

# Self-Paced Individualized Learning

By

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A Master's Paper  
Submitted in Partial Fulfillment of  
The Requirements for the Degree of  
Master of Science in Education-Montessori

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Date

## Self-Paced Individualized Learning in Mathematics

**Abstract**

As teachers, we strive to help every student be successful and develop a love for learning. We want, and expect, that every child can and will be successful. However, we are still falling short of our goal. Too much time is spent on whole group instruction that only reaches the middle. Students do not learn at the same rate or with the same methods as their peers. I propose the solution to this is developing a self-paced, individualized classroom. A classroom in which students are allowed to learn at their own pace and take control of their learning. In this study I analyzed data taken from my classroom of 7<sup>th</sup> and 8<sup>th</sup> grade mathematics students. I studied how taking control of their learning affected their attitude and understanding of mathematics. I observed student behaviors, conversations and interactions. I designed units, daily guides and reflection sheets that students completed to monitor their learning. The results showed increases in students' abilities to learn independently. Mathematics learning increased. The study showed an increase of between 11 -55% more math standards attained during the school year. Besides the mathematical knowledge gained, my students learned how to use an informational text (math book) to gain understanding and clarity about a topic. They learned how to take initiative and ask for help when needed. Students learned to trust one another and seek help and lessons from peers. The results suggest that it may be possible to have a successful, independent self-paced learning environment in mathematics.



## **Introduction**

As math teachers, we strive to help every student be successful and develop a love for learning mathematics. We attempt to create and lead innovative, engaging and creative lessons to capture students' attention and as a result lead them to learn and understand mathematics. We want, and expect, that every child can and will be successful. However, we are still falling short of our goal. Students do not learn at the same rate or with the same methods as their peers. Every child is different. I have spent many hours each week preparing engaging whole class lessons that end up teaching to the middle; students with the greatest mastery get bored while struggling students fail to keep up or act out due to frustration.

I believe self-paced, individualized learning can be more successful than whole class instruction in middle school mathematics. I want my students to be able to move on to the next topic when they are ready, not when the entire class is ready. I am concerned with students' ability to monitor their learning and understanding as well as their ability to take control of their learning and push themselves. In the discussion that follows, I will provide evidence that self-paced, individualized learning has a positive effect on student learning. I will discuss what factors are needed to ensure learning, how to help students self-regulate their learning, different approaches to independent learning and how to foster independent learning.

### **What is a Self-Paced Classroom?**

“Most math programs expect that the children will be working at the same level” (Kobelin, 2009, p. 11). A student should be allowed to work at his/her own pace. Self-paced learning can help the student become responsible for his/her own learning (Khan & Slavett, 2013). Self-paced learning is a method that allows students to work at their own pace and move on to a new topic when mastery has been reached on the previous topic, or skip topics if the student can demonstrate mastery by a pre-test. Students are assessed prior to beginning a unit and then are allowed to start where needed. Students are allowed to accelerate through the unit at their own pace. The instruction of the unit is student-based, not teacher-based. The students can work independently or in small cooperative groups. Students can ask for a lesson when needed from the teacher or preferably from their peers and they are free to use technology to aid them. The teacher is the facilitator of learning not the main focus. Students use checklists to keep track of their learning. The checklist contains the tasks that the student must complete to demonstrate mastery of the unit. In a self-paced classroom, answers (or controls) are provided so that the student can check their work on their own and monitor their progress towards mastery. Students are required to take a post-test independently to demonstrate mastery of the topic. Frequently, a unit project will follow which requires the student to apply the information acquired in the unit (Edwards, 2013, pp. 231-232). Self-paced learning allows a student to advance when ready while other students may continue to work on a topic longer. In short, students advance but not necessarily at the same pace. This brings up the next point, how do you make sure that students are making enough progress?

### **Fostering Independent Learning**

There are concerns with self-paced independent learning. One concern is that students will choose to work below his or her level. Another is that students will work too slowly. To alleviate these and other concerns, it is necessary to create an environment that will foster responsible independent learning. To start, “expectations must be set and conveyed to all students, who in turn must trust the instructor enough to accept that these expectations will help them succeed” (Edwards, 2013, p. 235). A prepared environment is also required. Materials should always be selected and utilized. Classrooms should provide multiple use spaces such as for individual work and group work, and to build community. With the increase in availability in technology, having a list of websites and online programs is also helpful to foster independent learning.

Middle school is an excellent time to foster independent learning. Research has shown that middle schoolers are at an age where they become capable of learning independently and with enthusiasm. They have reached an age where they understand the advantages of studying and they are actually willing to study. Middle schoolers are also likely to monitor their learning *during* learning. It is important to teach students skills such as self-awareness, accountability and personal responsibility so that they can begin using them as a means to become more independent. Students also need to learn how to take notes, monitor their learning and learn how to summarize what they have learned (Thomas, 1993). Self-paced, individualized learning teaches students to manage their own

time and to learn on their own, two factors that will help them exceed in higher education and into adulthood (Thomas, 1993).

Thomas states, from a study done in the 1990's, that a paradox exists in education regarding independent learning. The paradox is present when "the opportunity to engage in independent learning exists side by side with instructional practices that limit the quantity and quality of these learning activities" (1993, p. 576). Too often, teachers tend to provide outlines, handouts, etc.. that take away the students ability or desire to think through anything on their own.

Another problem is that teachers tend to tell their students to "study for the test", but middle grade students have yet to learn how to study. They often know only concrete and straightforward learning strategies taught in elementary schools. However, concepts in the middle grades are much more complex and abstract (Thomas, 1993) and therefore, require different study habits and problem solving techniques.

Gains in achievement are made when teachers can engage middle schoolers in strategic study activities like note taking, metacognition and summarizing. Studies also found that students spend very little time outside of class learning and an even smaller amount studying (Fetter, Brown & Owings, 1984; Thomas, 1991 (as cited in Thomas, 1993, p. 579)). Students' outside-of-class-work time is based on their perception of the difficulties of what is being asked of them. Teachers that give too much to the students, as in outlines or study guides, resulted in students not spending much effort on their learning.

Teachers that held students more accountable for their own learning, spent more time studying. However, high demands such as tough standards, tough tests, and long assignments do not appear to engage students or make them strong independent learners (Thomas, 1993, p. 583). Additionally, teachers that provide summaries, lead review sessions and allow for make-up tests also have the potential to discourage student engagement.

There are strategies to support independent learning. Teachers should provide as much information as possible about what is expected in the class and provide rubrics to let them see how they will be assessed. Teachers who expect and require independent learning and task mastery have students that more deeply process academic content. Teachers should also require their students to do more self-directed or student-led summaries of their learning. Additionally, “classroom environments that are characterized as being informal rather than formal, cooperative rather than competitive, student-centered rather than teacher-centered, and effort-focused rather than ability-focused offer the greatest promise for preventing the decline in achievement motivation characteristic of the transition to the middle grade schools” (Thomas, 1993, p. 587).

An observational study done in Dutch schools stated that they want to turn each secondary school into “a house of study” in which students would learn to study independently so that they would be more prepared for work and life. The study identified a major component called process-oriented teaching. “Process-oriented teaching is teaching that facilitates independent learning, supporting students to become proficient

learners in the field concerned and preparing them for lifelong learning” (Bolhuis & Sanneke; Voeten & Marinus, 2001, p. 838). There are four key ideas in process-oriented teaching.

- Move gradually to student regulation of the complete learning process
- Focus on knowledge, building of the subject area
- Pay attention to emotional aspects of learning
- Treat learning processes and results as social phenomena

Process oriented teaching includes developing social skills for social learning (collaborative groups), observing and learning from others, asking others for advice and help, understanding information from other points of view, and being able to have productive conversations with others about the subject. (Bolhuis et al., 2001)

From the observations, Bolhuis et al. (2001) found that “only 5% of the total amount of time was spent on process-oriented teaching: explaining, asking questions, and giving feedback concerning the learning process” (p. 846), and that spending less time on whole-class instruction is an important condition for process-oriented teaching. This allows for more time on coaching during independent work and focusing on the learning process.

Bolhuis and colleagues (2001) suggest that teachers need to extend student-activating teaching with explicit teaching of how to learn, and with coaching and guiding of learning processes. Failure to do so could cause students, especially low-income students, to drop out. “A major distinction running through our observational data was the distinction between teaching behavior driven by the subject matter and teaching behavior

driven by students' learning processes. To help students develop the capacities for active and self-directed learning a change is needed in teaching behavior" (Bolhuis et al., 2001, p. 854). Teachers need to teach students how to learn and then continue to coach their learning processes.

### **Self-Regulation of Learning**

The ability of students to self-regulate their learning is a key aspect in having a well run, successful, self-paced and individualized classroom. In order for students to control their learning, they need to know if they are learning. "Teaching students to self-regulate their learning involves promoting awareness of new and different ways to learn" (Paris & Winograd (as cited in Ness and Middleton, 2001, p. 47)). A study which involved helping special education students develop better self-regulation skills, created an acronym to help them remember the self-regulation skills they were working on mastering. The acronym is: MARS (Ness et al, 2012). M was for Materials (bringing pencils, paper and book to class); A was for Anticipate (prepare for barriers to learning); R was for Ready To Learn (focused and seated at beginning of class); S was for Stay On Task (Ness et al, 2012). As a result, the focus student improved in on task behavior an average of 17 %, his engagement increased from 25 – 50% to 50 -75%, and his final grade went from a C- to a B- (Ness et al, 2012 p. 273). Focusing on direct self-regulation skills and teaching those skills specifically have a positive impact on student learning.

Teachers also need to know how good their students are at self-regulating their learning and behavior. It is important for a teacher to know if a student is capable of realizing when he/she needs to ask for help or, to move on because mastery has been met. Teachers need to know each student's strengths and weaknesses as they pertain to learning and learning strategies. Students need to know how they learn best as well. In Germany, researchers wanted to see if teachers were able to accurately assess students' abilities to self-monitor and self-regulate their learning (Friedrich, Jonkmann, Nagengast, Schmitz and Trautwein, 2013, p. 27). Students in the study were between 10-14 years old and attended the lowest school track in Germany. 73 teachers participated. Students and teachers were given a survey to fill out and the results were compared. Teachers were asked to assess their students' self-regulating learning strategies (Friedrich et al., 2013, p. 28). The students also had a survey to complete about their own self-regulating learning strategies (Friedrich et al, 2013, p. 28). The concept of self-regulated learning is an important pre-requisite for learning and achievement. "The cyclical self-regulation model of Schmitz and Wiese (2006) divides learning actions into a phase before learning (preactional), a second phase during learning (actional), and a third phase after learning (postactional)" (as cited in Friedrich et al., 2013, p. 27). The study analyzed these phases in their surveys. The surveys consisted of questions that looked at how students and teachers think before they learn, as they learn and after they learn (Friedich et al., 2013, pp. 28-29).

The results of the study showed that teachers were capable of differentiating between student's use of self-regulated learning strategies and math competence (Friedrich et al, 2013, p. 31). However, students who were successful in math were not

always good in self-regulated learning strategies in math (Friedrich et al, 2013, p. 31).

Teachers were able to distinguish that preactional strategies are more important before the learning begins and that actional strategies were more important during the learning when they were monitoring the learning and behavior (Friedrich et al., 2013, p. 31).

### **Metacognition**

Metacognition is being aware of one's own thinking. In other words, metacognition is thinking about thinking. In order to work independently, students need to develop strong metacognitive strategies. Knowing how they learn, if they learn and why they learned it, is important if students are to advance their learning on their own. Studies were analyzed that looked at how the ability of a student to self-study affects memory retention and information learned (Tullis and Benjamin, 2011). They looked at whether the students spent more time on tasks that were more difficult or if students spent more time on easier tasks as they studied. Additionally they looked at how meta-cognitive strategies affected the learning and memory retention of the students (Tullis et. al., 2011).

Individual control of study time is beneficial to the learners. Self-paced learning greatly improves memory performance when compared to a control group that was given the same total amount of time but it was allocated equally among tasks—However, the students who retained the most also utilized better meta-cognitive strategies to learn (Tullis et al, 2011). The ability to self-study is not perfect on its own; one needs to be able distinguish between more complex (difficult) tasks and easier tasks. The students who

could distinguish the easier from the harder (in other words used more meta-cognitive strategies) did the best (Tullis et al., 2011). When the students were given control over their study behavior they had increased memory performance even when they did not increase their total study time (Tullis et al., 2011). “Overall, trusting learners with control over their own learning has the potential to improve their learning” (Tullis et al., 2011, p. 117).

Since all students do not come to school having strong metacognitive skills, scaffolding may help them develop new and stronger skills in metacognition. In a literature review on the research of scaffolding and metacognition done by Derek Holton and David Clarke (2006), six key functions of scaffolding were studied.

1. Recruitment (engage in interesting activity)
2. Reduction (develop around manageable components)
3. Maintenance (making sure student is on-task and headed for a solution)
4. Marking (highlight the main parts of activity)
5. Control (reduce the frustration level)
6. Demonstration (provide a model of the solution)

(Holton & Clarke, 2006, p. 129)

The authors defined scaffolding as an act of teaching “that supports the immediate construction of knowledge by the learner and provides the basis for the future independent learning of the individual” (Holton, et al., 2006, p. 131). The authors defined metacognition

as “a thinking act that operates on a cognitive thought in order to assist in the process of learning or the solution of a problem” (Holton, et al., 2006, p.133).

They identified three types of scaffolding: Expert scaffolding, reciprocal scaffolding and self-scaffolding (Holton, 2006, p. 134). Expert scaffolding occurs when an expert supports the learner, reciprocal scaffolding is when two or more people are working collaboratively on a task, and self-scaffolding is when the student is able to scaffold for himself or herself (Holton et al., 2006, pp. 134-136).

According to Holten et al (2006) , scaffolding and metacognition are basically the same thing. Scaffolding helps students think about the steps they need to do to solve a problem and metacognition is also a method that focuses on thinking about what needs to be done to solve a problem. Scaffolding and metacognitive skills can be applied in many different situations. If scaffolding questions can be written that focus on the processes required they could be reused in a number of different ways. Always keep in mind that the questions should not only be helpful in the current problem, but should also be ones that the students can think about and apply to new and different problems or situations (Holton et al, 2006). “By providing activities that promote the use of scaffolding acts by students through reciprocal and self-scaffolding, teachers will enable their students to become better learners and better problem solvers in situations when they do not have expert assistance at hand” (Holton et al., 2006, pp. 141-142). If students become better learners and problem solvers, they will be more equipped to succeed in a self-paced, independent learning environment.

### **Approaches to Independent Learning**

There are a variety of individual self-paced programs that have been created and implemented in classrooms. Reginald Melton studied five different models of individualized approaches to learning. The five programs are:

- The Keller Plan Model
- A Refined Linear Model
- A Variable Route Model
- A Modular Learning Model
- An Independent Study Model

(Melton, 1981, p. 404)

Each model provides the student with a wider degree of choice in determining their own goals and how to achieve those goals. The Keller Plan Model presents material in the form of a linear sequence of units. Students need to master one unit before proceeding to the next. Self-pacing helps students to determine the amount of time it will take him/her to accomplish this (Melton, 1981, p. 405). The Refined Linear Model has the same sequencing of units and the same requirement of mastering one unit before proceeding to the next. It differs from the Keller Model by taking into consideration the slower learners. It identifies core units that need to be mastered by all learners and additional units that can be learned if a student completes all core units (Melton, 1981, pp. 401-408). The Variable Route Model also follows the same requirements of mastering a unit before proceeding to the

next and allows for self –pacing. However, it differs because it offers students choice of alternative routes. This model uses the idea that if students have more choice they are more likely to be motivated to learn. So, in this model students are not necessarily following a linear path (Melton, 1981, pp. 409-410). The Modular Learning Model allows students more choice. It provides greater freedom by making its units of instruction independent of one another. This allows students to select units of study according to his/her interests (Melton, 1981, pp. 411-412). Finally, the Independent Study Model provides the most autonomy for learning. In this model, students are encouraged to formulate their own goals, develop their own plans and pursue their own interests. A director oversees and monitors their selected coursework (Melton, 1981, p. 413). Depending on the students, different models might work better with different students. Considering all of the models are providing some type of a self-structured learning experience, it may also be important to analyze them and use the one that best fits your students' current needs.

A current popular individualized learning program is Khan Academy. Khan Academy is a free online math program designed for students to learn independently and at their own pace. This program was designed by Salman Khan. "Khan Academy aims to encourage self-paced, mastery-based, and interactive learning" (Khan & Slavitt, 2013, p. 29). Khan Academy has a collection of 3500 videos and provides real-time reports (Khan et al., 2013, p. 29). As they are working on lessons, students have access to step-by-step hints and other related videos to assist them when necessary (Khan et al., 2013, p. 29). The real-time reports provide students with feedback about their progress that can empower them and

lead them to take control of their learning (Khan et al., 2013, p. 30). Khan Academy is helping schools and classrooms head towards giving students the power to learn and succeed independently.

### **Effectiveness**

Effectiveness of a program is vitally important. In order to implement a self-paced, individualized program, teachers need to know that it is fundamentally strong and successful. One of the hardest processes for students to really grasp is how to study for understanding. So often, teachers tell students to go home and study for the test tomorrow. Students do not know how to study and are frequently not taught what good studying entails. Jonathan G. Tullis and Aaron S. Benjamin were looking at how the ability to self-study affects memory retention and information learned. They also studied how the students studied. They looked at whether the students spent more time on tasks that were more difficult or if students spent more time on easier tasks. Additionally they looked at how meta-cognitive strategies affected the learning and memory retention of the students (Tullis & Benjamin, 2011).

Individual control of study time is beneficial to the learners. Self-paced learning greatly improves memory performance when compared to a control group that was given the same total amount of time but it was allocated equally among tasks. However, the students who retained the most also utilized better meta-cognitive strategies to learn. The ability to self-study is not perfect on its own, one needs to be able distinguish between

more complex (difficult) tasks and easier tasks. The students who could distinguish the easier from the harder (in other words used more meta-cognitive strategies) did the best. When the students were given control over their study behavior they had increased memory performance even when they did not increase their total study time. “Overall, trusting learners with control over their own learning has the potential to improve their learning” (Tullis et al., 2011. p. 117). Teaching students metacognitive strategies will help them retain information learned. “Improvements in metacognition could result in more successful and efficient learning, both in and out of the classroom” Tullis et al., 2011, p. 117).

### **Conclusion of the Literature Review**

A self-paced, individualized learning program is an excellent environment for students to take control of their learning. If students take control, motivation and effort will increase and as a result student learning will improve. Allowing students to work and learn at their own pace will provide student the time they need to be successful. No longer will students to wait for the class to catch up or feel like they are left behind. Every student will be able to experience success. In order to foster independent learning, a prepared environment is necessary. Students need goals and expectations that are clearly communicated and well understood in order to work independently. Trust between teacher and student is extremely important. Students need to learn how to take notes, summarize and study. The classroom environment should be warm, welcoming, conducive to learning and safe. In addition to this, self-regulation of learning is required in self-paced,

individualized program. Students need to know if they learned the material. They need to be taught how to monitor their progress. Teachers need to know how each student learns so they can help the student find what works for them. Students with strong metacognitive strategies are more successful than students without them. Teachers need to help students build up their skills in metacognition. Direct instruction and practice in metacognitive skills will be very beneficial to students. Providing the right scaffolding to students and having students learn how to provide their own scaffolding will lead them to be successful wherever they end up. There are many different approaches and methods available that provide independent learning opportunities. Teachers and students need to experiment with several models and find the one that works best. Every student is different and he or she should be given the chance to find the one that works. Overall, the effectiveness of independent learning is positive. Student retention increases as well as student attitude and behavior. Students gain a sense of accomplishment and pride when they can take ownership of their learning.

### **Furthering My Research**

I studied my students' ability to monitor their learning and understanding as well as their ability to take control of their learning and push themselves. For the first time in my teaching career, I attempted to have a self-paced individualized math class. I wanted it to be successful. I was concerned with students' ability to monitor their learning and

understanding as well as their ability to take control of their learning and push themselves. Additionally, I wanted my students to be able to move on to the next topic when they were ready, not when the entire class was ready. I hoped to further my research in several areas. How will individualized learning and self-monitoring affect students understanding of mathematical concepts? How do I aid students in the process of self-monitoring? Will my students ask for help? Will my students complete all of the required units? Will my students take control of their learning?

## **Methodology**

### **Participants**

Seventh and eight grade advanced algebra students

### **Setting**

The study took place in a public Montessori middle school in the upper Midwest of the United States. It is a diverse, urban and high-need public middle school in its second year of operation.

### **Materials**

Students received a folder used to manage pre-planned, well-designed mathematical units that cover the state's high math standards. Each unit was placed in the folder along with a weekly Daily Guide and Daily Reflection sheet. As students completed a unit and passed the corresponding summative assessment, they turned in the unit and received the next unit.

Surveys were also used periodically throughout the course to assess students' attitudes and feelings on learning independently.

**Data Collection**

1. Student behaviors were observed and recorded weekly.
2. Students were surveyed on their attitudes and feelings on learning independently in November, January and April.
3. The number of mini-lessons requested by students each week was recorded.
4. The number and overall unit grades of units completed were collected.

**Data Analysis**

1. Identify and interpret patterns of behavior such as increasing positive behaviors and increases in student collaboration.
2. Analyze survey results
3. Analyze the number of mini-lessons requested .
4. The number and overall unit grades of units completed will be compared with last year's completed units and their overall unit grades.

**Classroom Set Up**

I decided that I would like to give my students the opportunity to work at their own pace and learn at their own rate. I developed self-paced units designed to meet the state mathematics standards and based on what I had used in a traditionally delivered advanced algebra course.

**Community Meeting**

Each class period started and ended with a community meeting. In order to be able to ask peers for help, students needed to be able to trust one another. Each class needed to become a community of learners. Each meeting began with a greeting and a handshake. During the meeting, each student would complete his/her daily guide (Fig. 1). At the end of the meeting, each student was asked to share what assignment he/she was starting with



**DAILY THOUGHTS**

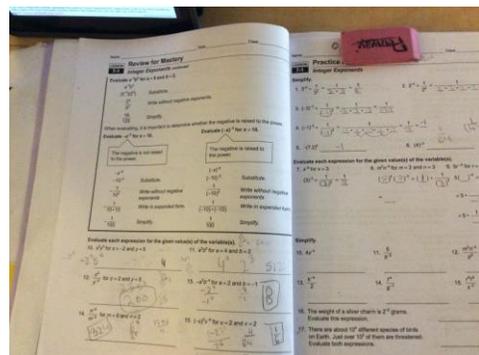
Name \_\_\_\_\_ Date \_\_\_\_\_

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
I feel good about...	Today I accomplished...	I feel good about...	Today I accomplished...	I feel good about...
I need to improve on...	I need to remember...	I need to improve on	I need to remember...	I need to improve on
Tomorrow I want to...	The first thing I want to do in class tomorrow is...	Tomorrow I want to...	The first thing I want to do in class tomorrow is...	Next week I need to...

**Figure 2. Daily reflection sheet**

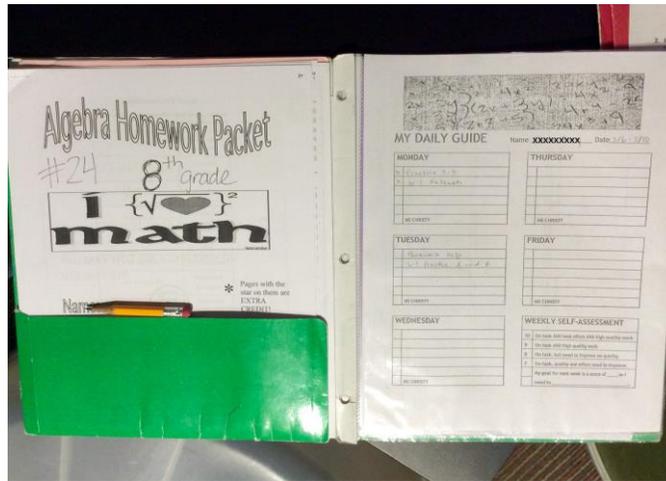
**Organization of Units**

In order to help students monitor their learning they needed to be organized. Many middle school students needed support in this area. Therefore, each student in my room was given a folder for math. (See Figure 4.) As a class, we set the folders up together at the



**Figure 3: Student folder work**

beginning of the year. Each student was given page protectors, which would hold unit checklists, daily guides and reflection sheets and the yearlong timeline of units. Each unit is hole-punched and placed in the prongs of the folder followed by any needed loose-leaf paper.



**Figure 4. Student folder**

Each unit had several requirements. Students were required to have a separate notebook for notes. I made this decision because I wanted my students to have all of their notes in one place and also because it would be an invaluable resource for them to use as a reference in high school. During each unit, students were responsible for reading the related sections in the math book, take notes on the information and write down all new vocabulary words with definitions. After this was completed, students had choices. The student could move on to the practice work if he/she was able to understand the information and examples in the book, if not, the student would come and ask for a mini-lesson on the topic. Students could also ask peers for lessons or help. Additionally, students could use approved apps and the Internet on their district supplied iPads for

additional help. After a student completed a lesson in a unit, he/she would go to the “control” (answer key) and correct his/her work. Upon completion of a unit, the student would request the post-assessment. Each student was required to pass the assessment with the score of 3, or proficient, on a standards-based grading scale. If a student scored less than a 3, they would go over mistakes, receive additional mini-lessons as needed and retake the assessment

## **Findings/ Results**

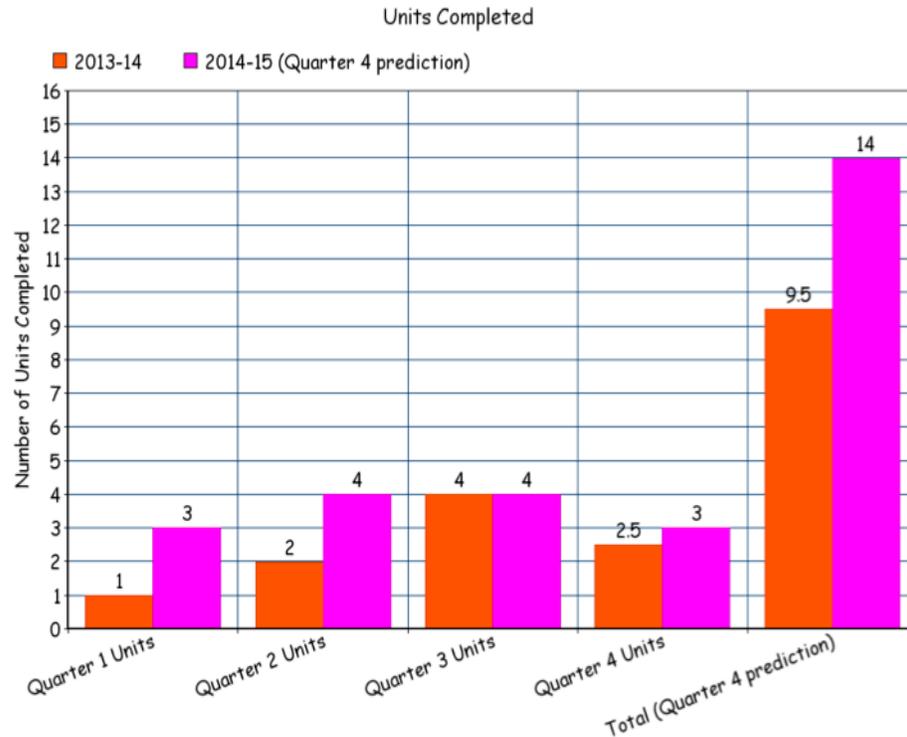
### **Data Analysis**

1. Identify and interpret patterns of behavior such as increasing positive behaviors and increases in student collaboration.
2. Analyze survey results to compare students’ attitudes and feelings about independent learning after each quarter.
3. Analyze how the number of mini-lessons requested changed throughout the year.
4. The number and overall unit assessment grades of units completed will be compared with last year’s completed units and their overall unit assessment grades.

### **Units**

One aspect of individualized learning that I was curious about was how it would affect the amount of math standards completed in a year. Would the students be able to complete enough work? I collected data to compare the number of math units completed this year in comparison to the number I was usually able to complete in a year. I worried about how I could keep them on a minimum pace to make sure that they could at least complete the required standards. To scaffold this for my students, I created a year-long pacing guide and gave it to them at the beginning of the school year.

In my previous years of teaching I was able to complete 9 units, taught in a whole-class learning environment, during the school year. This year, I allowed my students to complete units at their own pace. By the end of third quarter, I already had nineteen students complete ten units. One student, who joined my class at the start of third quarter, was able to complete seven units (in one quarter) to catch up with her classmates during the quarter. 100% of my students completed 7 units, 90.4% completed eight units, 88.1% completed nine units, and 45.2% completed ten units by the end of third quarter. Fourth quarter is just beginning, so students will be continuing to complete between 2 and 4 additional units. Therefore by the end of this year, students will have completed between 10 and 14 units working at their own pace, in comparison to completing 9.5 units, whole class instruction, previously (Figure 5). That is an increase of 5- 47% depending on the student. In my years spent teaching algebra, this was the earliest I have ever had students in unit eleven. The increase in completed units by some students is an indication of what can happen when we allow students the chance to take control of their learning.



**Figure 5. Units completed**

### Observations

As a teacher, I am always observing my students. During this study, I was focused on how my students' attitudes and behaviors were changing as the year progressed. I wondered if and when students would begin to take control of their learning, what that would look like in the classroom and how it would affect the classroom environment as a whole. At the beginning of the study, most students did not ask for help. I spent most of my time walking around monitoring individual, independent work. Montessori instruction utilizes long, uninterrupted work-time. I wanted to honor that in my classroom. The students thought they were capable of learning everything on their own. The students were very quiet, and not interacting with one another. I allowed them to remain quiet and work in isolation so they could work at becoming independent learners. I reminded them

each day, several times, that if they were having trouble, to ask for a lesson or for help. “Struggling a little is OK, but progress needs to be made.” Slowly, a few students decided to ask for lessons. By November, I was giving an average of 3 mini-lessons a day in each class. I continued to encourage students to take responsibility for their learning to ask for help from me or from their peers. By January, I was giving an average of 4.5 mini-lessons a day in each class. After this, mini-lesson requests became constant. I was busy with students the entire class period. I started reminding and encouraging students to also ask peers for lessons. To aid in this, I created a display on the wall to show on which unit each student was currently working (Figure 6). So, students could look on the wall and find someone that had already completed or was currently working on and ask for a mini-lesson. It took students a couple of weeks, but by the end of February, students were walking across the room and asking peers for mini-lessons. It was amazing to watch this grow and blossom in my room. They were becoming independent and realizing that they can have control over their learning. There were also some less-productive behaviors happening throughout the year, which I will discuss in a later section.



Figure 6. Wall display portraying nature of student unit work

## Survey Results

I gave three surveys during the study, at the end of each of the first three quarters of the school year. Each survey was designed differently and for a slightly different purpose. All of the surveys focused on gaining an understanding of how students were feeling about independent, self-paced learning. The first survey was given at the beginning of November, the second at the end of January and the third at the beginning of April. All of the surveys were completed anonymously so I would get honest feedback.

### Survey 1

The first survey (Figure 7) was designed with a mix of open-ended questions and questions where the students rated themselves. I wanted to see how the students were

feeling about learning independently and how they felt about working on their own. This was so different from how I taught previously; I needed to see if they were feeling successful. I also wanted to know what they liked and didn't like about self-paced learning. When asked what they liked about math during first quarter, the most popular response was "working at my own pace". Other repeated responses centered on the organization of the folders and an easy going/comfortable atmosphere. Things that multiple students did not like were correcting work, feeling rushed at times (due dates), and too much work. The third question was what they would like to see changed for second 2nd quarter. Multiple students suggested less work, more time, asking for more lessons, increased student effort and for me to manage my time with individual conferences. Challenges that students admitted to struggling with were: not consistently working, getting distracted or distracting others, feeling rushed, missing important information, and working at too slow of a pace. From these responses, I could tell that students were starting to take control. They were noticing things about the classroom, peers and themselves that were getting in the way of their own success. When asked about the benefits, multiple students said that they felt like they learned more and got more accomplished and learned how to concentrate. Other positives mentioned were: being able to go ahead and not have to wait for everyone, liking their pace, ability to have mini-lessons when needed, choice, peace, helping others, learning to manage time, and increased responsibility.

The second part of the survey asked the students to rate themselves from 1 (not successful) to 5 (excellent). Question number 4 asked how successful students felt they were at learning independently. The average score was 4.1 out of 5. I felt that this was

such a high average because the mathematics at the beginning of the year (the first three units) is usually a mix of review material and new material. The students definitely had an easier time in the beginning of the year working independently. As I stated earlier, the amount of mini-lessons requested in the beginning of the year was far fewer than the amount during second and third quarter because of the mathematical content. Students had great success in the beginning working on their own because they recognized the math and didn't need to ask too many questions. The next survey question asked them how successful they were at working independently. The average score was 3.9 out of 5. The students replied that they liked working independently, but it was difficult to stay focused all of the time and several admitted that they needed to improve on asking more questions. I also asked students how they felt about working independently. The average score was 4.38 out of 5. Before I gave this survey, I had been wondering how my students were feeling about working independently. This score made me realize that overall, students were engaged and felt that independent learning was effective and worthwhile.

## QUARTER ONE REFLECTION 2014

1. What did you like about math this past quarter?
2. What did you not like about math this past quarter?
3. What would you like to see changed for second quarter?
4. How successful were you at learning independently?  
Rate yourself: 5-Excellent to 1-Not Successful \_\_\_\_\_  
Comments:
5. How successful were you at working independently?  
Rate yourself: 5-Excellent to 1-Not Successful \_\_\_\_\_  
Comments:
6. How often did you actually correct your work?  
Rate yourself: 5-Every day to 1-I didn't correct them \_\_\_\_\_
7. Did you see a benefit in correcting your work? EXPLAIN.
8. How do you feel about working independently (at your own pace)?  
Rate yourself: 5-Excellent to 1-Not Successful \_\_\_\_\_  
Comments
9. What are some challenges you are facing with working at your own pace?
10. What are some benefits you experienced working at your own pace?
11. Overall, how would you rate your first quarter of math?  
Rate yourself: 5-Excellent to 1-Not Successful \_\_\_\_\_  
Comments:

Figure 7. Survey 1

**Survey 2**

The second survey I gave my students was at the end of second quarter. This survey was designed to help them think through their first semester learning as an individual. I asked them four open-ended questions. I wanted my students to verbalize their thoughts

and feelings on self-paced, individualized learning with written responses. The four questions are listed below followed by student responses.

1. How has individualized, self-paced learning affected your learning of mathematics this year?

Some of the responses to question number one were:

- "It made me think more."
- "I liked the individualized approach because I got to go at my own pace."
- "Instead of going at the same pace as last year with the whole class and being behind and not knowing what to do I can get a lesson whenever I want."
- "Individualized math has helped me understand more because I can stay on a topic as long as I need to. The only bad thing is it leads to more procrastination."
- "Honestly, I prefer working like this. The only problem I would have is that because everyone is learning at their own pace, it's been a little difficult to get help."
- "Talking to people helps me over come problems."
- "I learned more and understand way more than I did from last year."
- "Better understanding equals better thinking."
- "It helped me how to comprehend on things by myself. It also help me in the real-world, learning how to work and concentrate and also not be lazy."
- "I say it's good because some people who worked at a fast pace didn't get frustrated."

2. How have you changed as a math student from the beginning of the year until now...what have you learned about yourself?

Some responses to question number two were:

- "I am smarter than I was before."
- "I think more"
- "I've become more responsible. I take notes and be more honest to myself."
- "I used to be lazy and now I finish my work on time."
- "I think I have changed since last year because I learned how I like to learn math."
- "I think that I've become more prepared and organized because I know what I want to work on one day."
- "I think I've changed a lot. And I found out I'm able to do challenging stuff. Or work at a higher level."

- “I learned that I can handle a lot more than I thought I could.”
  - “I learned working by myself is slower, but I get to know the problem. But if I work with someone else I work faster but don’t get the problem.”
  - “I am learning things a lot quicker from mini-lessons.”
  - “Before I relied on others for like groups project’s even though I knew it, but now  
I do what I think is right and I’m more independent and focused on my work in class.”
  - “I changed my behavior. I learned that I am capable to do things.”
3. What has been the hardest thing for you so far this year in regards to learning at your own pace?

Some responses to question number three were:

- “The hardest thing is being sure that I’ll remember all the information”
  - “The hardest thing is catching up when it’s due.”
  - “The hardest thing for me this year are getting mini-lessons. With everyone going  
at their own pace I find getting a 1 on 1 lesson get me really anxious.”
  - “The hardest thing for me is meeting the deadlines.”
  - “Asking for help.”
  - “I don’t manage my time wisely because I procrastinate a lot.”
  - “I can’t ask as many questions and the teacher is busier.”
  - “The hardest part was knowing when to ask questions, because there are times  
when there are a lot of mini-lessons.”
  - “Taking lessons because I really don’t like asking for help but I had to deal with it  
and tried my best to understand everything I did.”
  - “The hardest thing was managing my time on each unit.”
4. In what ways would you like to improve as a learner?

Some responses to question number four were:

- “I would want to improve on less procrastination because I am a huge procrastinator.”
- “I have started to work faster and ask more questions.”
- “I would like to be able to do everything myself without asking for help.”
- “I would like to be able to focus more.”
- “I would want to improve my notes and put them into my own words for easier  
understanding.”

- “Be more focused.”
- “I want to do more homework at home.”
- “Doing work outside of school more. Taking more notes. Going to lessons ahead of time.”
- “I would want to ask more questions.”
- “I want to take more lessons so I can 100% understand what I’m doing so I know later in the future so it helps me.”
- “I would like to be able to help others without confusion.”
- “I want to learn more.”

Overall, survey data shows students were very positive in their reflections of the first half of the year. One of the positives I saw in the student reflections was that students were beginning to see themselves as successful learners. They were gaining confidence in their abilities to make positive decisions, ask for help, speak up for themselves and realizing that through continued effort, they could be successful. They were also able to reflect and identify obstacles that had gotten in their way. By identifying them, they were well on their way to overcome them and be more successful. Students had learned what they needed to do in order to be successful, now they just needed to work on eliminating the obstacles.

### **Survey 3**

My third survey was given at the very beginning of April (Figure 8). My purpose for this survey was to see if my students’ opinions had changed since the end of first quarter. This survey was made up of questions that allowed the students to rate themselves on how they were feeling about different aspects of independent learning.

I specifically asked a couple of the same questions from the first survey to see if and how their answers changed. I wanted to know if they still felt that self-paced learning was effective. I also wanted to know if my students were beginning to take control of their

learning by rating themselves on questions involving skills of independent learners. The two questions that I re-asked were: 1) How successful have you become at working independently? 2) How successful have you become at learning independently? The results are shown in the tables below (Figures 9-10).

Third Quarter Survey

- 5- Excellent/Every Day/All the time
- 4-Good/Very Often
- 3- OK/Sometimes
- 2-Not so much
- 1- No

- |  |          |           |       |   |   |
|--|----------|-----------|-------|---|---|
| 1. How successful have you become at WORKING independently?  | 5        | 4         | 3     | 2 | 1 |
| 2. How successful have you become at LEARNING independently?   | 5        | 4         | 3     | 2 | 1 |
| 3. How often do you correct your work?   | Everyday | Sometimes | Never |   |   |
| 4. What is your overall opinion of learning independently, at your own pace?   | 5        | 4         | 3     | 2 | 1 |
| 5. Do you prefer whole-class instruction (like last year)?   | Yes      | No        |       |   |   |
| 6. Are you using your Ipad to help you learn your math?  | Yes      | No        |       |   |   |
| 7. Do you ask your peers for help?   | Yes      | No        |       |   |   |
| 8. How often do you ask peers for help?  | 5        | 4         | 3     | 2 | 1 |
| 9. How often do you ask Ms Christy for help or a mini-lesson?  | 5        | 4         | 3     | 2 | 1 |
| 10. What has helped you become a more independent learner: (check all that apply)  |          |           |       |   |   |
| _____ Daily Guide  |          |           |       |   |   |
| _____ Daily Reflection   |          |           |       |   |   |
| _____ Community Meeting  |          |           |       |   |   |
| _____ Due Dates  |          |           |       |   |   |
| _____ Mini-Lessons   |          |           |       |   |   |
| _____ Technology   |          |           |       |   |   |
| _____ Notes and Vocabulary   |          |           |       |   |   |
| _____ Controls (Answer Keys)   |          |           |       |   |   |
| _____ The folder   |          |           |       |   |   |
| _____ Other: _____   |          |           |       |   |   |
| 11. Have you grown as a learner since the beginning of the year?   | 5        | 4         | 3     | 2 | 1 |
| 12. We have talked a lot about taking control and responsibility of your learning.<br>How successful have you become in this area? | 5        | 4         | 3     | 2 | 1 |

Fig.8 Survey 3

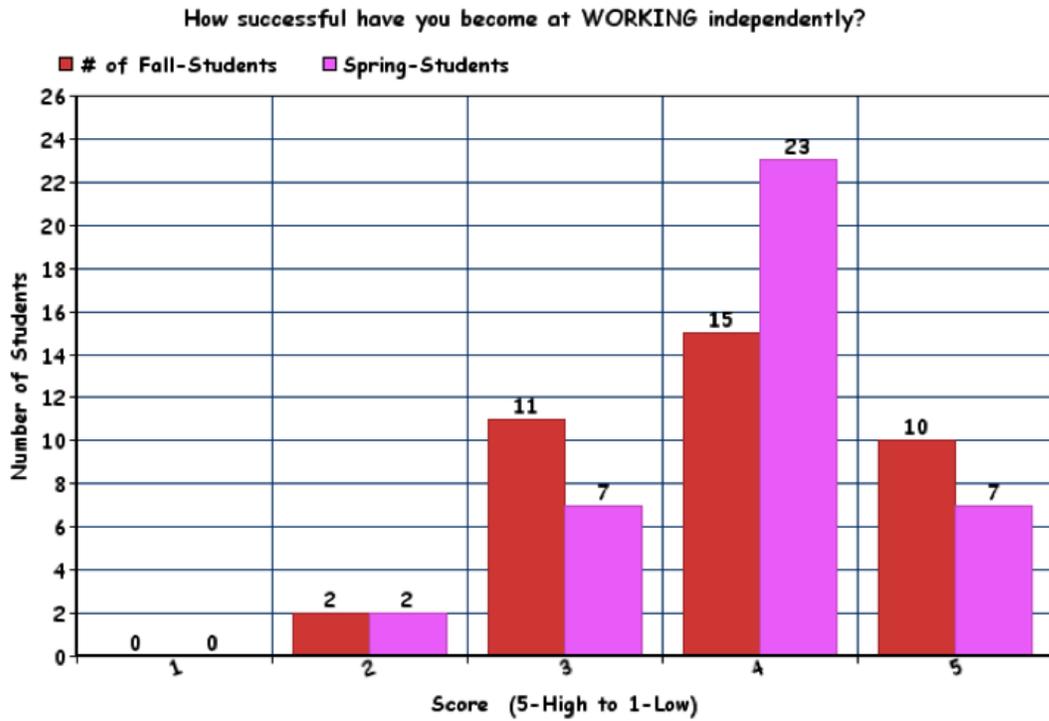


Fig. 9. Working independently

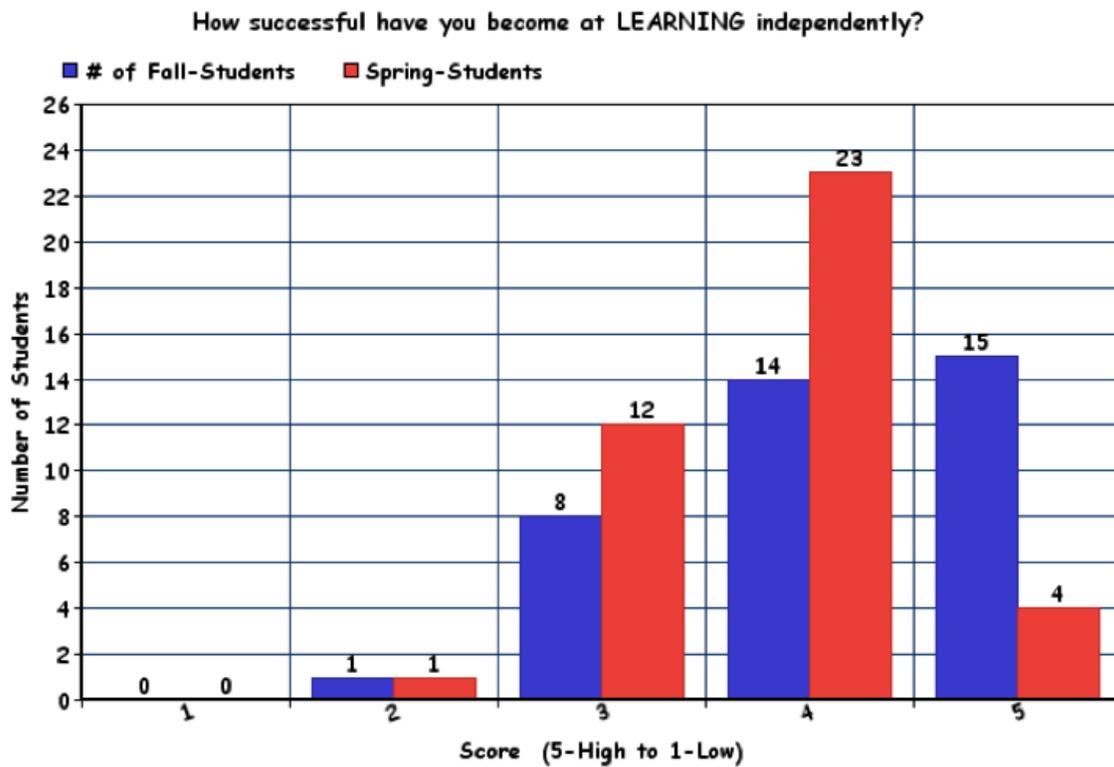


Figure 10. Learning independently

When they took the survey in the fall, the math was easier and it was the beginning of the year, when the students were fresh and excited about school. By the time they took the survey in April, the math had gotten significantly more difficult and new. I believe this had some effect on the survey results. As the math complexity increased, the more students needed to ask for help. Some students do not like to have to ask for help, they want to be completely independent. I feel that many of the students who gave themselves a 5 in the fall, lowered their score in the spring because they needed more help and therefore viewed themselves not as independent.

As I was analyzing the results of the two main survey questions, I wondered what the results would look like if I combined the two questions. The following table (Figure 11) shows the results of the two questions combined and compares the fall survey with the spring survey.

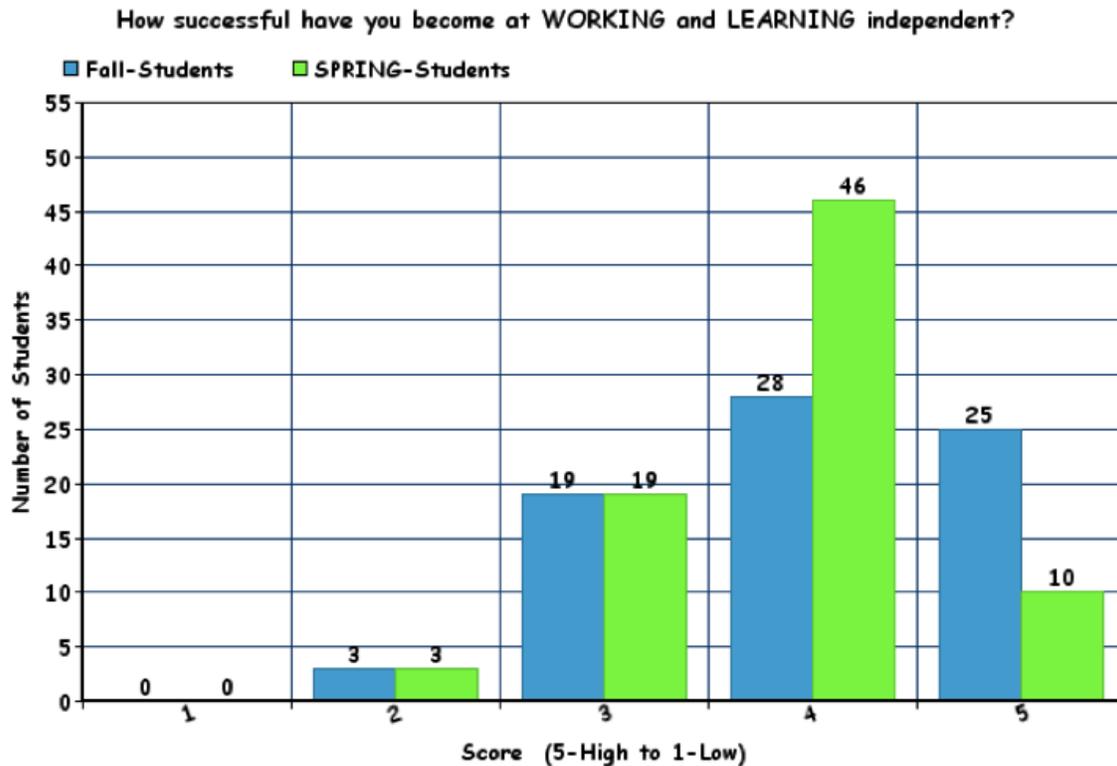


Figure11. Working and learning independently

I found it interesting that the students who rated themselves a 2 or a 3 stayed the same. The upper two categories had different results. In the fall, the scores of 4 and 5 were almost even, but in the spring the 4s greatly increased and the 5s declined. However, when I added the scores of 4 and 5 together for each the fall and spring, the results were 53 (fall) to 56 (spring). Overall, most of the students feel that they have found success in independent learning. When the math became difficult, some students lowered their rating. This lower rating could be a result of more honest self-reflection, a good day or a bad day, or feeling more dependent on mini-lessons for assistance.

One final survey question I asked was: Have you grown as a learner since the beginning of the year? The results are shown below (Figure 12).

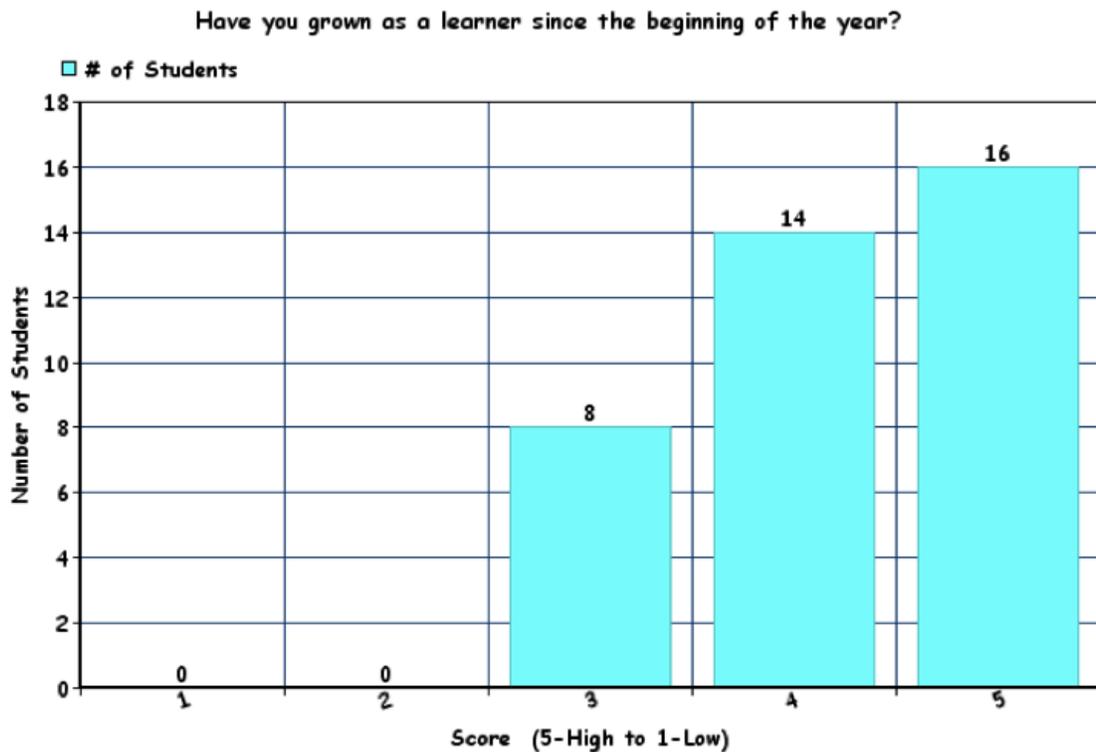


Figure 12. Growth as a learner

This graph shows that students feel good about self-paced, individualized learning. One student told me that I was “the best math teacher”. I asked her why. Her reply was, “Because when I ask you for help, you really listen to me and help ME until I understand.” Students want to learn and not be confused. Middle school students in particular, are always seeking control of their lives. I think that working independently has helped them gain some of that control over their lives.

### Assessments

I wanted to analyze the assessments that my students took this year and compare them to last year’s assessments. The assessments are district common assessments. This year’s assessments were the same as last years. I was wondering how individualized

learning would affect the assessment scores. (I do allow students to retake assessments if they did not demonstrate proficiency.) The results are shown in the table (Figure 13).

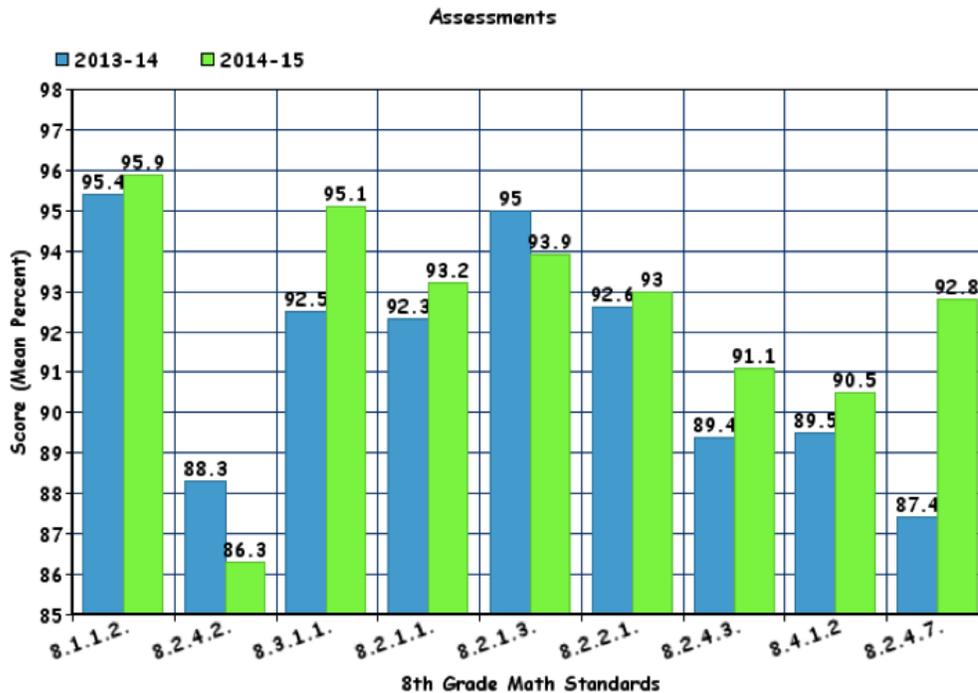


Figure13. Assessment comparison

The results show that my students did perform slightly better on most assessments during the past year. (There appears to be a significant improvement on the last assessment [8.2.4.7], however, that is partly due to the fact that only a small portion of the students have taken this particular assessment at the time this report was written.) While the results are not showing a dramatic difference in scores, they are showing that independent learning is, at the very least, as successful as whole class learning. However, when I add in all of the other benefits from individualized learning, such as, time management, study habits, responsibility, note-taking, independence, and learning to ask for help when needed, I feel that this is really the way of the future. One student said, “I am learning things a lot quicker from mini-lessons.” Another commented, “I learned more and

understand way more than I did from last year.” By allowing students to ask questions and get lessons when they are ready as individuals or in small groups, they learned so much faster because they are more actively involved in the lesson. Since they sit right in front of me for a lesson, they are engaged and part of the learning process. Students often would create their own examples and show me how far they could get in the problem and exactly where they were stuck. In years past, students would often come to me and say, “I don’t get it.” I would respond, “Get what?” and they would say, “Everything.” This did not happen this year. Students actually knew exactly where they were having difficulties and what they did not understand, so their questions became very specific. Independent, self-paced learning has really turned my students into active learners.

### **Interpretation/Discussion**

Overall, the results of the study are positive. Self-paced, independent learning is a viable alternative to the traditional teaching and learning that takes place in a middle school math class. The attitudes and dispositions that the students have cultivated through personal responsibility and accountability this year should lead them to success in high school and beyond. My students have really embraced a growth mindset. Comments like, “I am smarter than I was before” and “And I found out I’m able to do challenging stuff” show that the students have really had success and grown as independent learners. They have demonstrated that through hard work and effort they can learn difficult math. My

students did not quit when the math became difficult; instead they persevered. They asked for more help and continued to ask questions until they found success with the topic. One student commented, "I like how we can just ask you questions whenever we want and you answer them patiently." This comment also speaks to the importance of a teacher to be approachable and to create an atmosphere that is safe and inviting. Math is so often a subject that creates great anxiety for students. By creating this comfortable environment in my room, my students were able to relax and feel safe to ask questions and get needed assistance from peers and myself. This is crucial to success in math.

Improvements need to be made with respect to self-paced, independent learning. One of the areas I need to figure out is how to motivate the students who are too slow at mastering the content. They are learning, but not getting through enough curriculum in each quarter. Part of the problem is the grading periods that are imposed by the district. I have to post grades four times a year and students are working and learning independently, so they are not all at the same place at the same time. Students work through some content faster than other content. I would rather students not be confined by grading to demonstrate content master.

Another problem area centers on mini-lessons. I need to develop a better plan to make sure that I am fairly giving mini-lessons. Some students are very insistent about getting lessons and others are much more passive. I need to develop a system to make sure that I am helping my quieter students and making sure that they are not missed. I want everyone to have an opportunity each day to have a lesson.

## Conclusion

Maria Montessori said, “The greatest sign of success for a teacher is to be able to say: The children are now working as if I did not exist.” Independent, self-paced learning is transforming my room into that environment. By giving my students some control over their learning, many of them have blossomed into independent learners. Montessori also

said, “ The essence of independence is to be able to do something for one’s self” (Montessori (2012), p 155). My students have begun to take control of their learning. They have experienced the power of asking for help, receiving it, and then using it. My students have learned to trust their peers and realize that their peers can teach them a thing or two. In addition to this, I did have a few students begin to use their Ipads for math help. Those students are watching

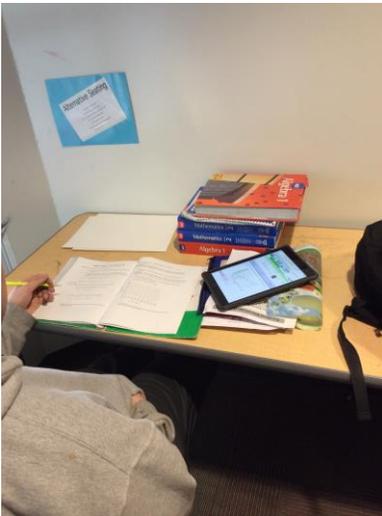
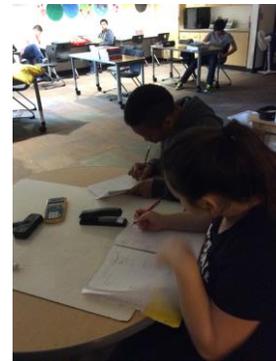


Figure 14: Independent learning

math videos and learning from online math websites. As a result, when I am not giving a mini-lesson and I get a chance to observe my classroom, I am seeing students asking student for lessons, students working together, students checking their answers, and others are quietly working independently.

As I think back on this year, I am pleased with how my classroom climate changed and how my students progressed into active, independent learners. Besides the mathematical knowledge gained, my students learned how to use an informational text (math book) to gain understanding and clarity about a topic. They also learned how to take initiative and ask for help when needed. Students learned to trust one another and seek out help and lessons from peers. Students learned to use iPads for learning not just for fun. Students learned how to use the controls (answer keys) for help not just for marking items right or wrong. Students learned that a passing grade isn't good enough, and that they are capable of learning more about a topic and trying again. There are still many more things that need to be improved for this type of program to be really successful.



**Figure 15. Students working independently**

### **Action Plan/Implications for Further Research**

There are many things I would like to change or do more research on in the next year. I would like to look into using Project-Based Learning in my classroom. I would like to be able to have my units based on a theme or overarching project. I think it would give the students more motivation and perhaps more real-life connections. So often, algebra is taught one skill at a time without enough connection between them. I think that if I can center some of the units on a project or theme, it will help my students make more connections with the mathematics.

More research needs to be done in the area of technology and learning. Some of my students began to use technology to assist their learning, but most were using it for the online calculator feature. I need to look for more apps that directly allow students to practice the skills they are learning in an interactive method. I also need to research free online math programs, like Khan Academy, Virtual Nerd, or Study Island that will allow my students to have the option of learning from their iPad, from me or most likely, a combination of both. I would really like to offer my students those options for learning each unit. By opening up the technology learning world to them, my students will leave my class knowing that they can help themselves learn new material. They will have developed life long learning skills that will follow them into high school and beyond. As Maria Montessori stated, “My vision of the future is no longer of people taking exams and proceeding on that certification from the secondary school to the university, but of individuals passing from one stage of independence to a higher, by means of their own activity, through their own effort of will, which constitutes the inner evolution of the individual” (Montessori, 2007, preface).



Figure 16: Learning with the

Ipad

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