Results of Specific Intervention Developed from Analyzed Data for Arithmetic Sequencing of

Eighth Grade Pre-algebra Students

A Master’s Research Project Presented to The Faculty of the Patton College of Education

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by

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This Master’s Research Project has been approved
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Abstract

The purpose of this study was to determine if using error analysis could improve scores. To test this theory a problem of a quiz was analyzed for common errors. This information was used to implement a specific intervention. Finally an end of chapter test containing the same problem was analyzed to determine if comprehension improved. Research indicates that there is evidence that error analysis is a worthwhile endeavor and can improve student scores. The study included 16 underachieving eighth grade pre-algebra students over a six week period. Data were gathered from a quiz and a chapter test. A problem from the quiz was analyzed for frequency and reason of error. An intervention was implemented and the same problem on the chapter test was analyzed in the same way as the questions on the quiz. Before the intervention 6 students got one portion of the problem correct. After the intervention 12 of the students got all or a portion of the problem correct. The total points for the class increased from 4 points earned to 11 points earned. Scores increased after the error analysis and intervention took place, this implies that analysis of errors on formative assessments can be used to adjust instruction and increase summative scores.
Introduction

Can error analysis of problems on formative assessments, followed by a specific intervention increase scores on summative assessments? Students’ errors in mathematics are inevitable. Some errors are made by performing the calculations incorrectly but having the knowledge. This could have been incorrectly adding or writing the information down incorrectly. Other mistakes are made because of a lack of correct understanding. Some mistakes are made by applying understandings the students believe to be correct, but are not. Only by looking at where in the process these errors were made can we determine why the errors were made (Coker, 1991). This is where error analysis comes into play. For this study, error analysis is the systematic breakdown of an incorrectly answered problem to determine why an incorrect answer was given. This allows a teacher to determine if it was a calculation error, if the topic was not fully grasped, or if the student holds a misunderstanding of the mathematical process in question. Error analysis is a powerful tool in student improvement (Borasi, 1987). It can be conducted on individuals or on groups. With error analysis you can break down the mathematical problem to determine what kind of understanding the student may have. It is possible to analyze errors in able to find common misunderstandings of an entire class. These can be addressed in order to improve error rate on future student assessments of the same type of problem (Borasi, 1987).

Significance of Error Analysis

There are several reasons why error analysis should be considered for research. Teachers at elementary and middle schools may contribute to misconceptions with their teaching
styles which inhibit the learning of algebra (Welder, 2012). These misconceptions may go uncorrected causing mathematical difficulty for the students for years to come. Studies indicate that students continue to use incorrect algorithms even when these algorithms produce incorrect answers (Coker, 1991). Unless these misconceptions are identified and corrected, the students will not be able to master that process in mathematics. This can directly reflect both student scores and on the current teacher’s rating when value added is involved. So identifying misconceptions is an important aspect of teaching and error analysis is an important tool for the identification process.

Common miscalculations cannot be corrected by error analysis, but misunderstandings can. If a topic is not fully grasped and a misunderstanding can be pinpointed, then a specific intervention can be applied. This can give the students the support they need in the area they need it. Re-teaching an entire topic is not a constructive use of time when only a portion may need to be reinforced.

**Helping Student Achievement**

Error analysis if implemented on a regular basis could increase student knowledge. In doing so would increase student scores on summative and high stakes tests. Since students use prior knowledge to answer questions and build schemas, any misconception held will produce incorrect algorithms for the student to follow. These incorrect algorithms will then produce incorrect answers which will affect the students’ achievement on assessments. These scores affect both the student and teachers because of high-stakes tests for graduation and states value added policies for teachers.
**Purpose**

Can error analysis of problems on formative assessments, followed by a specific intervention increase scores on summative assessments? The purpose of my research was to determine if using error analysis on a problem of a quiz to implement a specific intervention could improve the score of the problem on the end of chapter test. The topic of this research was arithmetic sequencing. I gave weekly quizzes to my students during every unit. During the arithmetic sequencing unit I analyzed one such quiz to determine if the students held any common misconception. I analyzed the errors on the quiz to look for commonality. Then I implemented an intervention aimed to clarify the equation constructed to identify the $n^{th}$ term. It was specifically geared to help the students identify the values to use in each of the locations of the equation.

**Conclusion**

I believed that the students might demonstrate a common misconception. After determining what the common misconception was, an intervention based on that misconception was introduced to the class. I projected that the number of students making errors on the final assessment would decrease after introducing an intervention. It is important to ensure the students’ base knowledge is correct in order for the students to perform accurate calculations. Since teachers have no control over what the students were exposed to prior to their class, an analysis must be given to know where the students are coming from. By analyzing the work of the students for a common mistake and then analyzing that mistake to see why the error was made, better results in student improvement should become evident.
Definitions

*Miscalculation* is a common mathematical error that is not repeated on other problems of the same type.

*Mistake* is a mathematical error that is due to not fully understanding the mathematical process to solve a problem. It may not be repeated because the students do not know what steps to take to come to a correct solution.

*Misconception* is a mathematical error that students repeat for all common problems. It is an incorrect algorithm the students believe to be correct. Often it is based on previous knowledge of a topic.

*Arithmetic Sequence* is an ordered list of numbers that have the same difference between all of the consecutive numbers.

*Term* is used to identify the numbers in sequences. First, second, third… are added before the word term to indicate a numbers position in the sequence.

*Common Difference* is the difference between each of the terms in an arithmetic sequence.
Chapter 2
Review of Literature

Introduction

In the literature reviewed for this topic, several key issues surfaced. This section provides benefits and problems connected with error analysis, misconceptions, importance of student performance, and errors associated with arithmetic sequencing. Error analysis research can be found from the beginning of the 20th century. It has been utilized to pinpoint problems. After discovering the root of the error, corrective action can be taken. The process is lengthy, but the overall length of time required would be less than re-teaching the concept until it was mastered without knowing why the students did not grasp the topic. One problem that is embedded in mathematics is the misconceptions students hold. Students have prior knowledge that may not be accurate or applicable to the current process, but the student retains that knowledge and applies it to content which generates incorrect answers. Another issue related to error analysis relates to student performance. Due to high stakes testing that affects students, teachers, and districts, scores have become of the utmost importance. Finally, there is research that students have common errors when working with arithmetic sequencing.

Error Analysis

Error analysis has been around long enough to have both opponents and advocates. This section will reveal research on each side to determine it is and worthwhile action to be taken by educators. The history of analyzing errors is long rooted in education. Studies were published regarding student error in the 1920’s (Radatz, 1979). By using error analysis, educators can discover where in the process the student got off track (Coker, 1991). However, it is a difficult and time consuming task (Coker, 1991). Time is a precious commodity for educators who must
meet time restraints in covering content before high-stakes tests are given in the spring. The question “Is the time and effort associated with error analysis worthwhile to today’s educator?” must be answered.

The advocates of error analysis argue that misunderstandings and misconceptions must be identified in order to improve student comprehension. Error analysis is a means to determine what these misunderstandings and misconceptions are. Only by offering intervention that addresses the root of the problem can a mastery of the topic be achieved. After the analysis and identification, the teacher can then offer direct remediation (Borasi, 1987). According to Lewis (2010), a student received 19 tutoring sessions, but did not show improvement until her errors were analyzed and a specific intervention was introduced during session 13. This suggests that for complete understanding you cannot reteach a topic; you need isolate the misconception and apply precise mediation for that misconception.

Error analysis is an old process that has fallen out of common practice in recent years. This may be attributed to an emphasis being placed on “teacher strategies” rather than “learner strategies” (Coker, 1991). The way individual students learn (or do not learn) has been overshadowed by the most current educational strategy. This compounded with an “increasingly unmanageable workload of teachers” has created a learning environment that focusses on the final answer (Coker, 1991). Error analysis does take additional time for the teacher initially. The increase in the students’ performances and decrease instructional time on that concept can outweigh the negative aspect of analysis time (Coker, 1991).

**Misconceptions**

Generally, no cultural aspect is linked with error patterns. Instead, previous teaching of mathematic problems from educators who do not know how to explain them to students has
instilled misconceptions (Isik, 2012). Mathematical educators in early grades teach the immediate skills and symbols the students need to use. When symbols have duplicated meanings this increases the difficulty for later content understanding for the students. Some mathematical teachers do not have a deep understanding of the material to communicate it to the students (Isik, 2012). Research suggests that teachers pursue understanding of higher level mathematics to better teach lower level mathematics (Ball, 2002). Teachers must understand that mathematics is a building block upon which new concepts are layered. When one layer is faulty it must be secured before construction continues. This is why error analysis is important.

Some of the misconceptions that the research indicated included symbols, meanings and knowledge. Many symbols used in algebra are introduced earlier in the study of mathematics, but do not adequately portray what the symbol means in algebra. In some cases there are multiple meanings like the negative sign and subtraction symbol. Other times it is just a misrepresentation or incomplete knowledge (Welder, 2012). This all contributes to the misconceptions students advance with in mathematics. Students build their knowledge through years of exposure to incomplete or erroneous information that then lead to problems. When student use an algorithm they tend to continue to use the same algorithms even when it produces incorrect answers. This is because is logically makes sense to the student (Coker, 1991). Error analysis gives a teacher the opportunity to correct this misconception which will improve student performance (Coker, 1991).

**Student Performance**

One important aspect of error analysis is the error patterns found for students. This is due to students following logic in completing problems (Coker, 1991). When this logic is based on incomplete or misunderstandings it will lead to an incorrect answer. The algorithm the
student makes is repeated even when it gives incorrect answers because the process is still logical to the student (Coker, 1991). That is why patterns can be detected. The cause of these patterns is generally related to prior knowledge. This prior knowledge can be the result of past educational or personal experiences. If elementary or middle school teachers introduce symbols that seem to have an absolute meaning but later the same symbols are used slightly differently, it may cause a resistance for the student to change their way of thinking (Welder, 2012). A student may also have a misunderstanding or an incomplete view of a concept. Any misconception held by the student can cause them to process a calculation to an incorrect answer. The student has logically deduced this process, so the incorrect answers will continue until the misconception is addressed. Therefore, prior knowledge is a root cause to error patterns.

Students are not a blank slate waiting on the teacher to fill them with all the knowledge they need. The students have prior knowledge and ideas. If this knowledge is complete and correct it can be a great asset to the student and the teacher in the instruction of new material. If however, the information is incomplete or a misconception, this will lead to barriers in the learning of new material (Welder, 2012). One reason for the resistance to change is that the student feels they already have a working and logical knowledge base. If new information is in conflict with or in some way incompatible with what they already know, the student is likely not to accept the new information (Welder, 2012). Therefore, any misconceptions students have regarding a teachers instruction can lead the student to making their own logical algorithm for a problem type that, even when incorrect, will be repeated when given that problem type (Coker, 1991). The importance of this is that students cannot get past these misconceptions without special guidance. Often times, a building block process needs to be put in place. This allows the student to start with an accurate prior knowledge and build upon that so they can see their own
misunderstanding and logically come to a correct conclusion. Welder (2012) used examples of this when demonstrating to the students that the equal sign was a sign of relationship and not a sign for an operation. Students wanted a problem to the left and a single answer to the right. Welder (2012) proposed show examples the student accepted and then exposing them to other examples in reverse of the students’ idea. Then building further to equal number sentences on each side. This allowed the student to recognize the conflict in preconceived information and new information and then process the information correctly.

The need for analyzing errors for patterns is because of the effect it has on the student and the education system. November of 2011 Ohio adopted a framework to evaluate teachers. 50% of a teacher’s evaluation is based on observations which are aligned to specific criteria. The other 50% is based on value-added to the students (Bloom, n.d.). School boards are expected to adopt ways to use the criteria for advancement and termination. Therefore, the Ohio’s Teacher Evaluations System, OTES, has a direct effect on a teacher’s employment. The value-added is determined by how much a student learns over the course of a year (Bloom, n.d.). Ohio Achievement Assessments, OAA, is given to grades 3-8 in various subjects to determine what they know and are able to do. In subjects, like mathematics, when the OAA is administered yearly, it is used to determine the value-added to the students. If students have a misconception that is hindering them from correctly showing current knowledge it will reflect badly on the teacher. Due to high stakes testing, it can have negative results for the students as well. Students in Ohio are required to pass all five parts of the Ohio Graduation Test (OGT) or they will not get a diploma (Messina, 2007). Therefore correcting any misconceptions that could cause students to perform poorly is important to the student and the teacher.
Common Errors in Arithmetic sequencing

As an eighth grade instructor I am concerned about the student’s retention of the content both for their future and for the repercussions that can come from substandard grades on the OAA. This directly relates to OTES. It also affects the school rating. When a topic like mathematic sequencing systematically causes students to get problems incorrect, it affects the student, teacher, and school standing. Research indicates there are some common mistakes and misconceptions that accompany this topic. These issues include understanding subscripts and identifying the first term of the sequence. A formula commonly to be manipulated for arithmetic sequencing is $T_n = a + (n-1)d$. This formula allows for the sequence to be used in order to predict the $n^{th}$ term, $T_n$. The first term is represented by $a$. The position in the sequence is numerically represented by $n$. The common difference is the represented in the formula as $d$. Both of these issues directly affect the student’s ability to manipulate the formula. Determining if my students have these misconceptions will enable me to relay the information better.

Another formula used is $T_n = a_n + b$. The common difference is $a$. The term is $n$. And $b$ represents the zero term. This is the first term minus the common difference. Students have difficulty understanding the concept of a zero term. This formula also requires the students to understand what each portion of the equation represents and how to determine its value.

The mentor teacher in the 8th grade mathematics classroom of the research study has taught for 7 years. He indicated that mathematic sequencing is a common problem for eighth grade comprehension. He indicated that students have problems identifying the first term in the sequence. Looking at the formulas $T_n = a + (n-1)d$ and $T_n = a_n + b$, being able to identify the first term properly is essential to solving an arithmetic sequence. If the students use an incorrect first term they will not be able to successfully answer the problem. The other issue that was
identified was the understanding of subscripts (Building arithmetic and geometric functions, n.d.). This formula introduces subscripts to the students. If the students do not understand the formula or what each part of the formal represents, they will not know how to utilize the formula in order to correctly solve the problems.

Conclusion

The research indicates that there is evidence that error analysis is a worthwhile endeavor and can improve student scores. It is a time tested procedure that can determine common misconceptions and mistakes that directly affect student scores. It is a time consuming process, but with scores influencing graduation requirements and OTES it is sensible use of time. Misconceptions have been identified in arithmetic sequencing. Therefore, I incorporated error analysis into my education practice in arithmetic sequencing.
Chapter 3

Methods

Introduction

The purpose of this study was to answer the question, “Can error analysis of problems on formative assessments, followed by a specific intervention increase scores on summative assessments?” The research project was designed to have an initial assessment in the form of a quiz, an intervention, and a summative assessment. Data were gathered from a quiz and a chapter test. An incorrect problem from the quiz was analyzed for frequency and reason of error. An intervention was implemented and the same problem on the chapter test was analyzed in the same way as the questions on the quiz. The results were then compared. The participants in the study included 16 underachieving eighth grade pre-algebra students. The original lesson was taught with direct instruction, guided practice, and independent problem solving. The research was conducted over a six week period in a 7th and 8th period block class.

Participants

The participants in the study included 8 girls and 8 boys in an eighth grade mathematics class. The students attended a high school/junior high in southeastern Ohio. They came from a low to moderate socioeconomic status. None of the students had an IEP, but they all were deemed at risk academically. They were placed together in a block language arts and mathematics. These students were placed in the block to receive extra help in their language arts, mathematics, and organization.

Setting

The block class started immediately after lunch and continued until the end of the day. It started with language arts. Mathematics took place immediately following. This block used
three 45 minute periods. This topic was started the last Friday in January after a full week of snow days. Further inclement weather limited instruction to two school days the following week, Tuesday and Friday. Tuesday the quiz was administered and Friday the intervention was given. These were both on days with a two hour delay. Typically both language arts and mathematics receives 45 minutes of instruction each with the extra 45 minutes used collaboratively between either subject to meet content demands. The two hour delay allowed for a total of 50 minutes to be devoted towards mathematics on those days. Twenty weekdays passed before the summative assessment. This was extended from the 16 that was in the original scheduling due to inclement weather. There were two adults supervising the class for the math portion of the block, a mathematics mentor teacher and an intern.

**Topic Delivery**

Arithmetic Sequence was delivered in a direct instruction game format. The students were given sequences number by number until they could guess what came next and name the common difference. They were given examples on using the common difference and the zero number to construct an equation. Guided practice finished the period. This was done in a standard 45 minute period. The period that followed was monitored individual practice of non-homework and homework problems. The intern and teacher circulated around the room to answer questions and monitor student comprehension.

Two days for the weekend and one inclement weather day occurred between the instruction and the quiz. Homework was reviewed prior to the quiz (Appendix A). The quiz was graded and analyzed and two inclement weather days later a worksheet was given for intervention on the topic (Appendix B). Twenty-eight days later including weekends, holidays, and inclement
weather closures the summative assessment was given (Appendix A) which included the same question as on the original assessment.

**Initial Data Collection and Analysis**

The quiz consisted of problems from the last two topics covered. Only problem number 6 was analyzed. This problem was exactly duplicated as problem 17 on the summative assessment. It was presented to the students after reviewing the homework and asking the students if they had questions. No time limit was given for the assessment. The class was quiet. The students were dispersed throughout the room. Students turned the quiz over when completed and all quizzes were collected at the same time.

The answers to the quiz were evaluated for correctness. Points were allotted for the $n^{th}$ term correctness and for the equation correctness. Problem number six was analyzed for commonality between errors. Totals were tallied for $n^{th}$ term correctness, identifying common difference and placing it in the correct part of the equation and determining the zero value and its placement in the equation. It was determined that the class could not construct an equation and needed assistance in determining values to use in the equation and the placement of said values in the equation.

**Specific Intervention**

Three days after the initial assessment the students were given an intervention to aid in there placement of numbers in the equation. It was a worksheet with blocks to be filled in for the starting value (first term) and subtracting the common difference to determine the last number in the equation (zero value).
Final Data Collection and Analysis

The summative assessment included all topics in the chapter. It was given twenty-eight days after the intervention. Problem 17 was exactly the same as the problem on the initial assessment. It was worth 2 points. One point was given for the correctness for identifying the $n^{th}$ term. One point was given for correctly constructing the equation. Totals were tallied for $n^{th}$ term correctness, identifying common difference and placing it in the correct part of the equation and determining the zero value and its placement in the equation.

Final Data Analysis

The totals were tallied for $n^{th}$ term correctness. The times the common difference was used were tallied. The common difference correctness in placement in the equation was also identified. Determining the zero value and its placement in the equation was also recorded. These amounts were recorded for both the initial assessment and the summative assessments. They were compared for improvement.

Summary

The research was designed to answer the question, “Can error analysis of problems on formative assessments, followed by a specific intervention increase scores on summative assessments?” The students were given two identical problems. One was given after the instruction on the topic of arithmetic sequences. The question was analyzed for common errors and an intervention was given. The other problem was given on the summative assessment. Totals were tallied for $n^{th}$ term correctness, identifying common difference and placing it in the correct part of the equation. Tallies were also made for determining the zero value and its placement in the equation. The tallies from the initial problem (the quiz) were then compared to the tallies from the final problem (the test) to see if improvements were made.
Chapter 4

Findings

Can error analysis of problems on formative assessments, followed by a specific intervention increase scores on summative assessments? To answer this question we need to review our findings. Sixteen students were involved in the study. Of the sixteen none of the students correctly wrote an equation. Four of the students predicted the $n^{th}$ term to the initial problem. We can compare this to the results of the problem on the chapter test. After the specific intervention was delivered, three students correctly constructed an equation and determined the $n^{th}$, five students correctly gave and answer without an equation, and eight students could not construct an equation or determine the $n^{th}$ number. In short, the number of students whom correctly identified the $n^{th}$ term increased by 4. This means that there was a 25% increase in generating the $n^{th}$ term after the intervention.

**Initial Problem**

On the initial problem, 4 students determined the correct answer. One had shown his work of continuing the sequence. The student listed the numbers to count down to the final answer. Two gave the correct $n^{th}$ term, but did not show any work or attempt to write an equation. One student attempted an equation but did not get the equation correct, but still listed the correct $n^{th}$ term. Of the twelve who did not determine the correct $n^{th}$ term nor construct a correct equation, one left the problem blank and one unsuccessfully tried to continue the sequence to the $n^{th}$ term. The remainder attempted an equation but could not correctly determine what the equation should be.

To analyze those who tried to construct the equation it must be understood that a standard equation should be $a \, n + b$. In this $a$ represents the common difference and $b$ represents the zero
term value. In this problem $a$ should have been -7.5. Of the eleven, three correctly determined the $a$ value. Five got the $a$ value incorrect because they listed it as a positive instead of a negative. The remaining three had pulled numbers from the sequencers and one of which did not use the correct equation format. None of the students who attempted the equation determined the correct $b$ value.

The problem was worth 2 points, one point for the $n^{\text{th}}$ term and one point for the equation. The initial problem gained 4 points for the entire class for the correct $n^{\text{th}}$ term. No points could be awarded for a correct equation due to the incorrectness of the equation by the entire class.

**Final Problem**

On the final problem two individuals did not show any work. One determined the $n^{\text{th}}$ term correctly, one did not. Five listed numbers continuing the sequence to the indicated term. Four of these students determined the correct $n^{\text{th}}$ term, one did not. One student constructed an equation that did not contain the correct $a$ or $b$. Four students confused the sign and listed $a$ as positive instead of negative but did get the correct $b$ term. One student listed the $a$ term correctly but got the $b$ term incorrect. Three students got the equation entirely correct and the $n^{\text{th}}$ term correct.

The points awarded for the final problem were awarded on the same basis of the initial problem. This award system allowed one point for a correct equation and one point for a correct $n^{\text{th}}$ term. For the entire class, 8 points were awarded for a correct $n^{\text{th}}$ term and 3 points were awarded for a correct equation for a total of 11 points.

**Comparison**

Before the intervention zero students got the entire problem correct. After the intervention 3 students got the intervention correct. Before the intervention 6 students got at
least one portion of the problem correct. After the intervention 12 of the students got all or a portion of the problem correct (See Table 1). The points awarded for this problem increased from 4 on the initial assessment to 11 on the summative assessment.
Table 1 Results

<table>
<thead>
<tr>
<th></th>
<th>Initial Problem</th>
<th>Indicated Term Correctly Identified</th>
<th>Final Problem</th>
<th>Indicated Term Correctly Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left problem blank</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Showed no work</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Continued Sequence</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Equation written neither a nor b correct</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Equation listed a incorrectly (was common difference but listed as a positive number) and listed b correctly</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Equation listed a incorrectly (was common difference but listed as a positive number) and listed b incorrectly</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Equation listed a correctly and listed b incorrectly</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Equation listed a correctly and listed b correctly</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
Chapter 5

Conclusion and Implications for Practice

Interpretation of Results

My research question was: Can completing error analysis followed by a specific intervention based on the analysis results improve summative test scores? My findings in brief: error analysis did improve summative test scores. Given the same problem there was a 175% increase in points awarded. Since the studies show that unless a specific intervention is given that incorrect processes would continue to be followed in order to solve a problem resulting in an incorrect answer, I feel that the intervention was a success in changing the misunderstandings on the topic.

Even with the improvement of understanding, several errors were still made. I believe this can be attributed to the length of time from the intervention to the summative assessment. Also the class that was analyzed was an underachieving class. Complete mastery of a topic by all students is rare. This was compounded by the inclement weather. I feel that some did not concentrate on homework thinking they would not be at school the next day. Inclement weather shortened instruction time and lengthened the total number of days to complete the chapter. This larger gap of time between instruction of this topic and summative assessment of this topic could have adversely affected the final responses. The class went from 25% able to predict a n\textsuperscript{th} term of a sequence to 50% being able to predict the n\textsuperscript{th} term of a sequence. This is an improvement.

Generalizations

It can therefore be generalized that by analyzing common misconceptions and introducing a specified intervention that understanding and scores can be improved. This is demonstrated in the findings. Initially six students demonstrated partial knowledge. Three
students listed a correctly and three other students determined the correct $n^{th}$ term. On the summative assessment 12 of the students demonstrated accurate knowledge. Three of which got all the portions of the problem correct. Four listed $b$ correct and $a$ incorrect as a positive number and not negative. This in turn gave them an incorrect $n^{th}$ term. This misconception of a decreasing sequence was not specifically targeted during the intervention. The students did place the correct value in the correct space of the equation demonstrating the intervention was a success but further analysis and instruction would be needed for complete student mastery.

Coker (1991) suggests that students follow their own logic when solving problems. This implies that one assessment and analysis may not be enough for each topic. Analysis must be continued until students can demonstrate mastery of a topic. By analyzing the students’ errors, it can increase performance (Coker, 1991).

**Limitations**

This study has several limitations, scope, weather, and practicality. One of the limitations of this study is in the scope. One topic and one analysis show improvement, but further analysis on other topics would validate the research question. Also the amount of inclement weather may have skewed the results against the study. The break in instruction and practice on the topic in conjunction with the period between initial instruction and summative test was extended greatly. This could have also had an adverse effect on the results. Finally, this research did not address practicality. Time spent in analysis was not recorded. Improvement of a non-intervention topic was not recorded. This would have allowed the comparison of initial and final results with respect to amount of time allotted by the instructor. So time of year, additional scope, and comparisons to non-analyzed error would be good extension research on the topic of error analysis.
Implications

Having the results and knowing the limitations I advocate the implementation of error analysis to improve scores. Error analysis has been studied in teaching division (Lewis, 2010) and in subtraction (Fiori, 2005) and now in arithmetic sequencing. This implies it would be beneficial for other mathematical topics as well. Not only should it be used on other mathematical content, it should be implemented early in the teaching process of each topic. By applying error analysis early in a new topic any misunderstandings and misconceptions can be identified. These can be addressed to improve error rate on future student assessments of the same type of problem (Borasi, 1987).
References


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Appendices

Appendix A: Quiz and Test Question

Write an equation that describes each sequence. Then find the indicated term.

120, 112.5, 105, 97.5, ...; 11th term
Appendix B: Intervention Worksheet

Write equation and find $20^{th}$ term.

1) $5, 8, 11, 14, \ldots$

Starts with \[ \square \]
Common difference $\square$ (subtract)
Number you add in equation $\square$

$+ = \square \cdot n + \square$

$20^{th}$ term $= \square$

2) $5.5, 4.0, 2.5, 1.0, \ldots$

Starts with \[ \square \]
Common difference $\square$
Number you add in equation $\square$

$+ = \square \cdot n + \square$

$20^{th}$ term $= \square$
Write equation for Find the indicated term

3) 10, 11, 12, 13, ... Find 50th term

4) 3, 6, 9, 12, ... Find 11th term
Appendix C: Plagiarism Check

Abstract The purpose of this study was to determine if using error analysis could improve scores. To test this theory, a problem of a quiz was analyzed for common errors. This information was used to implement a specific intervention. Finally, an end of chapter test containing the same problem was analyzed to determine if comprehension improved. Research indicates that there is evidence that error analysis is a worthwhile endeavor and can improve student scores. The study included underachieving eighth grade pre-algebra students over a six-week period. Data were gathered from a quiz and a chapter test. A problem from the quiz was analyzed for frequency and reason of error. An intervention was implemented and the same problem on the chapter test... (only first 800 characters shown)

Analysis complete. Our feedback is listed below in printable form. Some of the items have been truncated or removed to provide better print compatibility.

**Plagiarism Detection**

**Original Work**

Originality: 95%

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A low originality percentage is indicative of plagiarized papers. Sometimes the score is lower due to long quotations within a document, so please make sure that you use proper citations if this is the case. For more information on our originality scoring process, click here.
regarding student error in the 1920's (Radatz, 1979). By using error analysis, educators can determine where in the process the student got off track (Coker, 1991). However, it is a difficult and time-consuming task (Coker, 1991). Time is a precious commodity for educators who must cover content before high-stakes tests are given in the spring. The question “Is the time and effort associated with error analysis worthwhile to today’s educator?” must be answered. The advocates of error analysis argue that misunderstandings and misconceptions must be identified in order to improve student comprehension. Error analysis is a means to determine whether misunderstandings and misconceptions are. Only by offering intervention that... (only first three lines shown)

Analysis complete. Our feedback is listed below in printable form. Some of the feedback may have been truncated or removed to provide better print compatibility.

Plagiarism Detection

Original Work
Originality: 100%

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first term properly is essential to solving an arithmetic sequence. If the students use an
term they will not be able to successfully answer the problem. The other issue that was
the understanding of subscripts (Building arithmetic and geometric functions, n.d.). This
introduces subscripts to the students. If the students do not understand the formula or
part of the formal represents, they will not know how to utilize the formula in order to
solve the problems. Conclusion The research indicates that there is evidence that error analysis
is a worthwhile endeavor and can improve student scores. It is a time tested procedure that
determine common misconceptions and mistakes that directly (only first 800 chars sh

Analysis complete. Our feedback is listed below in printable form. Some of the text
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**Plagiarism Detection**

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On the initial problem, 4 students determined the correct answer. One had shown his work of continuing the sequence. The student listed the numbers to count down to the final answer. To the correct nth term, but did not show any work or attempt to write an equation. One student attempted an equation but did not get the equation correct, but still listed the correct nth term. The twelve who did not determine the correct nth term nor construct a correct equation, one left the problem blank and one unsuccessfully tried to continue the sequence to the nth term. The remainder attempted an equation but could not correctly determine what the equation should be. To answer those who tried to construct the equation it must be understood that a... (only first 800 chars seen)

**Analysis complete.** Our feedback is listed below in printable form. Some of the items have been truncated or removed to provide better print compatibility.

### Plagiarism Detection

**Original Work**

Originality: 100%

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### Spelling

Spelling Suggestions
Appendix D: IRB Approval

Ohio University
Office of the Vice President for Research

14E010

A determination has been made that the following research study is exempt from IRB review because it involves:

Category 1: research conducted in established or commonly accepted educational settings, involving normal educational practices

Project Title: Can Error Analysis on an Arithmetic Sequencing Quiz Determine Common Misconceptions Which can be Addressed to Improve Scores on the Chapter Test?

Primary Investigator: Vanessa Lynn Sowards

Co-Investigator(s):

Advisor: Ralph Martin

Department: Education

Rebecca Cale, AAB, CIP
Office of Research Compliance

Date 1/15/14

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved (as an amendment) prior to implementation.