Contextual Factors

Gateway Institute of Technology (GIT) High School is located in southwest St. Louis city, surrounded by a loose fitting industrial park. Once home of O'Fallon High School, the building was later sold and rehabbed into a factory itself. After yet another transition period, St. Louis Public Schools acquired the school and opened in August 1992. Located a few blocks away from Forest Park and Tower Grove Park, Gateway is situated near two of St. Louis' most renowned neighborhoods, The Hill, to the south and the Central West End to the north.

GIT was created in response to a court order mandating the creation of a technological magnet school. Therefore, the school has partnerships with a number of local businesses. Monsanto, Mallinckrodt Chemical, McDonnell-Douglas and Lucent Technologies Bell Labs have all played a role in the development of Gateway's physical and computer science, engineering technology, and very successful robotics programs. These partnerships help provide students with real-world learning experiences designed to reach students with a variety of learning styles.

The school's 1,400 students arrive at Gateway from across the district. Enrollment is determined by a lottery system, where families within the district apply and are randomly selected. Therefore, the students at Gateway are from all corners of the city and arrive with incredibly diverse socioeconomic backgrounds. The student population, the majority of whom are African American, consists of large subpopulations of Vietnamese, Bosnians, Pakistani, among others. This diversity contributes to rich classroom discussions and meaningful cooperative learning experiences.

As a mathematics teacher, I witness the wealth of diversity by reading and responding to their math journals. Although teenagers first, students' interests lie in a wide variety of fields such as computers, art, drama, science, and sport. These interests ensure students take a number of approaches to learning. Students throughout the year will be encouraged to think metacognitively about how it is they organize data, develop strategies, solve problems, and study for tests. This reflection serves as a tool to both teacher and student; to provide myself with a better understanding of their specific learning modalities, and perhaps most importantly, encourage self-reflection and ultimately self-regulation among students. Knowledge of how you learn, and how you can maximize the effectiveness of your learning strategies will help develop learning autonomy which is integral in your development as a life-long learner beyond organized schooling.

During the first two days of school, students completed math autobiographies and completed a diagnostic exam. Math autobiographies are excellent ways for teachers to gain insights into the students' perceived backgrounds, as well as encourage students to self-assess their knowledge of mathematics. Students were asked to reflect on their prior dispositions in math class, likes and dislikes, and success and failures. In addition, I wanted them to mention areas they felt they were good at and areas they felt they needed improvement on. The benefits for this exercise was twofold; for me to gain a better understanding of their past experiences in math, and for them to begin this yearlong reflection into who they are as active learners. The diagnostic exam was based on content, or more specifically, Algebra I and II. Although many students seem to exhibit significant deficiencies in these areas, the deficiencies displayed were typical to students

at this level of their mathematics careers. In other words, most deficiencies were in areas that typically give students fits and are not insurmountable.

Instructional planning and assessment must reflect the given contextual characteristics present in the classroom. Therefore, classroom activities must focus on the development of language, learning communities, as well as autonomy. Students are greeted daily with a brief warm-up (sometimes called "Do Now," a command I don't particularly care for) while I take attendance and visit with students to check their homework. I encourage students to communicate ideas and strategies during this exercise. This serves to encourage the use of mathematical language as well as the development of interpersonal skills. Furthermore, I encourage students to display their knowledge in a number of ways. By assessing their understanding in their journals, as group quizzes, and class discussions, students can express their abilities in a variety of modalities. Last week I introduced the trigonometric functions sine, cosine, and tangent by giving students, in groups of three, triangles with the direction of finding different ratios between the sides. Each group had to divide up the tasks: measuring the sides with a ruler, recording the data in a table, and calculating the ratio. Then I asked the students to talk about these relationships. This exercise served a number of purposes. First, the students had to agree on the assignment of tasks, which develops interpersonal skills. Secondly, students who take a tactile approach to learning were allowed to use their hands while measuring. Thirdly, students were constructing a conceptual understanding of trigonometric ratios. I wasn't the dispenser of knowledge, but a guide that encouraged the students to take an active role in their development as young mathematicians.

Perhaps it is important to note that as the school year progresses, I will continue to gain valuable insights into the contextual factors affecting the learning environment in my class. As a consequence, I will continually have to reassess my instructional planning and means of assessment. Moreover, I will continually refresh my knowledge of the characteristics of my students. As a teacher, I must constantly reevaluate and reassess my practices, while continuing to utilize effective methods, so I may provide a rich, dynamic learning environment for my students.

Learning Goals

The instructional sequence represents the beginning unit in a Trigonometry / Analytical Geometry course. The course is problem-based with communication and reasoning playing integral roles. Furthermore, the unit is required curriculum under the Missouri Show-Me Standards for Mathematics.

Target Goal 1: (Knowledge-Level)

Students will know and understand Trigonometric Ratios and Angles

Target Goal 1 (TG1) builds on the students' knowledge of geometry and algebra II from the previous year while building upon their prior knowledge of basic trigonometric relationships. Students will know angles as two-dimensional objects measured in degrees, minutes, and seconds, the standard position of an angle and coterminal angles, the six trigonometric ratios for acute angles in right triangles and the Unit Circle. Students will know how to find the number of degrees in a given number of rotations, find the values of trigonometric ratios in a right triangle, draw or use visual models to represent and solve problems, and use trigonometric ratios to determine lengths and angles measurements. TG1 is aligned to Show-Me Standard 2& 4 (cf. Appendix A) and Grade-Level Expectations-Algebraic Relationships 2A and Geometric and Spatial Relationships 1A, 2A, 4B (cf. Appendix B).

Target Goal 2: (Knowledge/Skills Level)

Students will use trigonometry to find measures and solve right triangles

Target Goal 2 (TG2) builds upon TG1 by delving further into the study of the Unit Circle and its uses. In addition, students will begin the application of knowledge

acquired in problem-solving activities and discussion. Students will apply their understanding of trigonometric ratios to find measures of the sides of right triangles, find missing angle measurements, evaluate inverse trigonometric functions, and solve right triangles. This includes the solving of real-world problems using the tools of trigonometry. These content and performance expectations are adequate since they are direct extensions of TG1. TG2 is aligned to Show-Me Standard 2& 4 (cf. Appendix A) and Grade-Level Expectations-Geometric and Spatial Relationships 2A and 4B (cf. Appendix B).

Target Goal 3: (Knowledge/Skills Level)

Students will know, understand, and apply the Law of Sines and Law of Cosines.

Target Goal 3 (TG3) extends the students' study of trigonometric relationships to the world outside of right triangles. The use of the Law of Sines and the Law of Cosines becomes integral in applying trigonometry to real-world situations. In other words, without this targeted goal, our applications are isolated and reduced to problems dealing with right triangles. However, with the addition of TG3, the world of scalene, or "irregular" triangles opens up before us. Students will understand that they can solve triangles if the measures of two angles and a side are given. In addition, students will find the area of triangles if the measures of two sides and the included angle or the measures of two angles and a side are given. Furthermore, students will investigate geometric properties and their applications to trigonometric relationships, solve problems using proportions, use and solve equivalent forms of equations and inequalities, and draw or use visual models to represent and solve problems. TG3 is aligned to Show-Me

Standards 2 & 4 (cf. Appendix A) and Grade-Level Expectations-Algebraic Relationships 2C and Geometric and Spatial Relationships 1A and 4B (cf. Appendix B).

Target Goal 4: (Skills/Reasoning Level)

Students will derive and explore the graphs of trigonometric functions and their applications using traditional means as well as technological advancements.

Target Goal 4 (TG4) returns the students to the investigation of trigonometric functions. Students will convert degrees into radians and vice versa, find angular displacement, angular velocity, and linear velocity. They will develop the ability to graph trigonometric functions as well as investigate applications of periodic functions to real-world situations. More specifically, students will interpret and extrapolate meaning from the graphs of trigonometric functions. They will write equations of the sine and cosine functions given the period and amplitude, and find phase shift and vertical translation. Furthermore, students will write equations and construct graphs, using paper and graphing calculators, when given the period, amplitude, phase shift, and vertical translation of periodic functions. Finally, students will model real-world data using sine and cosine functions and sinusoidal functions. These goals are appropriate since the students will have the pre-requisite knowledge acquired from TG1-3. TG4 is aligned to the Show-Me Standards 2 & 4 (cf. Appendix A) and Grade-Level Expectations-Algebraic Relationships 1C, 1D, 1E, 4A and Geometric and Spatial Relationships 3B (cf. Appendix B).

Assessment Plan

Due to the nature of Mathematics in general, and Mathematics curriculum in the United States in specific, students tend to spend a year on a certain topic, only to begin a new subject area the next year. Some countries focus on Integrated Mathematics, where the student embarks on a journey that spans multiple areas of Mathematics and is led to see the connections between each area. In my particular district, we spend a year on algebra, a year on geometry, a year on algebra II, etc. and don't tend to encourage overlap. Therefore, pre-assessments were given at the beginning of the unit, however given the nature of the curriculum; there was a good chance that these topics were completely new to the students.

Two of the pre-assessment tools used were discussions on number operations and an informal test on algebra I and II. The tests were used primarily to get students thinking about their own deficiencies, an exercise that encourages the students to start thinking metacognitively. These tests were taken in small group settings while students discussed and collaborated on solving the problems. Students shared their difficulties with number relations and algebra, while reflecting on their own mathematical histories. This activity was followed by a third form of pre-assessment, which included a student-centered reflection on their previous experiences in Mathematics, as well as any deficiencies they might have. This reflection (along with other general prompts used to develop stronger teacher-student relationships), called a Mathematics Autobiography, was recorded in the students Math Journals, which I bought and distributed to each

student on the first day of school. Some examples of these reflections, with my comments, can be seen in Appendix C.

As a Mathematics teacher, I feel it is important to have students actively engage themselves in the learning process. In addition, I feel reflection plays a major role in metacognition and your ability to self-assess, self-motivate, self-regulate, and ultimately develop into an autonomous learner. Therefore, after each post-assessment (Target Goals 1-4), I ask my students to reflect on their progress, their ability to prepare for a formal assessment, their disposition and behavior in class, and what they can do next time to improve their understanding. Some of these reflections, along with my comments, can be seen in Appendix D. A scoring rubric used to evaluate journal entries can be found in Appendix E.

Formative assessments (Target Goals 1-4) include a daily Warm-up: a problem or set of problems that provide an arena for problem-based instruction, or a problem that reviews the previous day's lesson. The latter form is used informally (not graded) and serves as a tool for the students to self-assess their understanding. In addition, students are assigned homework problem sets which are to be completed at home and scored in the following manner: homework completed-2pts, homework incomplete (missing more than two questions but *attempted*)-1pt., and other-0pts. I do not collect homework and check their solutions. I do this for a number of reasons. First of all, it is my philosophy that when teachers require students to hand in *all* homework assignments for scoring, students tend to see homework as an exercise to be done for the teacher. On the contrary, I believe students should see that homework should be completed to aid the student and their development. Furthermore, modern textbooks come equipped with solutions to half

of the problems. Therefore, by carefully selecting my assignments, I can be certain that the students have access to the answers to all types of problems assigned for homework. This encourages students to check their own answers and therefore take ownership of their learning process. As with the journals, I believe teachers must encourage students to take full responsibility for their educational development. Again, my goal is to help develop the ability to self-assess, self-monitor, self-regulate, and develop autonomous learners.

In addition to the formative assessments above, students in small-groups were given triangles and rulers and were asked to find the ratios of the sides. I cut out the triangles such that each triangle had angles of 30º, 60º, and 90º. The students formulated the ratios of all the sides and we compiled a table of each group's ratios. The students were astonished to see that the ratios found were equal regardless of the size of the triangle. Then, students composed letters to someone explaining the six trigonometric ratios, which assessed the acquisition of Target Goal 1. These were scored according to the journal rubric (cf. Appendix E). A few examples of these letters can be seen in Appendix F. In addition, students were given a post-assessment at the end of the few days to assess the entire acquisition of Target Goal 1 (cf. Appendix G).

The post-assessment used for Target Goal 1 was used as the pre-assessment to Target Goal 2. In addition to the formative assessments stated above, students were given a formal post-assessment to assess the ability to solve a right triangle; the central theme of Target Goal 2. This assessment was developed in the form of a small-group activity were students were given a triangle and asked to find all of the sides and all of the angles (solve the triangle) (cf. Appendix H for student samples). Students were asked

to copy and record all data in their journal along with their rationale behind each step. Essentially, students were asked to record their thought-process along with any difficulties they encountered. This activity was assessed using the journal rubric (cf. Appendix E) and served as an authentic assessment as well as a post-assessment. This activity also allowed students with different learning modalities to strive given the wide range of intelligences included in the activity.

The post-assessment used for Target Goal 2 was used as a pre-assessment for Target Goal 3. Along with the formative assessments listed above, students were asked to find the distance from first base to dead center field in Busch Stadium. Students were given the general dimensions of Busch stadium, however they had to discuss with each other the dimensions of a general baseball stadium. Then, students were to assess whether they needed the Law of Sines or the Law of Cosines to solve the problem. Students were asked to work in groups of two, which supports the contemporary research on the benefits of cooperative learning. Students were asked to record the problem in their journals and attempt to find a solution (cf. Appendix I). The scoring criteria for this activity can be found in Appendix E. Furthermore, students were given a formal post-assessment that covered the entire content in Target Goal 3 (cf. Appendix J: assessment and scoring criteria).

The post-assessment used for Target Goal 3 served as a pre-assessment for Target Goal 4. Along with the usual daily formative assessments outlined above, students completed a project-type assessment where students were given three days to complete a list of questions while working with a partner. This would allow students who weren't as strong to use their classmates and exhibit their understanding in a variety of ways. Each

student would submit a packet of solutions to the problems. Students were asked to write the problem, show all their work, and document the process used to arrive at their solutions. Regardless if they used an example from the book as guidance, asked their partners or classmates for help, or asked me for help; they were to document the process. Students were told that they would be graded on organization, neatness of visuals, the quality of their explanations, and their solutions. Therefore, the journal rubric was used to assess everything but the solutions to the problems (cf Appendix E). Given the length of the assignment, only a few examples are exhibited in Appendix K along with the answers (cf. Appendix K). In addition, students were given another assessment after the introduction of phase-shift, vertical translation, and graphing that came in the form of a more traditional test. An example of this examination with solutions and can be viewed in Appendix L (cf. Appendix L).

Design For Instruction

My initial pre-assessment, which entailed students reflecting on their past difficulties and writing Math Autobiographies, and a brief algebra I & II test completed in groups, led me to believe that trigonometry was more or less a completely new area of Mathematics for almost all of my students. The exception was a student who was repeating the course for the second consecutive year. Therefore, my analysis of the pre-assessment for this particular task will begin with the results from the Target Goal 1 post-assessment (cf. Appendix G). I feel this is an adequate place to begin since TG1 focused on just the very basics of trigonometry.

The pre-assessment results, calculated out of 20 total points for twenty of my students are listed in Figure 1. As a teacher, it is our job to informally assess students through observation and discussion. Therefore, most of these results are not entirely surprising.

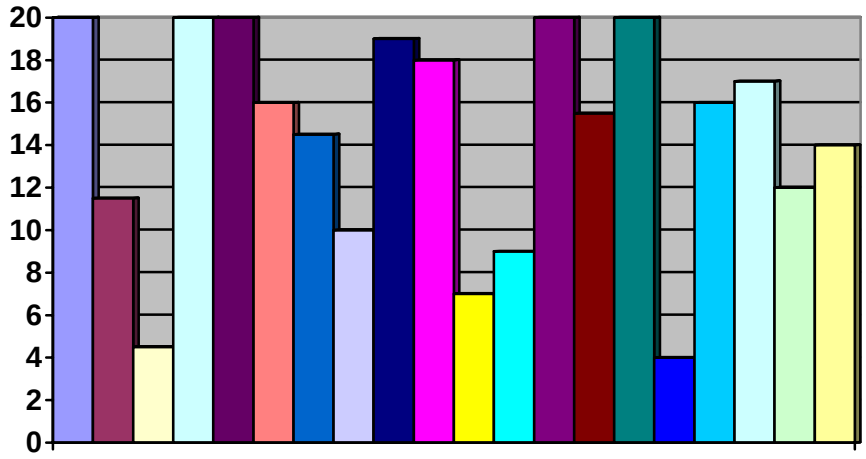

Figure A

In regards to Target Goal 1, students showed the ability to convert angle measures from decimal degrees to degrees, minutes, and seconds. This ability was exhibited across the board. However, some students showed an inability to recall the trigonometric ratios. Despite deriving these ratios as a class, students weren't remembering the ratios. These ratios should be recalled without hesitation. Therefore, I foresee myself focusing on some memorization strategies or mnemonics.

Many of the students were able to calculate degrees in a number of rotations, regardless if these rotations were integers or decimal fractions. However, many of the students showed difficulty in finding missing sides of a triangle. This is a major focus of this Target Goal and therefore must be re-taught by direct instruction.

Perhaps most troubling was the inability to answer problem #9, which appeared as a word problem. Students had a very difficult time translating the information into a diagram, in addition to difficulties in solving the problem once they had a picture drawn. I believe the study of Mathematics at the high school level should focus on applications and the ability to translate mathematical language into a functional verbal expression. Therefore, we will spend time discussing strategies for translating these mathematical expressions into verbal language and vice versa.

Overall, I was very happy with the outcome of the pre-assessment. Most students displayed an adequate understanding of the foundations of trigonometry. However, the four students who scored below 50% (10 out of 20) need to re-evaluate their standing in the class. These four students have a poor attendance record and are often unprepared for class. They rarely complete the daily Warm-Up exercises and do not hand in homework

assignments. I will approach this delicate problem with care; meeting with each student individually and discussing how we can turn their approach to this class around. I feel these students do have the ability to be successful and are simply not working to their capacity.

Unit Overview

Target Goals	**Period(s)**	**Topics**
Target Goal 1: Students will know and understand Trigonometric Ratios and Angles	**2-3**	• Angles • Coterminal Angles • Trigonometric Ratios • Rotations • Determine Lengths and Ratios • Use Ratios to Solve Problems
Target Goal 2: **Students will use Trigonometry to find measures and solve right triangles**	**2-3**	• Find Measures in Right Triangles • Find Missing Angles • Evaluate Inverse Functions • Solve Right Triangles • Applications

<u>Target Goal 3:</u> **Students will know, understand, and apply the Law of Sines and Law of Cosines.**	**1-2**	• Solve Scalene Triangles using the Law of Sines and Law of Cosines • Find Area of Triangles • Applications
<u>Target Goal 4:</u> **Students will derive and explore the graphs of trigonometric functions and their applications using traditional means as well as technological advancements.**	**3-4**	• Angular Displacement • Angular Velocity • Linear Velocity • Extrapolating from Graphs • Drawing Graphs using Graph Paper • Drawing Graphs using Calculators

Activities

Activity 1

The main activity for the acquisition of Target Goal 1 encouraged students to actively construct their own understanding of a concept. Contemporary cognitive scientists believe that learning takes place when students are actively engaged in the construction of their own knowledge and new experiences are linked to previous experiences. This was the motivation for this activity. In this particular activity, students in small-groups (cooperative learning) were given triangles and rulers and asked to find the ratios of the sides. I cut out the triangles such that each triangle had angles of 30º, 60º, and 90º and the students used rulers and calculators to calculate the ratios of all the sides. The students formulated the ratios of all the sides and we compiled a table of each group's ratios. The intention was for the students to see that the ratios found were equal regardless of the size of the triangle. These ratios were the six trigonometric ratios we were going to use throughout the Unit. Instead of introducing the ratios through direct instruction, I thought the students would construct a more thorough conceptualization of the topic. Then, students composed letters to someone explaining the six trigonometric ratios, which assessed the acquisition of Target Goal 1. These were scored according to the journal rubric (cf. Appendix E). A few examples of these letters can be seen in Appendix F. In addition, students were given a post-assessment at the end of the two days to assess the entire acquisition of Target Goal 1 (cf. Appendix G).

Activity II

I used a similar activity to introduce and assess the ability to solve triangles. This was because the previous activity worked so well and students were exhibiting a firm grasp of trigonometric ratios. In this activity, students were given a triangle and asked to find all of the sides and all of the angles (solve the triangle) (cf. Appendix H). Along with the triangle, students were asked to make only two measurements with their rulers. This was to ensure they were using the trigonometric ratios appropriately. Students were asked to copy and record all data in their journal along with their rationale behind each step. Essentially, students were asked to record their thought-process along with any difficulties they encountered. My intention was for the students to not only display their understanding mathematically, but express themselves through a written exercise as well. The National Council of Teachers of Mathematics lists the ability to communicate mathematical ideas as a major theme in secondary mathematics. The pre-assessment tool prior to the push towards this Target Goal led me to believe that this was an adequate exercise. This activity was assessed using the journal rubric (cf. Appendix E) and served as an authentic assessment as well as a post-assessment. This activity also allowed students with different learning modalities to strive given the wide range of intelligences included in the activity.

Activity III

The third activity I would like to mention brought current events into the classroom, even if the event only dealt with the sporting world. Students were asked to find the distance from first base to dead center field in Busch Stadium. Due to the lack of availability of computers, students were given the general dimensions of Busch stadium. I would have preferred to withhold this information and let them practice their research skills. In any event, they had to discuss with each other the dimensions of a general baseball stadium. Then, students were to assess whether they needed the Law of Sines or the Law of Cosines to solve the problem. Students were asked to work in groups of two, which supports the contemporary research on the benefits of cooperative learning. Students were asked to record the problem in their journals and attempt to find a solution (cf. Appendix I). The scoring criteria for this activity can be found in Appendix E. Furthermore, students were given a formal post-assessment that covered the entire content in Target Goal 3 (cf. Appendix J: assessment and scoring criteria).

Technology

It is my personal belief that the use of technology should be pervasive throughout any curriculum. However, I now realize that this isn't always a realistic goal. The students in my school have computer classes, however the labs aren't open to other classes. Therefore, I am reduced to using the class set of graphing calculators and my own computer in the class. I have the ability to display my computer screen through the classroom television through a modest video interface. This works adequately well for presentations, but hardly allows each student personal time on the computer. During our

investigations into period, amplitude, phase shift, and vertical translation (TG4), I was able to display the real-time consequences of changing the aforementioned values. This was done through a geometry program that allows the user to graph and animate designated coefficients. Again, due to the fact that we have one computer in the class, this was more of a presentation, however students were encouraged to make assumptions and predictions as to the consequences of increasing and decreasing the coefficients. In the future, I could set up stations and have small groups of students spend a few minutes at the computer while other groups are on task in other areas of the classroom. This would be one way to increase the use of technology in the classroom.

Classroom Management for Instruction

Mathematics' greatest value might be the fact that it teaches you how to use your mind. In particular, it will teach you how to use your mind. It can teach you strength, perseverance, and moreover, self-efficacy. It has the ability to introduce yourself to your own inner cognitive skills. In Education, as in life, shouldn't this be the ultimate goal? In this age of hyper-external influence and persuasion, the seemingly endless bombardment of information, we all too often ignore the development of our intra-personal relationship. I believe this is most prevalent in the adolescent stages. In How to Solve it, Polya refers to the "intelligent problem-solver as having the ability to…solve problems, choose the problems which are in his line, meditate upon their solution, and invent new problems. By these means, and by all other means, he should endeavor to make his first important discovery: he should discover his likes and his dislikes, his taste, his own line."

Learning about one's self involves taking risks. If students aren't comfortable emotionally, socially, and intellectually, their learning experience is hindered. Therefore, in order for students to feel comfortable in the classroom environment, the teacher must establish an environment of respect and rapport. The foundation of my classroom is based upon the acceptance of, respect for, and caring about students as human beings in an autonomous community. A teacher must communicate the idea that the classroom is a place for intellectual, emotional, and social growth. We are all learners and teachers alike, interacting in not a work-oriented classroom, but a learning-oriented classroom.

It is important to create a democratic environment that affords students an appropriate degree of self-determination. This promotes responsibility and effective social values. In addition, the teacher must express enthusiasm for the curriculum and learning by explicitly discussing the empowering nature of learning. One of my goals is to create autonomous learners; students that use higher-order thinking skills in order to illuminate new phenomena in their world. The classroom should reflect the philosophy that learning is not filling a bucket, but lighting a fire.

Students are told that once they arrive in class, they are to quickly get seated and begin the Warm-Up. That being said, most days necessitate a little encouragement. While students are working on the Warm-Up, I will walk around and check homework and take attendance. On days when we use our journals, I will ask students to help pass out the journals. On most days, this is done seamlessly and without a problem. Students know that the class ends on my signal. Some periods finish early in order to address make-up assignments, unfinished journals, or peer tutoring.

My expectations are very clear from day 1. I am here to support the growth of the student and therefore will respect, care for, and encourage each student. My focus is to develop self-regulatory skills. Students in this particular class, as juniors and seniors in high school, should be respected and treated like the young adults they appear to be. Therefore, students should gain experience in regulating their own behavior. Students are reminded of consequences of behavior inappropriately outside of school and therefore are encouraged to take responsibility for their own actions. In a school where behavior is a problem, I can honestly say that students in my class respect and care for myself as a teacher. As a result of establishing this environment of respect and rapport, I don't have

many behavior problems in class. Students list goals in their journals and are constantly reminded to reflect on their own behavior and whether their behavior is moving them closer to, or further away from their goals. I am not particularly quick to call parents regarding problems, preferring to address the situation with the individual directly. However I do not hesitate to communicate with parents my expectations and intentions. Feedback from parents has been very positive while displaying approval for my respectful approach to classroom management.

Limits, or rules, should be concise, reasonable, and consistently reinforced. Rules should be stated in a positive manner rather than as what not to do. Students at this developmental level should be able to come up with general guidelines for the class to follow. Giving students this responsibility to decide reasonable rules promotes self-regulation and responsibility. When students develop their own rules, they take ownership of the rules and know the reasons for having them. Therefore, the rules or guidelines for the class were established by the students in a democratic meeting. Students agreed that respect should be the centerpiece of any classroom. I have never been a significant supporter of the behaviorist approach to teenagers. In addition, we are seeing research that refutes the effectiveness of punishments and rewards in developing caring, respectful, individuals. Therefore, consequences in the form of punishments or rewards have never played a big part of my class. The school's policy must be followed, however I try to address and solve problems as a class. It isn't uncommon for me to ask the class as a whole to help decide how we should address problems. Again, self-regulation is what I am trying to foster. I try to remind students of the intrinsic benefits from behaving appropriately as well as the natural consequences of behaving

inappropriately. However, I have removed one student from the class for violent behavior. On the first day of school, I promised my students that they would be safe in my class. Once this has been compromised, I must remove the student immediately.

When students are behaving appropriately, I try to praise the student by reminding them how their behavior affects their learning or the wellbeing of other students. I do not find the distribution of candy to be an effective means of developing caring individuals. Rewards are an easy way to get students to comply with my request, but not a great way for students to see the real benefit of their appropriate actions.

The classrooms should be organized in a manner that promotes discussion and the sharing ideas between all members, while easily manipulated to facilitate cooperative learning experiences. In addition, explicit procedures should be communicated for which desks "peel" off for cooperative learning experiences. An explicit plan ensures a smooth transition from class discussion to cooperative learning experiences.

Ideally, the classroom should be arranged in order to facilitate both cooperative and individual learning and experiences. Tables and chairs arranged in groups of four would be ideal. However, my classroom has thirty-four small desks with attached chairs; hardly conducive to cooperative learning experiences. In fact, the face or desktop isn't large enough to accommodate both a notebook and a textbook. Therefore, students are asked to slide desks together in groups of two quickly and quietly so as not to disturb others at work. The arrangement isn't what I would like in a classroom, but being flexible is an extremely valuable trait as a teacher.

It is important to keep your students engaged while in class. Students will be provided with ample thought-provoking activities during each lesson that are well

prepared and presented by the teacher. Activities should be presented thoroughly and clearly so as to give the students a clear picture of what is being asked of them. In addition, the curriculum promotes the use of elaborate enrichment activities that students work on individually or as a small group once they have finished the daily activities.

It is often the case that when a lesson deviates from what was intended, negatively affecting the learning environment, the teacher must change his or her behavior. Flexibility is incredibly important. When students are having difficulty paying attention, constructing understanding, or completing assignments, the teacher must first alter his or her instructional strategy. Modifying instructional strategies may change the outcome of a lesson. It is important to determine where the students' focus lies and how this focus can be guided back towards the curriculum.

Family Involvement Plan

When I think of family involvement, I think of the proverb, "It takes a village to raise a child." As a teacher, I am just one member of this village. It is extremely important to include parents in the development of a student. Furthermore, it is extremely important for parents to understand that we are to work cooperatively if we are to assist in a student reaching his or her full potential.

The community provides a number of resources to support student learning. For example, Mathematicians from the surrounding universities could come and speak about what motivated them to pursue a career in Mathematics. In addition, students could visit industrial laboratories to learn more about how Mathematics affects our lives. Furthermore, students could participate in local and state Mathematics competitions to display their knowledge on a larger scale.

I communicate regularly with parents when issues arise pertaining to the development of their child. However, I enjoy communicating good news as well. I try and call a parent with good news for every call I make to address a problem or difficulty. In addition, I wrote Thank You letters to the parents that attended the parent-teacher conferences. This small token of appreciation was well receipted. In the future, I would like to organize a website where parents can list questions and concerns regarding their child's education. This may function well as a blog.

As a teacher, it is important to express my interest and enthusiasm for Mathematics to my students' parents. This can be done by holding a Mathematics Night at school. Parents can join their students in problem-solving activities and investigating

the lighter side of Mathematics. In addition, parents that work in Math-related fields can come in and speak to the class, or participate in a lesson. In the future, I would like to have an after-school program that encourages parents to develop their own understanding of Mathematics.

Since the ability to express Mathematics in language is a major focus of the National Council of Teachers of Mathematics, parents could assist in their child's development by asking their child to explain their homework assignment to them. This could reinforce a student's ability to speak mathematically.

I have composed a letter to be sent home at the start of my Trigonometry unit. The letter can be viewed in Appendix M.

Instructional Decision-Making

There are a number of areas in trigonometry in which students may seem overwhelmed or intimidated. For one, students often find it hard to conceptualize the fact that (sin x) is just a ratio, or number, that can be susceptible to the usual operations in Mathematics. As any teacher will tell you, instructional decision-making is vital in presenting concepts in a number of ways. A teacher makes hundreds of decisions in a class period, all of which impact the content, delivery, and the ability for students to grasp a specific concept.

One particular instance occurred when I was introducing the basic functions sine, cosine, and tangent. As I reflect on my personal experience learning these functions, I was taught the ratios and told to memorize. Furthermore, the teacher did not insist upon, or even encourage, a true understanding of what these ratios *meant*. As I introduced these concepts, I struggled with the approach to remain dedicated to basic skills, i.e. students had to memorize the ratios in order to be successful applying them, while staying within my philosophy of having students develop these ideas from first principles and therefore develop a conceptual understanding of the concepts.

I began the lesson by encouraging students to brainstorm their initial beliefs regarding the trigonometric functions. Then I asked students to compare their beliefs. This served as a pre-assessment and could be used to compare new knowledge to old knowledge. What I found was that students had very little knowledge of what these ratios actually meant. They had heard of sine, cosine, and tangent in geometry class, however they were only exposed to these concepts on the most superficial level.

Therefore, when we began our discussion, students didn't realize that (sin x) was actually just a number that we could multiply and divide by, add and subtract. So, I developed an activity where small groups of students would measure the sides of a triangle (each group given a right triangle of varying sizes but with congruent angles) and take ratios of the sides of the triangles. In other words, students found the ratios of the lengths of the three sides. They chose an angle and found the ratio of the side opposite the angle to the hypotenuse, or the largest side opposite the right angle.

My motivation for this exercise was to lead students to see that the sine of an angle is just the ratio of the side opposite that angle to the hypotenuse. Even though the students had different sizes of triangles, given the fact the triangles were all similar (in a mathematical sense, each triangle had corresponding angles congruent) they found that their ratios were the same as those of the other groups. The students reacted very well to this exercise and were able to adequately describe the use of these functions afterwards.

As we progressed through the unit, there were other times when I had to adjust or modify a portion of my original design. This particular occasion is an example of deviating from a lesson that was intended to help students see where we get the Law of Cosines. The Law of Cosines is a fairly complex algorithm that students need to memorize in order to solve a triangle. Learning from my previous example above, I had planned a lesson that would allow students to see the derivation of this algorithm. However, this proved to be more difficult then I had imagined.

My lesson began with a triangle and a series of questions developed to encourage students to proceed down a path that would yield the Law of Cosines. I must admit, I was fairly proud of this plan and had anticipated an "Ah Ha!" moment at the end.

However, this did not happen. Students struggled with the derivation and expressed discouragement. Some claimed that I was making this harder than it had to be (a comment I thought was peculiar since they didn't know the Law of Cosines yet anyway). In the middle of this lesson, I stopped and communicated the purpose of this exercise. I then explained that they could vote on whether they wanted me to continue or if I should just tell them the formula and not mention how it came about. They unanimously agreed that it would be better if I just gave them the formula and if time permitted, we could quickly review the process at the end of class. I obliged and the students were given the formula and the situations that would necessitate its use. This went against my beliefs about studying Mathematics, however students should have a say in how content is delivered to them. Students preferred direct instruction over a more discovery based approach to learning that day.

As a teacher, we must remain flexible and be willing to abort any unsuccessful attempt at introducing a lesson or concept. My students felt I was clouding the content a little too much and since they were going to use the Law of Cosines for practical purposes, i.e. solving triangles, they didn't see the need to really understand the derivation of the law. In the end, I realize that the students were using the Law of Cosines accurately and in the right situations. This legitimized the use of direct instruction in this instance, regardless of my preference for developing a true conceptual understanding of the topics in the curriculum.

Analysis of Student Learning

The pre/post-assessments were evaluated for twenty students. This is due to the fact that attendance is a problem. I neglected to include two students that rarely make their presence felt due to issues affecting their learning outside of school. The results for twenty students can be viewed in the Design for Instruction section of this report.

This pre-assessment did not include all of the Target Goals. This is because I felt it was necessary to break these Target Goals into small, manageable subsections. Essentially, the pre-assessment covered TG1 and TG2. This means I had to assess TG2 and TG3 in another separate post-assessments. This will be evident by a graph in which you will see three bars for the pre-assessment, and two post-assessments (PA1, PA2). The results are listed in table form in Figure A:

STUDENT	PRE (TG1, 2)	PA1 (TG1-3)	PA2 (TG1-4)
A	20	20	19
B	11.5	0	12
C	4.5	17	19
D	20	20	20
E	20	20	17
F	16	16	14
G	14.5	3	9
H	10	14	20
I	19	19	17
J	18	7	14
K	7	3	8.5
L	9	20	2.5
M	20	17	19
N	15.5	20	14.5
O	20	9	17
P	4	19	9
Q	16	15	17.5
R	17	18	18
S	12	6	14
T	14	12	15

Figure A

Out of the twenty students studied, 30% of the students improved their scores for TG1 and TG2 from the pre-assessment to the post-assessment 1. Out of the remaining, 45% lowered their scores. This is fairly troubling. I was anticipating better results. A look at the assessment tool (cf. Appendix N) shows that the students were assessed through a fairly mundane test. Students were asked to solve triangles using the trigonometric ratios and the Law of Sines and Cosines. I chose the assessment tool in order to eliminate the problem of translating word problems into mathematical language. However, this change might have affected the students' performance negatively because it wasn't what the students expected. In class, we focus on higher-order thinking and problem-solving skills, but this assessment was void of multiple expressions of intelligence.

Out of the twenty students, 50% improved from post-assessment 1 to post-assessment 2. In addition, from pre-assessment to post-assessment 2, 45% improved their scores. Again, I would prefer to see the number of students progressing to be higher, but as I look at the number of students that are scoring above 60%; 13 out of 20 on the pre-assessment, 14 out of 20 on post-assessment 1, and 16 out of 20 on post-assessment 2. This leads me to believe that as we address our Target Goals and proceed through the unit, more students are moving closer to proficiency. Furthermore, as I look at the averages of the three assessments, I see very little fluctuation. The pre-assessment average was 72%, the post-assessment 1 average was 69%, and the post-assessment 2 average was 71% (for post-assessment tool, see Appendix O). So, despite some major fluctuations in individual scores, the overall performance seems fairly consistent.

An interesting investigation might be to look at general trends in results. I prefer to see the results of these three assessments using trend lines. By analyzing the graphic below (Figure B), I see the general trends in my Mathematics classroom. This information is vital when I reflect on the modes of instruction, activities, and assessment tools used the decision-making process.

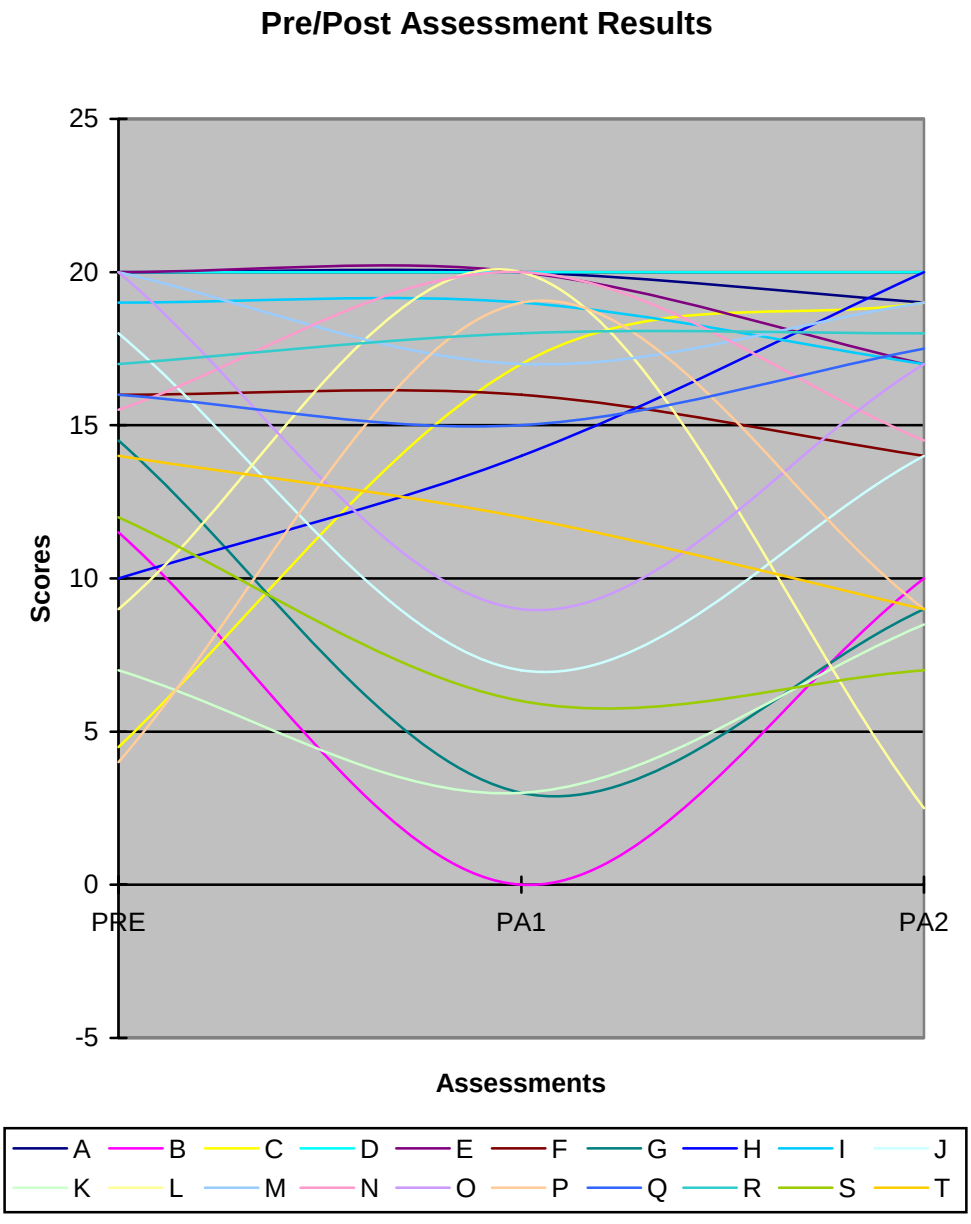

Figure B

An analysis of the trends motivates me to choose a few students and look more carefully at their results. As a conscientious teacher, I am never satisfied unless all of my students are performing at an appropriate level. Their were a number of students who seem to be very proficient, i.e. students A, D, E, F, I, M, N, Q, R, which is almost half of the class. This is very good news. However, there are a number of students that are performing at a very low level. I would like to choose students B, G, K, L, O, P, and S as a subgroup and investigate further into their results (Figure C).

STUDENT	PRE	PA1	PA2
B	11.5	0	10
G	14.5	3	9
K	7	3	8.5
L	9	20	2.5
O	20	9	17
P	4	19	9

Figure C

In addition, it might be helpful to view these results in a chart (Figure D):

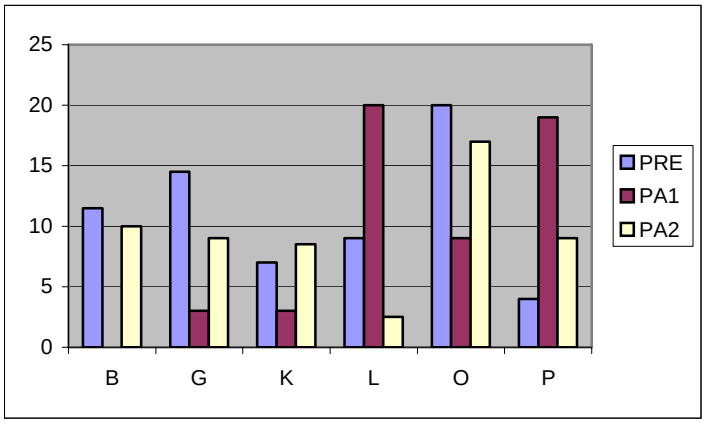

Figure D

Instead of looking at one particular Target Goal, I would like to investigate a more interesting phenomenon, mainly the scores as they proceed from pre-assessment to post-assessment 1. Students that seemed to just be doing enough, Students B, G, O, dropped dramatically between these assessments. This could be because of a number of

factors. First, the concepts were much more developed and complex. Second, the assessment tool was slightly different, i.e. more mundane. Third, as I mentioned earlier, the delivery was different. When introducing the Law of Sines and the Law of Cosines, I relied more on direct instruction and less on my usual discovery approach. Apparently, some students didn't internalize the concept as well through direct instruction. However, students L and P did remarkably better on post-assessment 1. Therefore, the challenge is to find a way to combine a discovery approach with direct instruction. One way is to have stations where students can choose their own path to learning. This is an interesting idea. Why shouldn't students be able to choose the style of delivery?

On an individual basis, I would like to look at students D and K (Figure E).

STUDENT	PRE	PA1	PA2
D	20	20	20
K	7	3	8.5

The data suggests that Student D is doing everything they can in and out of class. Student K seems to be working well below an acceptable range. As their teacher, I am well aware of who these students are. Student D is a very good student. They (use of "they" keeps the sex confidential, despite being grammatically incorrect) are always prepared for class and once they arrive, they always get down to work. Student D comes from a very supportive home environment where education is revered as very important. Student D displays interest in all subject areas and in knowledge for the sake of knowledge. Student D also participates regularly and always contributes effectively and cooperatively during small group exercises. On the contrary, Student K often arrives in class without a book or notebook. Student K often falls asleep in class and is defensive when I make suggestions. Unlike Student D, Student K's parents did not attend parent-

teacher conferences and have been very difficult to communicate with. Student K rarely shows a passion for anything, even when they are talking with friends.

The difference in Student D and Student K's work is most evident when we look at the journals. Student D exhibits a strong understanding of the concepts, as well as a great ability to express themselves verbally. In addition, it is clear that Student D has a wonderful disposition in regards to learning. Some examples of Student D's work can be seen in Appendix P. Student K rarely completes their journal exercises and if completed, it is done with very little effort or honest reflection. Due to the lack of journal entries (attendance is also an issue), an example of Student K's work can be seen in Appendix K. The first example was supposed to be a letter to someone explaining the trigonometric ratios we studied in class. It is evident that there is very little conceptual understanding of the ideas. In addition, the entry located at the bottom of the page was a post-test reflection. Student K (I will use "he" for the sake of readability) claims he did better than expected, which is alarming given the grade of 3 out of 20, or 15%. In addition, to prepare the night before, he admits he played basketball. I appreciate their honesty, however this is evidence that he isn't preparing for the test It is important to view these students together and try and understand the differences and similarities. In my opinion, these students probably began on divergent paths at a very young age. Home environment is extremely important in the success of students.

Reflection and Self-Evaluation

I feel my most effective instructional strategies were the discovery-based instruction, and the cooperative learning activity. In discovery-based learning, students are encouraged to arrive at the lesson objective by seeing what it is like to be a mathematician. This means to investigate, analyze, problem-solve, and form ideas; not memorize, regurgitate, and repeat processes without a true conceptual understanding of their actions. In cooperative learning, students are encouraged to work together attaining common goals. They are encouraged to discuss and even argue over strategies and ideas with the goal of common understanding. Learning is about hitching new ideas to old ones and these instructional strategies were proven to develop conceptual understanding, problem-solving skills, and the ability to work with others towards a common goal. In addition, these instructional strategies helped me add dynamic assessment strategies in order to assess the attainment of our learning goals.

The two greatest barriers were my struggle to make trigonometry applicable to my students' lives and my ability to create dynamic learning experiences for each and every student. Given the enormous amount of time it takes to plan an engaging learning experience for every student every day, I sometimes find myself planning journal activities too infrequently. Given the number of students I teach, which is approximately 170, reading journal entries and making comments can take quite a long time. I could improve on the efficiency at which I assess the journal entries. One activity I would like to participate would be to attend a seminar on cooperative learning. Although I often

endorse cooperative learning strategies, I believe that I could be implementing this practice more effectively. In addition, I would like to include teachers from other disciplines in instructional decision-making. In particular, I would like to collaborate with the computer science department in order to integrate technology more effectively into my lesson.

As a teacher in his sixth year of teaching, I feel I have the ability to provide a meaningful learning experience for all of my students. However, the results show that some of my students are still working below an acceptable range and below their capacity. It is hard for me to view successes without the failures, so I find it difficult to overlook the under-performing students. I greatly enjoy collaborating with other teachers and parents in order to find the best way to effective reach my students. Since there are a number of trigonometry teachers, I found it useful to inquire into their effective practices as well as share my successes and failures.

I also feel I have developed by incorporating the pre-service teacher work sample standards. I regularly used information about learning to guide my decision-making processes. By using multiple assessment tools such as journals, tests, homework, and discussions, I am able to get a better understanding about what it is my students know. I have become better at selecting learning goals as well as choosing the appropriate instructional model needed to achieve these goals. I have established an environment built on respect and a culture of learning in my classroom. Finally, I have developed a strong interest in reflecting on my own practices and have used these reflections to move myself closer towards being a master teacher.

I take pride in my ethical teaching practices. I always try to do what is right for my students while always remaining close to my own beliefs. Part of a teacher's job is to remain accountable and assess each student as accurately as possible. Some teachers give an enormous amount of extra credit work, which dilutes the accurate assessment of each student. I tell my students that I do not give grades, they earn grades. I find it difficult to give students poor grades sometimes if I know they are trying hard or that they certainly will be successful in life regardless of their ability to solve trigonometric problems. However, I have to remain true to my assessment tools and I have to show students that they will have to work in order to be successful.

Final Reflections

A teacher's ability to reflect is essential. We look to our prior experience to illuminate the most effectual pedagogical tool needed to connect linear equations to literature, limits to laughter, and logarithms to life. Every student brings to the classroom an amalgamation of interests, desires, and curiosities that must be taken into consideration while the teacher delves into his or her pocket of tricks. Our successes and failures are rooted in our ability to reflect. To teach is to reflect.

I truly believe I have grown a great deal as a result of the certification process. One area of growth has been the ability to reflect on my own practices as a teacher, as well as the practices encouraged throughout the world of mathematics education. The construction of mathematical understanding necessitates an environment that allows

students to discover and explore the wonderful world of mathematics. This fascination is dulled, or even lost, when we focus on the memorization of algorithmic procedures. The automation of mathematics by focusing on memorization and algorithms asphyxiates a student's excitement and wonder of mathematics. Mathematics isn't following procedures, but the ability to discover new ideas by the juxtaposition of ideas already existing. The certification program at Harris Stowe State University has encouraged me to improve on the delivery of content and provided an arena in which to reflect upon these ideas while considering my previous successes and failures.

As I progressed through the program, I became aware of my own mathematical abilities and moved closer to the role as a master of content. I truly feel that I have developed a more thorough conceptual understanding of mathematics and what it means to study mathematics. Conceptual understanding should be a major focus of mathematics education. In addition, I reflected upon my own problem-solving strategies and acquired new ones. This metacognitive practice plays an integral role in the development of mathematical competencies. Furthermore, as a result of this development, I have improved my self-efficacy. As a mathematics teacher, I believe it is important for students to build self-efficacy by reflecting and improving on their own strengths and weaknesses.

My passion for different philosophies of education flourished as a student in the program. In this regard, I have become a more skilled instructor. When I wasn't contemplating a specific problem or assignment, I was actively seeking out literature pertaining to the art of teaching. As a teacher, I strive to instill a belief in my students that education is an unbounded process of living. The pre-service work sample has

helped me develop a passion for education that extends far beyond my class responsibilities. I often find myself spending leisure time seeking out the latest research and developments in education. The program has encouraged me to acknowledge and nurture a passion for education.

This year brought me back to the classroom and I entered as a teacher in the midst of extraordinary growth. This I truly believe. I completed the required classes needed for certification as well as finished a master's degree at Webster University. And as I progress, I will continually reflect back to the lessons learned. Sometimes this reflection will elucidate growth that at the moment remains imperceptible. This reflection, vital to the art of teaching, will continue to provoke changes in my practices as a teacher.

I have become more adept at using technology in my classroom as well. Perhaps due to the lack of resources, I have become more skilled in being flexible as well as creative in the use of technology. I only anticipate improving on these abilities as well.

Finally, my student teaching has helped me become more patient when managing behaviors. I consider myself to be a very reasonable teacher, and through the last four months I have fine-tuned my philosophies on classroom management and have been more effective at providing a culture of learning for my students where students are encouraged to participate rather than act out.

These reflections are just the beginning. As a teacher, we must constantly reflect on our practices. An effective teacher is always reflecting on best practices and therefore, perhaps "final reflections" is an inappropriate title for this section. As a professional teacher, I can say with great pride that these reflections will be anything but final.