a teacher may tell his or her students to group up with the person next to th**e**m, or have students pick a color as they walk in the room and sit with their peers who chose the same color. Overall, there is no meaning or data behind random grouping. Excluding purposeful and random groups, the other grouping types sometimes use data from a

previous chapter test to form the groups for the next chapter's lessons. These grouping types may also use current or "timely" data, which means that the assessment that is used to form the groups was just taken immediately before the groups were decided to be used and then formed. With my "timely" data from class, I ordered my students from best to worst grade on the Unit 1 Test next to their "opener" results in order to see how the two compared (see **Table 2**).

"Opener" Results According to Unit 1 Test Scores							
Name	**Test**	**Score**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**
Wo	193	2	0	1	1	0	0
Go	191	4	1	1	1	1	0
Me	191	4	1	1	1	1	0
Lu	189	3	1	1	1	0	0
Pa1	182	3	0	1	0	1	1
Fu2	180	4	1	1	0	1	1
Fu1	176	2	0	1	0	1	0
Ev	169	4	1	1	1	1	0
Pa2	165	4	1	1	1	1	0
Bo	163	4	1	1	1	1	0
Ov	158	1	0	0	0	1	0
Pu	155	1	0	0	0	1	0
Coh	153	2	0	1	0	0	1
Ba	151	4	1	1	0	1	1
Ma2	149	4	1	1	1	0	1
Wr	148	1	1	0	0	0	0
Re	144	3	1	1	0	1	0
Mc	143	4	1	1	1	1	0
Ts	136	1	0	1	0	0	0
Es	131	3	1	1	0	1	0
Gr	125	4	1	1	0	1	1
Mu	114	2	1	1	0	0	0
Cor	113	0					
Ng	112	1	0	1	0	0	0
Ma1	94	1	0	0	0	1	0
He	74	3	1	1	0	1	0
Hy	na	0					

Table 2: "Opener" Results According to Unit 1 Test Scores

As you can see, just because a student has done well on the previous chapter test does not mean that the student is prepared or going to be successful in the current lesson. This is why timely data is important. Without this timely assessment data, you do not know where each student stands with the new material being covered. If I would have grouped based on the test results, I would have my highest scoring student on the test as a leader in the group; however the student missed more questions than were answered correctly. If I had relied on that top test score student, the group might not have been successful in learning the material in the new chapter.

To help form the best group possible, I compared several different group types (see **Table 3**) including:

- Homogenous (based upon "opener" results)
- Heterogeneous (based upon "opener" results)
- Alternative method (based upon Unit 1 test scores)
- Alternative method (based upon "opener" results)
- Random
- Purposeful (same as used in the fall 2018 class, involves the use of timely data and ensuring that at least one student in each group could provide the necessary information for the group to succeed).

For the homogeneous, heterogeneous, and one of the alternative method groups, and the purposeful groups, I used the data from my lesson's "opener." That way I could compare the groups with the timelier data, a random group not based on any data, and the other

alternative method group that was based on the Unit 1 test scores and see what the students collectively as groups know.

Grouping Method	**Group 1 (G1)**	**Group 2 (G2)**	**Group 3 (G3)**	**Group 4 (G4)**	**Group 5 (G5)**	**Group 6 (G6)**
Homogenous	Mc Go Ev Bo	Ba Fu2 Gr Ma2	Pa2 Me Re Lu	Pa1 He Es Mu	Wo Fu1 Co1 Ts	Ma1 Ng Ov Pu Wr
Heterogenous	Gr Ev Re Wo Ov	Mc Fu2 Pa1 Ma1	Ma2 Me Lu Ng	Ba Go Mu Ts	Bo He Coh Wr	Pa2 Es Fu1 Pu
Alternative Method (Unit 1 Test Grades)	Wo Go Co1 Ba	Me Lu Ma2 Wr	Pa1 Fu2 Re Mc	Fu1 Ev Ts Es	Pa2 Bo Gr Mu	Ov Pu Ng Ma1 He
Alternative Method (“Opener”)	Go Me Re Es	Fu2 Ev He Wo	Pa2 Bo Fu1 Co1	Ba Ma2 Mu Ng	Mc Gr Ma1 Ts	Lu Wr Pu Ov Pa1
Random	Ba Gr Ma2 Pa1	Ov Ts Co1 Fu2	Lu Mu Pu Wr	Bo Fu1 Ma1 Ng	Re Pa2 Ev Go	He Mc Me Es Wo
Purposeful Groups	Ba Mc Fu1 Re	Pa1 Ma1 Pu Lu	Gr Go Es Ts	Fu2 Ev Me Ng	Co1 Bo Pa2 Ov Wr	Ma2 Mu He Wo

Table 3: Grouping Based on Group Types

For the purposeful groups that I used in the class, I went through the data and saw that only six students answered question #5 correctly. Those students became the first students I put into groups. Question #3 was the second most-missed question. So, I went

through and placed those students in a group. During that process, I made sure that everyone who got question #3 correct, had incorrectly answered #5. That way the students who correctly answered just one of the question, but incorrectly missed the other, had a chance to limit social status and be able to have a piece of information that other students may not have. After grouping those students, it did not matter as much who went to what group. I thought about eliminating social status and the social dynamics of the class to place the remainder of the students.

Once I grouped the students into the six different group types and placed them in the table, I went through each student and the questions they missed and compared that to their group members. Then I compared the grouping method with the questions that no one in the group had correct, meaning that no one in the group had some piece of information that they would have needed to succeed. In **Table 4** all group types, besides purposeful, have at least one group where every student in the group missed a particular question. So, if I tried to have the students complete an activity with that information, no one in the group would have the knowledge to answer the question without my help or assistance from someone in another group.

Grouping Method	Question 1	Question 2	Question 3	Question 4	Question 5
Homogenous	G5		G4, G6		G1, G3, G6
Heterogenous					G6
Alternative Method (Unit 1 Test Grades)					G1
Alternative Method ("Opener")					G1, G4
Random			G2		G3, G5, G6
Purposeful Groups					

Table 4: Questions Missed According to Group Type

With grouping methods such as heterogeneous, the teacher does not have to think or purposefully group. They go down the list based on accuracy and count out 1-6, and place students in groups. Then, they start over and count the next six students and the students with the same number get placed in a group. In cases like the alternative method, the research says it should work, because in theory there is someone else at the same approximate level. However, **Table 4** shows that at least one group will not have the information needed to succeed regardless of the use of timely data or untimely data. Random, being truly random where I just went down the list and picked whoever I wanted, had a high number of groups that were missing information that they needed to succeed. For homogenous groups, the teacher groups the students by ability. The four highest-performing students are placed in a group, then the next four in a group, and so on until the last group has the four lowest performing students. Even the groups with some of the highest performing students are missing information that they would need to be successful in the class that day. The groups in all of these cases, would at some point fall apart.

I try to make groups to make sure my students have all the knowledge that they need to succeed. Based on the timely results of the "opener" I gave on that day in the fall of 2018, I "purposefully" grouped my students. For this particular lesson, the students were doing an inquiry activity and I wanted the students to work through that activity together without my assistance. Because of that desire, I tried to put students together so that all groups had students that knew everything collectively. I disregarded how they did on the last test, because that information is not timely enough. Also, I noticed that some of my stronger students who performed well on the

Unit 1 test did not necessarily perform well on the "opener." If they did not know the material and they are in a group where the other students rely on them, then that is still not helping them to learn. That is why I was trying to develop these groups where everyone had a place, purpose, and as a whole, the groups could successfully complete the inquiry activity. Between each group, I felt that they had a pretty good chance of figuring out how to do the problem set. They could support one another better than me just giving an interactive lecture. While my students worked on the "opener," I worked on grouping my students so that they were not spending much time waiting and sitting without any kind of material to work on. If students did finish early before I was done grouping, I had extra challenge-type problems ready that would lead them into the lesson. Overall, these grouping decisions were happening as I was receiving the data from my students.

CONCLUSION

My Reflection

Purposeful groups are used to achieve learning that may not be able to occur with just one person or in a different type of teaching environment by using timely data and flexible groups. Sometimes, there may need to be more than one person doing a problem in order to complete it. In the case of my lesson in the fall of 2018, the purpose of the groups was to do something together. Without the purposeful groups, my students did not have the pre-requisite skills needed to figure it out on their own, and so the groups gave them these needed skills. Looking at my data, I am not saying that those six students who got Question #5 right can explain the idea to their peers, but the purposeful grouping is giving them a better chance in the group to discuss it together. The alternative would be to group students based on untimely data like test scores, because some students may seem like they should know it, even though the "opener" data shows they do not. Even if no one had the background, by talking together, the students can figure it out.

As the year has progressed, I have been continuing to try to do what is best for my students to succeed, and almost every day they are working in groups. For example, in a recent class period my students were studying parabolic conic sections. The students had seen parabolas before in a previous unit during the fall semester, therefore the majority of the material should have been review. I used the "opener" to

assess my students' skills and activate the knowledge they would need to be successful on this particular day. From the "opener," I formed groups for my students to work in. They did relatively well on the "opener," and so I decided that I did not need to go over any material before the students started the activity. I grouped the students so that they had all the information they would need to succeed for the day. In order to discuss parabolic conic sections, I had the students complete a Desmos activity that introduced directrix and focus to find the equation of a parabola. In these groups, the students worked well together. As I monitored the students on my laptop, I also circled the room listening to conversations. The majority of the students stayed together, discussed how to work problems, and helped each other out. At times students did raise their hands. When this happened, I asked advancing questions to get them back in the right direction. With minor support from me throughout the class period, all groups were progressing towards the learning goal until the end of class. Towards the very end of class, there was a group where three typically strong students were in a group with one other student who has an overall average performance (if you were to classify students based on scores from the class). One of the top students, Wo, and the "average" student, Ma2, did very well on the "opener." The remaining two typically strong students, Ov and Lu, had missed some questions from the "opener," and so I placed them in a group together. While they were working, they came across a Desmos slide where the students disagreed about the answer. Lu and Ov had the incorrect answer while Ma2 had the correct answer. This was an interesting case where social status was removed, because the "lower" student was able to prove why she was right to the "smarter" students. Without the timely data from the "opener" that led me to

make these groups, that may not have ever happened. It is also an indication, that these groups are working, but I am still learning. This shows me that the timely, purposeful groups are necessary in order for the class to succeed.

Purposeful groups are used to achieve learning that may not be able to occur with just one person or in a different type of teaching environment by using timely data. Sometimes, there may need to be more than one person doing a problem in order to complete it. In the case of my lesson in the fall of 2018, the purpose of the groups was to do something together. Without the purposeful groups, my students did not have the pre-requisite skills needed to figure it out on their own, and so the groups gave them these needed skills. Looking at my data, I am not saying that those six students who got Question #5 right can explain the idea to their peers, but the purposeful grouping is giving them a better chance in that the group can discuss it together. As opposed to having students sit and scribble some notes down or grouping students based on untimely data like test scores, because some students may seem like they should know it, even though the "opener" data shows they do not. Even if no one had the background, by talking together, the students can figure it out.

This study has reviewed several grouping strategies and the research behind implementing them. Although my teaching experience is limited so far to student teaching, I have witnessed the effectiveness of using groups in teaching as well as the pitfalls (and chaos) that can occur when a targeted approach to forming them is not used.

I plan to use these grouping strategies in my teaching career, but want to take a much more targeted approach by making "purposeful" group selections that are "timely," "flexible," and "dynamic." As shown in my teaching examples, the ability to use

technology (such as Desmos) for student assessments, retrieve performance data instantly, and organize it in a manner that can be used for quick group-forming decision making is very important, as it allows "timely" (instant or same-day) use of the student's readiness. Using targeted assessments such as "openers" and "closers" at the start and end of class to obtain and analyze this data is also important. "Flexibility" is key in my group forming as the type, composition, and size of the group that they may be in will probably change frequently. Finally, groups should be "dynamic" as students should expect to be moved into different groups frequently to maximize their performance, which is also good for their brain. Overall, I look forward to using and refining this purposeful grouping approach during my teaching career with the goal of providing the best math education I can possibly give to my future students.

Limitations

From my experience, there are some limitations that I am not sure would apply to everyone who might try this method. I think that if a teacher invests enough time at the start of the year using and explaining this method, setting and enforcing norms like the ones I use for my students, and realizing that it will take around 6 weeks for all students to buy in to the idea, then I think all teachers can master this concept. This year I was only a student teacher, but I was allowed to do anything I wanted in the classroom. I did not have any difficulty with getting my students to move into groups to work. My students were willing to work with one another when I asked. As I begin my career, I will be able to continue to see how purposeful groups can work in my own classroom.

Some possible limitations to consider about my experience in using purposeful groups may include:

- This was used in a high school setting. It might would work differently in a middle or elementary school setting.
- As a teacher enforcing these norms and using purposeful groups, you might be the only person in a school with the norms. Therefore, students may revolt for an extended time since they have not done this before or worked under these norms.
- The students might have never worked in appointed groups and thus do not trust that they can work.
- I was also working with the upperlevel Honors Algebra 2 and Geometry classes. Therefore, the norms and experience may be different with different types of students.
- I had at least one other student teacher working the classroom with me. We would discuss the groups on occasion and monitor the groups.
- The school I was working in was a one-to-one school. Meaning each child had access to an individual computer both at school and at home. As the teacher, I had access to multiple technological resources that could aid in quickly assessing whether students were right or wrong.

APPENDICES

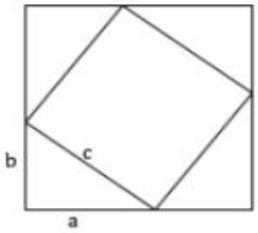
APPENDIX A:

Geometry Pythagorean Theorem and Special Right Triangles Activities

PROVE PYTHAGOREAN THEOREM ACTIVITY

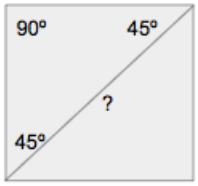
1) Use your colored cutouts to recreate the diagram to the right.
2) Use any tools and materials at your group to prove why the Pythagorean Theorem works.
3) Write a brief proof in your own words.

Pythagorean Theorem Proof 3



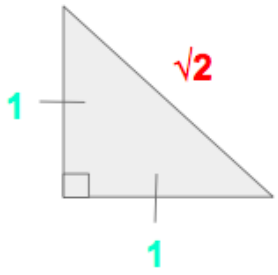
G

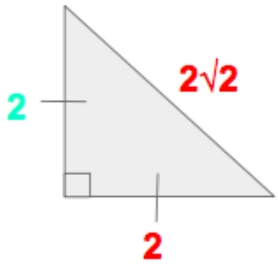
- Mark what you know on your square.
  - Measure the side lengths to the nearest inch.
  - What do you know about the angles?
- Draw a diagonal.
- Find the length of the diagonal in simplest radical form.
- Estimate how long it would be. Measure it and compare.

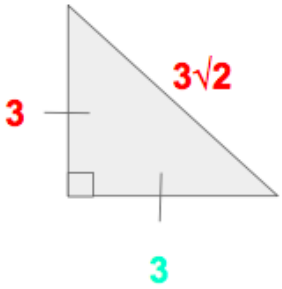


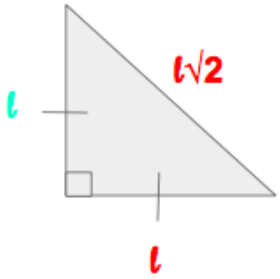
- Everybody draw a 45°-45°-90° triangle and label it with your leg and hypotenuse lengths.
- Compare your boards with each other.
- What do you notice?

What type of triangle do we have?









What do all of these triangles have in common?

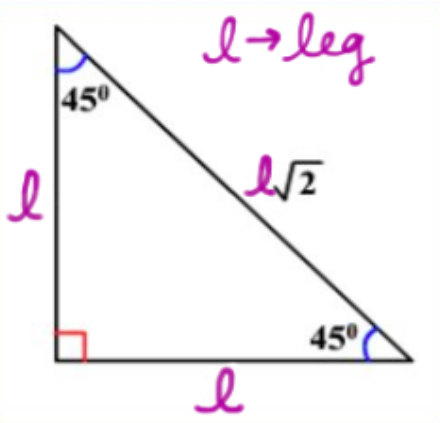
What do all of your triangles have in common?

- All 45°-45°-90° triangles are <u>similar</u> because they have the same angle measures, so their sides always have the same ratio.

What is the ratio?

- The hypotenuse is always √2 times as big as the legs.

Shortcut for 45°-45°-90° Triangles



(We call **45°-45°-90°** triangles a type of **special right triangle**.)

APPENDIX B:

9/27/18 “Closer” Questions

1.) One-Step Away:

Simplify: $\frac{1-2i}{5i}$

2.) Target:

Simplify: $\frac{3-2i}{2-5i}$

3.) Challenge:

How can we find i^{45}? Keep in mind the properties of i.

LIST OF REFERENCES

Bainbridge, C. (2018, December 10). *Heterogeneous Grouping in the Classroom.* Retrieved from verywellfamily: https://www.verywellfamily.com/heterogeneous-grouping-1449185

Bogert, S. (2010). *Purposeful Grouping.* Retrieved from University of Alabama Interns: http://uaintern.weebly.com/uploads/2/6/0/0/26008614/purposeful_grouping.pdf

Cohen, E., & Lotan, R. (2014). *Designing Groupwork: Strategfies for the Heterogeneous Classroom.* New York, NY: Teachers College Press.

Finley, T. (2014, August 12). *The Science Behind Classroom Norming.* Retrieved from Edutopia - George Lucas Foundation : https://www.edutopia.org/blog/establishing-classroom-norms-todd-finley

Frey, N., Fisher, D., & Everlove, S. (2009). *Productive Group Work: How to Engage Students, Build Teamwork, and Promote Understanding.* Alexandria, VA: ASCD.

George, C. (2015, January 6). *7 Ways to Help Quiet Students Find Their Voices in Class.* Retrieved from Education Week Teacher: https://www.edweek.org/tm/articles/2015/01/06/7-ways-to-help-quiet-kids-feel.html

Gerlach, J. M. (1994). Is This Collaboration? In K. Bosworth, & S. Hamilton (Eds.), *Collaborative Learning: Underlying Processes and Effective Techniques, New Directions for Teaching and Learning No. 59* (pp. 5-14). San Francisco: Jossey-Bass.

Harte, K. (2016, June). *E-Teaching.* Retrieved from Australian Council for Educational Leaders: http://www.acel.org.au/acel/ACEL_docs/Publications/e-Teaching/2016/e-Teaching_2016_19.pdf

Johnson, B. (2011, August 11). *Student Learning Groups: Homogeneous or Heterogeneous?* Retrieved from edutopia: https://www.edutopia.org/blog/student-grouping-homogeneous-heterogeneous-ben-johnson

Knapp, M. (2016, September 27). *Teaching topics: Openers and Closers.* Retrieved from U.S. National Library of Medicine: https://news.nnlm.gov/nto/2016/09/27/teaching-topics-openers-and-closers/

Laal, M., & Laal, M. (2012). Collaborative learning: what is it? *Procedia - Social and Behavioral Sciences, 31*, 491-495. Retrieved from https://www.sciencedirect.com/science/article/pii/S1877042811030217#bibl0005

Lewis, B. (2018, April 18). *Homogeneous Groups in Education.* Retrieved from ThoughtCo: https://www.thoughtco.com/homogeneous-groups-in-educational-settings-2081647

Liljedahl, P. (2014). The affordances of using visually random groups in a mathematics classroom. In P. Liljedahl, *Transforming Mathematics Instruction: Multiple Approaches and Practices.* New York, NY: Springer.

Mathematics, N. C. (2017). *Common Core State Standards for Mathematics.* Reston: NCTM.

Nilson, L. (2010). *Teaching At Its Best - A Research-Based Resource for College Instructors.* San Francisco: Jossey-Bass.

Nkielo, D. (2019, March 18). *Classroon Management Strategies for 9th to 12th Grade.* Retrieved from PB Works - studentcenteredlearningiscool: http://studentcenteredlearningiscool.pbworks.com/w/page/132470103/CLASSROOM%20MANAGEMENT%20STRATEGIES%20FOR%209th%20to%2012th%20GRADE

Smith, M., & Stein, M. (2018). *5 Practices for Orchestrating Productive Mathematics Discussions.* Thousand Oaks: Corwin.

Sousa, D. (2015). *Engaging the Rewired Brain.* West Palm Beach, FL: Learning Sceinces International.

Srinivas, H. (2011, October 11). *Collaborative Learning*. Retrieved from The Global Development Research Center: http://www.gdrc.org/kmgmt/c-learn/index.html

Valentino, C. (2000). *Flexible Grouping.* Retrieved from Eduplace.com: https://www.eduplace.com/science/profdev/articles/valentino.html

Vygotsky, L. (1978). *Mind in society: the development of higher psychological processes.* Cambridge, MA: Harvard Universtiy Press.

Ward, B. (1987). *The School Improvement Research Series.* Retrieved from Education Northwest: http://educationnorthwest.org/resources/school-improvement-research-series

Wieman, C. (2017, May). *Instructor Guidance.* Retrieved from Carl Wieman Science Education Initiative at the University of British Columbia: http://www.cwsei.ubc.ca/resources/files/Setting-Group-Work-Norms_Activity_Wieman.pdf

Yee, V. (2013, June 8). Grouping Students by Ability Regains Favor in Classroom. *THe New York Times*.

Zimmerman, G., Carter, J., Kanold, T., & Toncheff, M. (2012). *Common Core Mathematics in a PLC at Work, High School.* Bloomington: Solution Tree Press.