

THE EFFECTS OF TEACHING PERSEVERANCE ON STUDENT INDEPENDENCE
IN MATHEMATICAL PROBLEM SOLVING

by

Jerald J. Brunt

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While one name is placed on the title page of this work, it could never have been completed without the help of a remarkable group of individuals. To my parents, Jim and Beverly, my wonderful wife, Jill, and our beautiful daughters Stephanie, Shaeli, Kaitlyn, and Kami, thank you for your steadfast support and patience. To my support team of Erika, Nikki and LeeAnn, thank you for helping to inspire, guide and develop this project. To my advisors Walt, Dave and Megan, thank you for your guidance, knowledge, and kindness. Every time I felt lost you led me back to the path. Finally, to the rest of the MSU staff and my classmates, thank you for making this one of the most enjoyable and rewarding experiences of my life.

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ABSTRACT

Perseverance is an attribute often required for student success but is seldom taught. This research investigated the effects of teaching and practicing perseverance to a combined class of second and third grade students. Data collected from surveys, teacher observations, journal entries and class discussions were analyzed to see if students' ability to work independently and appreciation of their individual ability to persevere could be increased through participation in lessons requiring them to work through difficult academic challenges. Student time-on-task, comments and questions were recorded during these lessons and other classroom assessments. Student journal sheets were also completed for each lesson, and a teacher journal was kept for the entirety of the investigation. This class proved to work independently as a whole; however, results did not show any improvement in student time-on-task over the treatment period, suggesting that student ability to persevere was not significantly affected. Survey results, journal entries, and class discussions showed an increase in students' understanding and appreciation of their ability to persevere. As a result of this treatment, students also appeared to become more comfortable and confident when presented with difficult academic challenges. It is the conclusion of this study that while directly teaching and practicing perseverance may not improve students' ability to work independently through challenging tasks, it can be a valuable tool in heightening students' understanding of their abilities and boosting confidence. Therefore, based on my research, teaching and practicing perseverance should be continued as a regular classroom activity.

INTRODUCTION AND BACKGROUND

One of my biggest pet peeves in teaching is when I give students a question to work on and immediately hear, “*I don’t get it!*” For years I’ve been telling students to reread the question, think about it and then tell me exactly what it is they *don’t get*. That guidance never seemed to produce any significant change in their behavior. Then, during lunch one day, our principal commented that she’d read that the willingness to persevere was the best predictor of student success in math. I realized that many of my students had gotten into the habit of quitting at the first sign of trouble. They had never learned how to work through difficulties. I also realized that I spent a great deal of teaching time walking students through problems they should have been able to solve on their own. This classroom research project endeavored to address these problems by teaching students to effectively persevere through academic struggles and was designed to answer the following questions:

- How does teaching and practicing perseverance affect elementary students’ ability to work independently over extended periods of time?
- How does teaching and practicing perseverance affect elementary students’ appreciation of their ability to persevere over extended periods of time?
- What are the effects of teaching and practicing perseverance on me as a teacher?

Teaching students to persevere could have immediate and long-term effects in and out of the classroom. Students who can continue working productively through difficult problems should develop a deeper understanding of and confidence in their own problem-solving abilities.

Students who are able to take ownership of their own learning early on should take this skill into future classrooms, allowing their teachers to guide them to even higher levels of understanding and achievement. The most important implications of this project might be seen outside the classroom. Students who learned to succeed through perseverance in school may carry the value of hard work into other facets of their lives. Knowing that they can work through problems to attain their goals could become an important lifelong value.

I am very lucky to have three of the most skilled and dedicated educators I've had the pleasure to work with supporting me through this process. They are LeeAnn Burke, Nikki Vradenburg, and Erika Christianson.

LeeAnn Burke has been the principal/superintendent of LaMotte School since 2005. Prior to working at LaMotte, she was the principal at Monforton School and a teacher at Sacajawea Middle School. LeeAnn has also taught classes in the Education Department at Montana State University. I selected LeeAnn because she has always been a wonderful source of professional and personal advice and feedback. Her experiences as both a teacher and administrator enabled her to see things from a variety of perspectives. In addition, LeeAnn is an excellent proofreader with a great deal of experience in writing and assessing professional and academic papers.

Nikki Vradenburg has been the kindergarten/1st grade teacher at LaMotte School since 2004. Prior to that, she taught for three years in Lake Havasu, Arizona. In addition to her teaching credentials, Nikki holds a Master's Degree in Educational Leadership and is a National Board Certified Teacher. She has a strong background and interest in gifted

education and education technology and is a licensed instructor and presenter for the Montana Region 4 Educational Services Agency (RESA4U) and a member of the board of the Montana Association of Gifted and Talented Education (AGATE). I have known Nikki since we attended undergraduate courses together at Montana State University. She has always been a trusted and valuable sounding board, advisor, and friend. Her expertise in gifted education and education technology helped provide a valuable set of tools to aid in the treatment portion of my research.

Erika Christianson is a former middle school Math and Science teacher at LaMotte School. She is currently working as a Learning Specialist at the University of Arizona. Erika is also a graduate of the MSSE program. Her experience and interests in science, education and statistical analysis made her a great resource. Erika's knowledge of the MSSE program was also a great help as I worked through it myself.

CONCEPTUAL FRAMEWORK

After hearing that perseverance was a major factor in student success in math, I tried to find the source of that statement. I failed. I talked to colleagues about the subject and was pointed to Malcolm Gladwell's book, *Outliers* (Gladwell, 2008). I was particularly taken by Gladwell's idea that it takes 10,000 hours of practice to achieve true mastery of what many mistakenly credit as a *God-given* talent. Gladwell cited examples ranging from computer experts such as Bill Gates and Bill Joy to musicians including Mozart and The Beatles. His premise was that these people weren't able to succeed at such a high level because of some talent they were born with, but because of their

opportunities for meaningful practice and willingness to persevere for at least 10,000 hours (Gladwell, 2008).

As with many Americans, I had often been told that *practice makes perfect* and heard the joke, *How do you get to Carnegie Hall? Practice, practice, practice!* Then again, I had also grown up hearing about *overnight success stories*, *get-rich quick schemes*, and *natural-born talents*. I started to think about the culture of perseverance and how it affects our students.

Research has shown that attitudes towards perseverance in school do indeed differ across cultural boundaries. Studies have been conducted comparing attitudes toward academic success and failure in American, Chinese and Japanese schools, (Department of Education and Early Childhood Development, 2009) and the findings are eye-opening. In American schools, we often attribute successes and failures to whether or not we are *smart* in something. This implies that we are born with or without some innate ability and that genetic circumstance predetermines our level of achievement. This view is not, however, universal. In China and Japan, academic success is attributed to hard work, and failures are considered indicators of what the student still needs to learn by working harder (Department of Education and Early Childhood Development, 2009).

This alternative model puts everyone on an equal playing field. It teaches students that they have the same opportunity for success as everyone else, and their mistakes are signs that more work is needed, not declarations of failure or inability. This perspective also gives credit for success to the work of the individual students and not to some innate quality they were lucky enough to be born with. This type of thinking is

analogous to the *growth mindset* discussed in Carol Dweck's, *Mindset, the New Psychology of Success* (2006). Dweck describes a *growth mindset* as one in which an individual believes that the qualities and abilities one is born with are only a starting point and can be developed through work and experience. This contrasts with what she calls a *fixed mindset* in which an individual believes these same assets are set at birth and remain constant throughout life. She writes that people with a growth mindset see failure only as an indication that more work is needed and value effort as a tool for success, while those with a fixed mindset struggle with failure and view effort as a negative, believing that having to work hard devalues their innate abilities. In her book, Dweck describes her work with the mindsets of early adolescents. In her study, she praised one group of students for their effort and another for ability. Over the course of the research, she found that those praised for effort began to display growth mindsets, no longer saw setbacks as failure, embraced challenges and improved their performance. Those praised for their ability, however, began to show signs of fixed mindsets, fearing failure, avoiding risks and eventually even began doubting their competence (Dweck, 2006).

The changes shown by the second group mirrored what Ian Byrd referred to in his keynote address to the 2015 Montana Association of Gifted and Talented Education Conference as the *Imposter Syndrome* (Byrd, I., *So Much More Than Smart Kids*, April 10, 2015). According to Byrd, many gifted students who experience early academic success begin to equate being smart with things being easy. When these students are challenged, they often worry that they are no longer smart and fear that others will find out. In order to avoid this, they see academic challenges as risks to be avoided and revert

only to areas where they can succeed with little effort. For these students, the perceptions built by early success may cause serious problems in the future. I hoped that the work in my classroom would help my students avoid these pitfalls and develop a more constructive growth mindset.

Early on in my research, I found an abstract from a classroom research project conducted by Ingrid Stallsmith, a teacher in New Hampshire. The abstract caught my attention because it dealt with teaching perseverance to third grade math students. Prior to reading her study, my treatment was only going to focus on student practice with perseverance through challenging problems and tasks. This type of practice was not a major factor in Stallsmith's work (Stallsmith, 2012).

Stallsmith's treatment focused on sharing biographies and children's literature as examples of individuals who succeeded by perseverance, and presentation of posters with slogans and pictures promoting hard work and continued effort. Data from student surveys and tests relating to their understanding of perseverance and its use during problem solving was collected and analyzed. Results of this analysis showed that student understanding of perseverance had improved, but actual willingness of students to persevere was not seen (Stallsmith, 2012). Upon my initial reading of Stallsmith's work, I was disappointed that it didn't mirror my ideas more closely, but after further reflection I realized that it did provide a strong support for the first stage of my research: teaching students to understand perseverance and its value in their lives. To extend her work, I had to provide direct instruction pertaining to perseverance and opportunities for students to practice.

My next goal was to find a way for the kids to practice perseverance. In 2012, Margaret Taplin of the Institute of Sathya Sai Education, Hong Kong wrote an article that focused on using mathematical problem solving to teach personal values. In it, Taplin writes that teaching students to effectively problem solve in math will help them learn to think independently and succeed throughout their lives. She also provides a 7-step model for problem solving and reflection (Taplin, 2012). Taplin's work helped me see that if I was going to teach students to persevere, I was going to have to give them the tools to do so. Therefore, a major component of my treatment would have to include teaching problem-solving models and strategies which allow students a means of practicing persevering.

After completing my classroom research, I found a professional paper published in April 2015 by Hyman Bass and Deborah Loewenberg Ball of The University of Michigan detailing their experience in teaching perseverance (Bass & Ball, 2015). Bass and Ball tried to promote perseverance in the mathematical work of approximately 30 fifth grade students over the course of a two week summer program provided for students who had previously struggled in math. Perseverance was practiced in two distinct ways. The first was through nightly homework which included a concept students had not yet covered in class. Much like our Practice Not Quitting! (*PNQ!*) lessons, the primary goal for these problems was to persevere, not to get the right answer. Perseverance was also practiced through an on-going group activity conducted over the two week program. Students were given a scenario in which they owned a company that built trains. A customer gave them a specific set of mathematically-based conditions he wanted his train

to meet and the students were hired to build it. The students worked together to design the train, not knowing that the task was impossible. This was done so students would not only learn to persevere but would also learn to recognize when perseverance was no longer productive. Unlike my research which required students to work with little or no help, the teachers in this study provided scaffolding for background lessons, prompting and direction to students as they progressed through the problem. This support was given to provide necessary skills and to keep students moving forward when they might otherwise have gotten discouraged and stopped. Bass and Ball concluded that students were able to learn to effectively persevere through a collective task when provided with specific and appropriate instructional support (Bass & Ball, 2015).

My final task was to find a way to measure perseverance. In 2007, a group of researchers studied students at an Ivy League school, The United States Military Academy at West Point, and competitors in the National Spelling Bee. These researchers were looking for a way to measure what Dr. Angela Duckworth had termed *grit*, a combination of perseverance and passion toward long-term goals, and to understand its usefulness when trying to predict future success (Duckworth, 2007). The researchers conducting the study developed a survey which participants completed on their own called the Grit Scale. The survey consists of statements pertaining to the subject's self-perceived attitudes of his/her ability to persist toward a goal despite difficulties that might be encountered. Points were then given to each survey based on the replies given. The results of the studies showed that the Grit Scale provided a better predictor of future success than other factors such as IQ, SAT scores, and GPA (Duckworth, 2007). The

Duckworth Lab later developed a version of their scale for children called the *8-Item Grit Scale for Children* (Duckworth and Quinn, 2009). I used this instrument for pre and post-treatment surveys to measure student grit and possible changes in attitudes toward perseverance over the course of my research. I also used it to provide students with some insight into perseverance in their own lives.

I approached this treatment design with three questions in mind: *How can I help students understand the value of perseverance?* *How can I teach perseverance?* and *How can I assess perseverance?* I believe that the sources I gathered provided me with a strong foundation for building a valid and workable treatment.

METHODOLOGY

Treatment

Student understanding of perseverance and appreciation of its value in their lives was imperative to the success of this project. To meet this goal, students took part in periodic classroom discussions defining perseverance and relating examples of it. As a class, we created a poster showing what perseverance should look like, sound like, and feel like. Other posters and quotations promoting perseverance were discussed and posted around the room. Perseverance was also the theme of our daily read aloud time. During this time, students were introduced to individuals who thrived despite obstacles that stood in their way. These characters and examples of their perseverance were informally discussed as they came up. Historical figures include Christopher Columbus, George Washington, Harriet Tubman and Thomas Edison. Fictional characters came from *The Trumpet of the Swan* (White, 1970), *The Miraculous Journey of Edward Tulane*

(DiCamillo, 2006), and *Far North* (Hobbs, 1997). While the treatment period for this research lasted from October through February, this activity continued for the rest of the school year.

Students who understand and see the value of perseverance can't apply that understanding if they didn't have the proper problem-solving tools. Therefore, the second element of the treatment was aimed at providing these tools. In one of our class mantras, I ask the students, "What's the right way to solve this problem?" They reply, "Any way that works!" I continued to stress this attitude because it encourages independent and creative thinking. Students were taught a variety of problem-solving models and strategies that included: various math algorithms; drawing pictures; talking through problems; brainstorming; rereading for clarity; and using graphic organizers. Students were given opportunities to explain the processes they went through to solve particular problems. These explanations were written and turned in, shared orally or recorded on iPads. The majority of this learning was done through math problem-solving lessons, but it was also referenced when solving problems in other curricular areas.

Students then needed opportunities to apply their problem-solving skills and practice perseverance. This was done through lessons we called *Practice Not Quitting!* (PNQ!). These lessons took about 30 minutes and were completed every one to two weeks. During this time, students were given challenging problems to complete, usually with very little or no help. These problems included: math equations or word problems; logical thinking exercises; and puzzles. This part of the treatment was important because

it gave students a chance to learn that mistakes and struggle are natural parts of life for everyone, and that both can be overcome by hard work and persistence.

Instrumentation

Data was collected throughout the treatment period and was both qualitative and quantitative in nature. Each source, as shown in the matrix below (Table 1), addressed my primary research question pertaining to the effects of my treatment on student ability to work independently.

The first set of data was collected at the beginning of the school year to set a baseline for later data collection, and was collected using the *8-Item Grit Scale for Children* developed by Angela Duckworth (Duckworth, 2009) (Appendix A). This scale was built to measure one's *grit*, or ability to persevere over long periods of time. Students selected choices on a continuum stating how strongly they agreed with a series of statements related to how they respond when confronted with challenging situations. I guided my students through each question of this tool prior to beginning the treatment and again at the end to determine any changes in their attitudes or perceived abilities to persevere. After taking the end of treatment survey, students were asked to write whether or not they felt their ability to persevere changed over the treatment period and why they felt that way.

Formal classroom observations provided another source of data. These observations were made every time we engaged in PNQ! lessons. When possible, the lessons and assessments were recorded or manually tracked to determine student attention, or time-on-task. Attention checks were made every three to five minutes.

Students were marked as either on task, off task, in line, out of the room, or finished (Appendix B). Relevant student activity, comments and questions were also recorded. I also used the recordings to gain an understanding of how my interactions with students might influence their willingness to persevere. As part of each *PNQ!* lesson, students made short journal entries to record their perceptions concerning the difficulty of the lesson and how well they persevered, along with comments on why they felt that way (Appendix C). They were also asked to describe problem-solving strategies they used.

Student attention and questions were also charted during other assessments.

Students knew the goal of *PNQ!* was to continue to work through problems with little or no help, thus they might have become accustomed to working independently through those lessons but not others. By recording data during other assessments, I hoped to see if the ability to work independently carried over into other work. The observations, student journals and surveys were the principal instruments used to address my primary research question and first sub question:

- *How does teaching and practicing perseverance affect elementary students' ability to work independently over extended periods of time?*
- *How does teaching and practicing perseverance affect elementary students' appreciation of their ability to persevere over extended periods of time?*

Another source of data I gathered was a journal which I used to reflect on all aspects of my research. Information collected from this source was used to help evaluate my research and make changes before, during and after the treatment period. It was also the primary instrument used to address my third research question:

- *What are the effects of teaching and practicing perseverance on me as a teacher?*

Table 1
Data Collection Matrix

Research Questions	8-Item Grit Scale	<i>Practice Not Quitting!</i> Observations	Other Assessment Observations	<i>Practice Not Quitting!</i> Student Journals	Teacher Journal
How does teaching and practicing perseverance affect elementary students' ability to work independently over extended periods of time?		x	x	x	x
How does teaching and practicing perseverance affect elementary students' appreciation of their ability to persevere over extended periods of time?	x	x		x	x
What are the effects of teaching and practicing perseverance on me as a teacher?	x	x	x	x	x

I didn't find research that mirrored mine directly and therefore had no ready-made template in regards to the instruments I could use to answer my questions. I felt the 8-Item Grit Scale for Children was by far the most respected and proven published instrument available, and the fact that it was developed for children left me confident that its results would be both reliable and valid. I designed the other instruments myself, making several changes over the course of the project. While these instruments were not published or tested, I felt they fit my project and class and the combination of multiple instruments directed at each question helped insure reliability and validity.

Demographics

LaMotte School is a rural, public k-8 school located east of Bozeman, Montana. At the time of this research there were 71 enrolled students with less than 5% Asian and less than 5% Native American populations. The school is not part of the Federal Free and Reduced Lunch Program. According to the most recent data from the 2010 census, the school population reported a 13% poverty rate.

Study Participants

The class used for this project was a combined second/third grade class. There were 15 students in the class with seven second graders and eight third graders. At the onset of this project, there were 16 students. One student moved before the completion of the treatment. Her data was removed from the research. The second grade group consisted of three boys and four girls. One second grader was gone for the entire month of November, missing a great deal of the treatment period. Another second grader missed large portions of the treatment period due to illness. The third grade group consisted of four boys and four girls. One third grader had an Individualized Education Program (IEP) requiring assistance due to multiple learning disabilities. Some work was read aloud to this student, but no other accommodations were made. Another student was accelerated into third grade before the completion of this project. He was always considered a third grader for the purposes of this research.

IRB Statement

The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix D).

DATA AND ANALYSIS

Survey

The first set of data collected was the pre-treatment segment of the *8-Item Grit Scale for Children* (Duckworth, 2009). I chose this tool because I felt it was the best instrument available for my research; however, I didn't employ this tool in quite the way it was designed to be used. The survey is meant to be given only once to measure individual grit, but my students took this survey prior to beginning the treatment and again at the end to see if there were any changes in my students' attitudes or perceived abilities to persevere. This instrument was primarily directed towards my second AR question: *How does teaching and practicing perseverance affect elementary students' appreciation of their ability to persevere over extended periods of time?*

The survey consisted of eight statements eliciting responses showing the respondents' ability to persevere. For each statement, the respondent selected an answer from a menu consisting of the following responses:

- *Very much like me*
- *Mostly like me*
- *Somewhat like me*
- *Not much like me*

- *Not like me at all*

In some survey items, a response of *Very much like me* would indicate a high level of grit while in others it would indicate a low level.

The pre and post-treatment surveys were given to all 15 students, and they completed the surveys together in class on September 30, 2014, and February 26, 2015, respectively. Even though this version of the scale was designed for children, I suspected that the reading was too complex for most of the students. Therefore, I chose to go through each question with the class, one at a time, and had them complete it together. The statements were displayed on the board, read aloud and explained while students followed along on their own copies. I was worried this might bias the survey but knew most of my students wouldn't be able to complete the survey accurately without this extra help. Knowing this, I tried to be impartial while presenting the survey, repeatedly stressed that there were no right or wrong answers and focused on the importance of being as honest as possible.

When compiling data from this survey, I grouped responses into three categories: *high; neutral; and low*. Survey responses of *Somewhat like me* were considered neutral. Responses of *Very much like me/Mostly like me* and *Not like me at all/Not much like me* were grouped together as *high* or *low* depending on the nature of the survey item.

Each student also received an overall grit score for each survey. Each response received a score from 1 thru 5 with 1 corresponding to the lowest amount of grit and 5 corresponding to the highest. The scores for each question were then totaled and that total

was averaged, resulting in a total grit score between 1 and 5 with a score above 3.0 representing a high level of grit and a score below 2.0 representing a low level of grit.

Pre-treatment Results

Figure 1 presents data for both the pre and post-treatment surveys. The first column for each survey statement represents pre-treatment responses. The second column represents post-treatment data. The numbers on each section represents the number of responses for each category. The pre-treatment data showed that most students considered themselves to have a fairly high level of grit, or willingness and ability to persevere before the treatment had begun. For almost every survey item, the majority of students reported a high level of grit, the next largest group was neutral and the smallest group considered themselves to have a low level of grit.

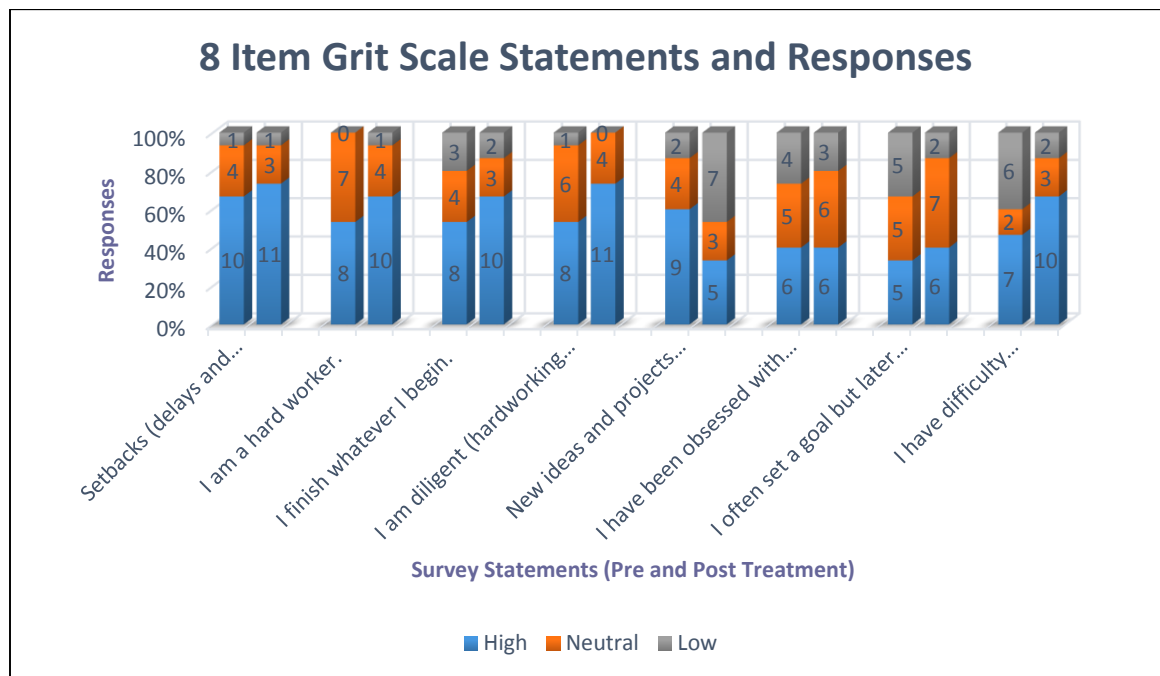


Figure 1. 8-Item grit scale statements and responses, (N=15).

When analyzing individual statements, I noticed that the items *I am a hard worker* and *I am diligent (hardworking and careful)* yielded almost identical results. In both cases, almost the same number of students responded with high and neutral responses. No students responded with a low response to being a hard worker, while one did when considering diligence. These items were probably the easiest for students understand and relate to, needing the least amount of explanation.

Three of the items pertaining to maintaining focus over extended periods of time yielded the greatest number of low responses. One of those items referenced being obsessed with a project or idea while another one asked students to consider projects taking more than a few months. While introducing these items, most students couldn't remember ever being obsessed with a project or idea or having a project that lasted for months. We took some time to talk about these items in more general terms which they could relate to. The extended discussion of these items may have led to more thoughtful responses, resulting in a greater number of low responses.

Figure 2 shows individual student grit scores. The first column for each survey statement represents pre-treatment responses. The second column represents post-treatment data. The standard deviation for the pre- and post-survey data is shown on each column as one standard deviation above or below the class mean, which for the pre-treatment grit score was 3.49 with a standard deviation of 0.83. Student ER, for example, had an initial grit score of 4.88. This was well above the 4.32 score calculated as one standard deviation above the mean. Overall, pre-treatment data showed that ten students

scored above 3.0 while five scored between 2.0 and 3.0. No student received a score below 2.0 in the low grit range.

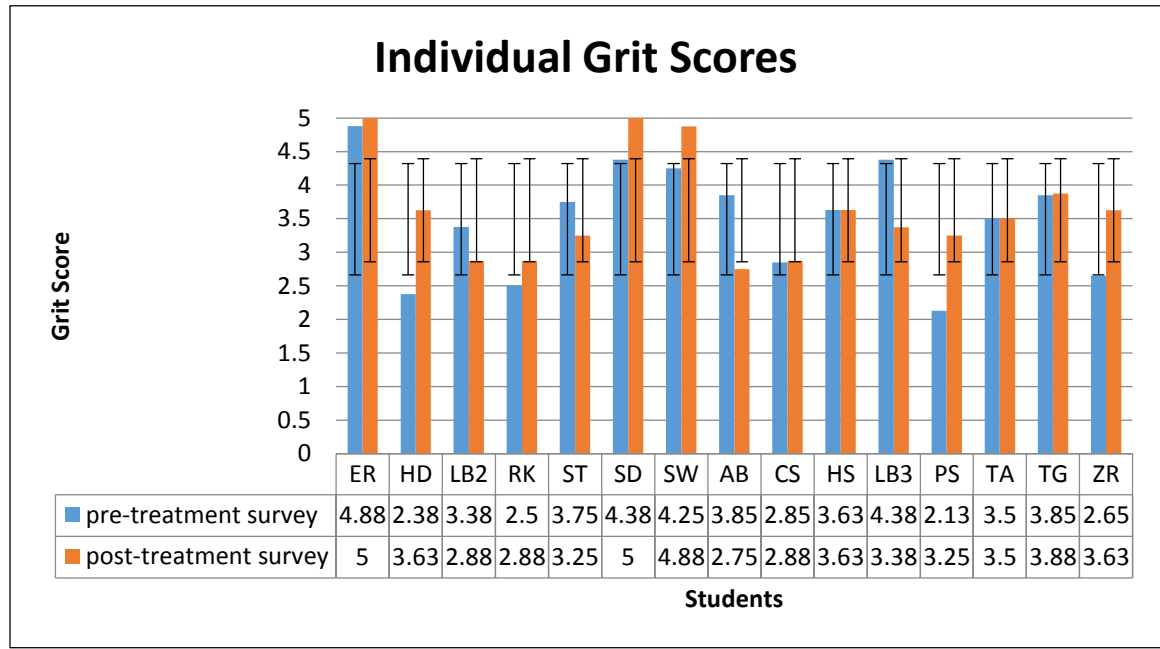


Figure 2. Individual grit scores, (N=15).

When considering individual grit scores, students with a truly high level of grit would not necessarily be the most advanced students, but would show a great deal of tenacity in their approach to any project or assignment they were presented with. They would not be dissuaded by difficulties that might arise and would stick to their task for as long as it took. Similarly, students with low levels of grit may or may not be academically advanced. However, these students would be stymied by any difficulties that presented themselves. They would be easily distracted and quick to complain or quit. As I looked at the individual grit scores, I tried to reconcile them with my experiences with the particular student.

Four students received scores at or above one standard deviation above the mean class value. From the work I'd seen in class, two of those students seemed to have inflated perceptions of their ability to persevere. While both of them are bright, capable students who do very well in regular curriculum work and assessments and turn in work in a timely manner, neither is especially diligent or motivated. They both have a tendency to rush through assignments, making careless errors showing no apparent desire to produce their best work. While claiming to be very gritty, one of them is actually the mostly likely student in class to complain and give up when faced with a challenge.

Of the other students in the group with relatively high grit scores (Fig. 1), one is very determined, focused, and hardworking. She will continue working on a project during recesses or at home to make sure it is just the way she wants it. She does very well with the regular curriculum and assessments and always turns her work in on time. Her score was probably accurate. The fourth student in this range is not a particularly gifted or hardworking student, but she is a two-time cancer survivor who spent much of the past two years receiving treatments in an out-of-state hospital. She is quite bright but sometimes struggles with the regular curriculum and assessments because of missed content and practice time. When present, she does turn work in regularly. The strength and resilience this child has shown has been awe-inspiring, and I have no doubt that her high score is a true reflection of her personal grit.

Four students scored below one standard deviation below the class mean score. One of these students is academically proficient but easily distracted and sometimes exhibits a lack of academic stamina. A second student is very bright but has a number of

diagnosed learning disabilities. She sometimes displays strong problem-solving skills but seems to have very little confidence in academics. I do not believe her grit score is as much an accurate measure of her grit as it is of her low of self-confidence.

Two other students, RK and ZR, also scored below one standard deviation. I found this extremely interesting because these are the two students I would be most likely to consider *gifted*. One of them, however, often complains of being bored, reacts very emotionally when he makes errors and does not appear to be a risk taker, wanting to contribute in class only when he knows he is right. When challenged by a difficult problem, he is quick to stop working and complain of being bored. The second student, ZR, began the year as a second grader but was accelerated to third grade during the year. He joined our second grade class for math while in the first grade, so he was familiar with our *Practice Not Quitting* lessons. When challenged with difficult problems last year, he was very quick to give up. I think these two students rated themselves low on the grit scale because they have very little experience with academic struggles. Almost everything in the classroom has come easily to them. They have very little experience with perseverance because they've seldom been required to do it. Neither considers himself a particularly hard worker because they've seldom had to work hard.

Post-treatment Results

The post-treatment survey was given on February 26, 2015. The survey was identical to the pre-treatment survey and was given in the same way. When comparing pre and post-treatment data, the over-riding trend indicated a slight increase in high grit responses while neutral and low responses tended to decrease.

One item; *New ideas and projects sometimes distract me from previous ones*, went very much against the prevailing trend. For this item; high grit responses decreased from nine to five, neutral responses decreased from four to three, and low responses increased from two to seven. This statement addresses student ability to persevere over a period of time. In the pre-treatment survey, other items that addressed this quality tended to have fewer high grit responses. This change in response actually brought this item more in line with other items addressing students' abilities to sustain projects over a long period of time such as: *I have been obsessed with a certain idea or project for a short time but later lost interest* and *I often set a goal but later choose to pursue (follow) a different one*. Similarly, each of these statements had only six high grit responses. I believe this pattern of response is due to a combination of their limited attention spans and the fact that most of these students have little experience working towards long term goals.

Another item of interest was the one student, RK, who gave a low grit response to the item, *I am a hard worker*. This student had previously given a neutral response for the same item. He is the student mentioned after the pre-treatment survey who is academically gifted but reacts very emotionally when struggling. Over the course of the treatment, he has learned to work much more diligently and seldom reacts with negative emotion. I asked him why he now perceived himself not to be a hard worker. He responded that because he always worked hard at school, he tended to rest and not do any work on weekends. I followed up by asking if he worked hard on projects or ideas he did choose to pursue at home. He thoughtfully answered, "No, not really." I found it very

interesting and encouraging that he was starting to see perseverance in a more global context to include his life outside the classroom.

When looking at the pre and post-treatment grit scores for individual students, I found there was an average increase of 0.14 from 3.49 to 3.63 over the course of the treatment period with a standard deviation of 0.97. Eleven students scored above 3.0 and four scored between 2.0 and 3.0. Again, no one scored below 2.0. Six students showed a growth of more than 10%, four students showed a decrease of more than 10%, three students showed an increase of less than 10% and two students showed no change.

Five of seven second graders reported an increase in grit while two reported a decrease. The three 2nd graders who gave themselves a grit score above one standard deviation in the pre-treatment survey and continued to score above one standard deviation in the post-treatment survey. Two of them received perfect scores in the post-treatment survey. Both of these students, ER and SD are certainly capable learners, but a perfect score is most certainly an over-estimation of their grit level. The same is probably also true of SW, the other second grader who scored above one standard deviation. HD and RK also showed increases in grit level. They both scored below one standard deviation in the pre-treatment survey and the increase in their scores is compatible with the work I've seen. The two second graders whose scores dropped do struggle to stay on task, and their post-treatment scores are probably a closer reflection of their abilities.

Two third graders reported a significant increase, two reported a significant decrease, and four reported a negligible increase or no change at all. No third graders scored above one standard deviation in the post-treatment survey. LB3, who scored above

one standard deviation in the pre-treatment survey scored in the lower half of the range in the post-treatment survey. This was probably a much more accurate assessment of his ability to persevere. This change, as with most of the third grade scores, seemed to show a maturation in understanding of personal grit and possibly the ability to understand and respond more accurately to the survey items.

All four students who scored at or below one standard deviation in the pre-treatment survey increased their scores within range on the post-treatment survey. For three of these students, the post-survey scores seem accurate. The student who struggled with confidence when given the pre-treatment survey made great gains over the treatment period, and the self-confidence that came with that growth seemed to be reflected in her score. The fourth student, ZR, showed a marked increase in grit score over the course of the treatment. While this might be accurate on other types of work, I would consider his second score highly overrated when dealing with our actual *Practice Not Quitting* lessons where he seldom did any work at all and was often distracting himself and those around him.

Of the four students who recorded a lower grit score on the post-treatment survey, three of them were scored much more accurately than the pre-treatment survey implied. However, the fourth student in this category, AB, always displays a tremendous amount of grit yet her post-treatment score dropped well below one standard deviation. Her post-treatment responses showed a decrease in statements pertaining to long term goals or projects. When asked about this change, she responded that the first time she took the survey she was only thinking about school where she always works hard. In the post-

treatment survey, however, she thought about home and remembered an adult commenting that she never finished most of the things she started. Once again, I found this growth into a global perspective to be very encouraging since we had worked hard to relate the ability to persevere to accomplishments both inside and outside the classroom.

After giving the post-treatment survey, I asked students to write whether or not they felt their ability to persevere had improved, stayed the same, or gotten worse over the course of the treatment. I then had them bring their papers to me so I could clarify any questions concerning their responses. Five students felt their ability had not changed. Three of those students felt this was the case because they had always worked hard while two felt they only worked for part of the time just as they had at the beginning of the treatment.

Ten students felt their ability to persevere had improved over the treatment period. Three of those students felt their improvement was due to their overall academic growth. Their statements included; “better because I can read, have gotten better handwriting too,” and “I think I got better. Because when I come home and look at my paper I got a lot more things better.”

The other seven students in this group attributed their feelings of growth to better focus or concentration. Their comments included; “I remember giving up on it. I’ve started getting back to the problem and figuring it out,” “Better because in PNQ I have been doing better at staying on top of it,” “Better because before I only got about one sheet per day and now I get about four,” and “better, because I have concentrated harder.”

Two students included pictures. Both drew “before” pictures of themselves looking out the window and “after” pictures of themselves at work. One added, “*I never look out the window anymore.*”

One student responded by addressing work done with a specialist. This student practices writing and handwriting while several of his classmates meet in a reading group. He commented that he could now stay focused on his writing even when there was a story being read aloud nearby. He was the only student who made a direct correlation between growth in perseverance bringing about positive results in other subject areas.

When I first gave the pre-treatment survey, I was disappointed in the results because I didn’t agree with most of the pre-treatment student assessments. I thought they were much too high. Upon further reflection, I realized that this was indeed a valid tool because my goal wasn’t to see if the students had an accurate understanding of their ability to persevere. The goal was to learn how they perceived their ability and to see if the treatment could improve that perception along with their ability to persevere. It was never about what *I* thought their grit level was. It was about what *they* thought it was. These surveys gave me the data I needed.

Once I began to compile and analyze the data, I found trends that will help guide my future work. First, I learned that most of my students are very confident in their ability to persevere. Accurate or not, confidence is almost always a good place to start. None of these students receive letter or percentage grades in class, but when comparing their regular classroom work to their individual grit scores there didn’t seem to be any distinct correlation between self-perception and academic success. Students who excel in

general classwork scored at all levels on the grit scale. The same was true for students whose work is at or near grade level. Students who tend to struggle in class scored in both the low and mid-ranges of the grit scale, but none of them scored in the high grit range. I believe this comparison helps validate the survey results. Some students who do well academically have never had to work hard, while others have to work extremely hard to succeed. The same can be said about the effort given by students who are at grade level or below. I think this comparison could change for higher achieving students as they get older and deal with content that delves deeper than the introductory instruction often done in second and third grade. These students may be forced to work harder to maintain the same level of academic success.

Second, I found that after the treatment period, most students were actually able to give an appraisal of their ability to persevere that more closely reflected what I saw in class. While the average grit score remained high, the overall range of scores was much more balanced across the board. This led me to surmise that as students had more experience with perseverance, they were able to more accurately assess their own abilities.

Third, I saw that most of the students who had scored outside one standard deviation in the pre-treatment survey were able to bring their scores within range over the course of the treatment period. I see this as a significant sign of success. It's vital that students who struggle academically learn that they can succeed with sustained hard work. It is just as important that those students who seem to naturally excel at academics learn

that there is nothing wrong with struggling and gain the confidence, experience and skills to thrive when they are challenged.

Finally, I learned that some students were able to carry the idea of perseverance beyond our classroom. In post-treatment discussions, all but two students felt they had improved in their ability to persevere, and three students gave specific examples of how this growth helped in other areas. These examples ranged from X-Box playing to jigsaw puzzle completion to making friends. As with all learning, we hope that students will be able to apply these lessons to their lives outside the school setting.

Practice Not Quitting! Lessons

Attention Rates

One of the major sources of data for this research came from *Practice Not Quitting* (PNQ) lessons. The lessons were usually 20 to 45 minutes long and data was collected through student *journal sheets* and observations made during the lessons. These journals consisted of a page where students made reflections on: how difficult they thought the lesson was; how much of the time they thought they had worked; how they felt emotionally about the lesson; and why they felt that way. They were also asked to describe a problem-solving technique they'd used during the lesson. If time allowed, mid-lesson and end-of-lesson journal pages were completed.

Observations were made by myself during the lessons, but I was usually too busy checking student work to keep close track at the time. Fortunately, I was able to video record some of the lessons and make observations based on those recordings. I tried to record student attentiveness every 3 to 5 minutes. Students were recorded as either: on

task; off task; out of the classroom; in line to be checked; finished; or quit. This was a very imperfect system. Some students happened to be in line or out of the classroom during multiple checks, others had a knack for being on task most of the time but not when the designated time came to check, and others had a knack for being off task a majority of the time but appearing on task when the designated time came to check. It was also difficult to tell whether some were sitting and thinking about work or daydreaming.

I also tried to record comments students made about the lessons during or after the lessons when time allowed.

When compiling the data, I first looked at student attention rates from the recorded lessons as shown in Figures 3 and 4. Due to the amount of data per student, I divided these figures by grade. Three students were recorded as staying on task 100% of the time. Five students were recorded as staying on task at least 80% of the time over at least 75% of the recorded lessons. Seven students were recorded as on task at least 80% of the time on fewer than 75% of the recorded lessons. There did not seem to be any significant differences in results between grades, however, two of the second graders who scored in the lower range have missed a significant amount school, and three of the third graders in that range receive additional help with reading. Missed content and struggles with reading comprehension could have contributed to their difficulty staying on task. There didn't appear to be any correlations between individual grit scores and time-on-task. Students in high, mid, and low ranges on the grit scale were found in all levels of attention rates.

The standard deviation is centered on the class average for each assessment and is shown on both figures. Eight students never fell below one standard deviation. Five students fell below it on one of the lessons, and two students fell below it on two or more lessons.

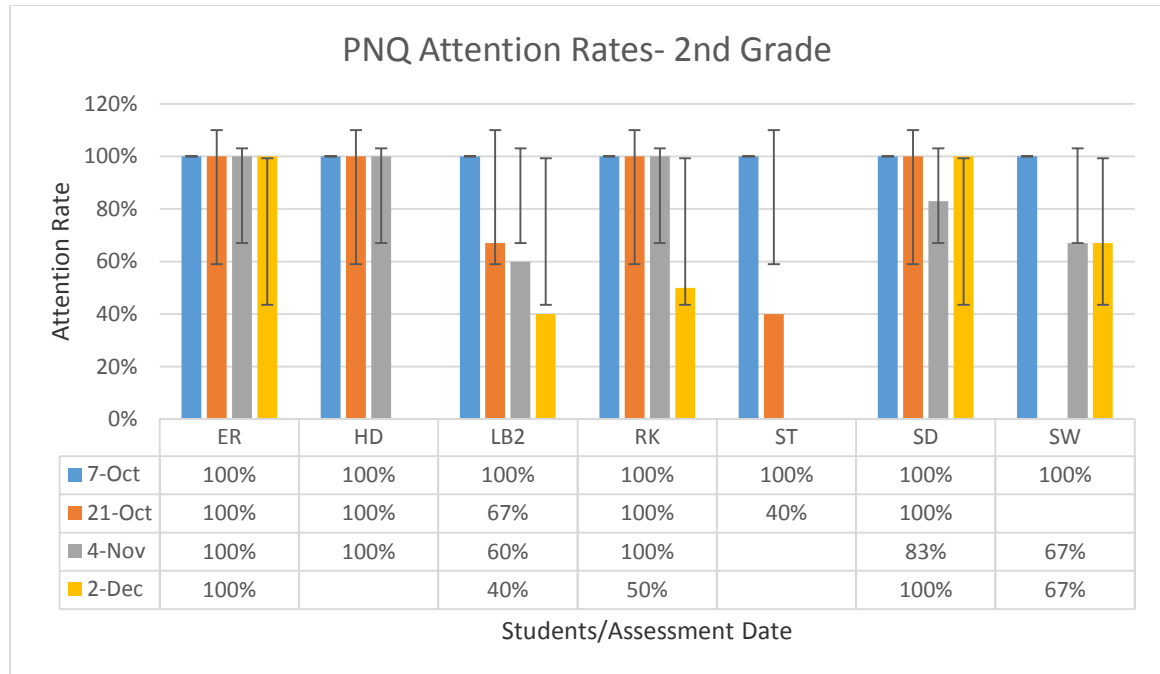


Figure 3. PNQ! attention rates – 2nd grade, (N=7).

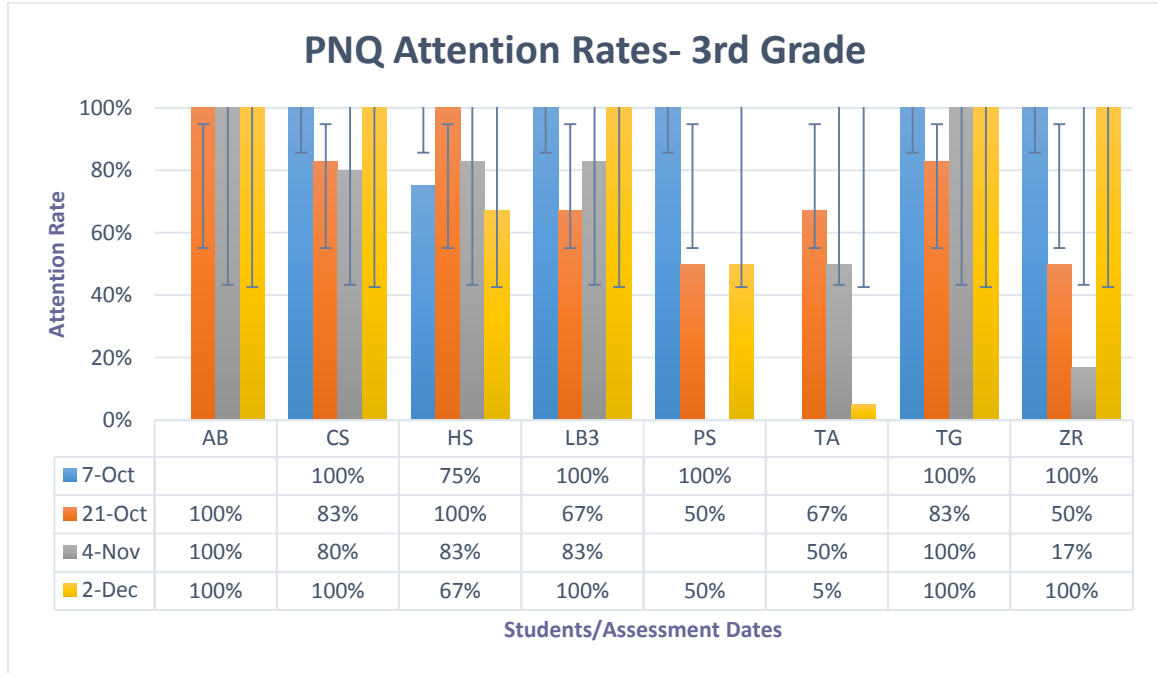


Figure 4. PNQ! attention rates – 3rd grade, (N=8).

Of the two students who fell below one standard deviation at least twice, one, LB2, is an average student who often struggles to comprehend new concepts without additional practice. She is quick to look at other students' work if she's unsure what to do, but once she has a plan she usually works diligently. The other student in this category, ZR, is highly capable academically. He struggled with these types of activities last year, always being quick to quit. He showed promise of improvement on some of the lessons this year but reverted to old habits on several occasions. These two students happened to be sitting next to each other during the November 11th lesson and although they were working on different assignments they were a constant source of distraction for each other.

One student, ST, was below one standard deviation on only one assessment but was only present for one of the recorded assessments. He is often off task during the

school day. I believe that if he had been present for additional lessons, he would have been in the group with more than one lesson below one standard deviation. All four of the other students who fell below one standard deviation only once were also in the group that failed to stay on task for 80% of the time on at least 75% of the lessons. Three of these students received additional help with reading and often struggle when complex directions or problems are presented in text. The fourth student in this category has missed a great deal of school this year during illness and because of this sometimes lacks stamina.

After compiling the attention data from the recorded lessons, I then compared it to the section of the student journal sheets that recorded how much they felt they had worked during the lesson. This item is represented on the sheet as the fill-in-the-blank statement:

I worked hard for _____ of the time. (all, most, about half, less than half, hardly any)

Students circled the answer they thought most accurate. For some lessons, students answered differently on their mid-lesson and end-of-lesson responses.

I charted the comparison of reported attention and observed attention in Tables 2 and 3 below. I was only able to base this comparison on three of the lessons due to a lack of student journal sheets for the October 7th lesson. When more than one response was given for a lesson, both are posted. Estimates that were accurate when compared to my observations are shown in with no background shading. Under-estimated time-on-task is shown with light shading, and overestimates are shown with dark shading.

Table 2
Second Grade Student Attention Rates

Student	Attention	Assessment Dates		
		21-Oct	4-Nov	2-Dec
ER	Reported	all	all	all
	Observed	100%	100%	100%
HD	Reported	half	half/most	
	Observed	100%	100%	
LB2	Reported	half	all	most
	Observed	67%	60%	40%
RK	Reported	half/ less than half	half/ less than half	half
	Observed	100%	100%	50%
ST	Reported	all		
	Observed	40%		
SD	Reported	all	all	all
	Observed	100%	83%	100%
SW	Reported		most	most
	Observed		67%	67%

Note. For each assessment, unshaded data represents an accurate estimation of time on task by students, light shading represents an under-estimation and dark shading represents an over-estimation ($N=7$).

Table 3
Third Grade Student Attention Rates

Student	Attention	Assessment Dates		
		21-Oct	4-Nov	2-Dec
AB	Reported	all/most	most/half	most
	Observed	100%	100%	100%
CS	Reported	most/all	most/most	most
	Observed	83%	80%	100%
HS	Reported	all	most/half	all
	Observed	100%	83%	67%
LB3	Reported	all	less than half half	all
	Observed	67%	83%	100%
PS	Reported	all		most
	Observed	50%		50%
TA	Reported	all	most	all
	Observed	67%	50%	5%
TG	Reported	all	most	all
	Observed	83%	100%	100%
ZR	Reported	all	all/most	most
	Observed	50%	17%	100%

Note. For each assessment, unshaded data represents an accurate estimation of time on task by students, light shading represents an under-estimation and dark shading represents an over-estimation ($N=8$).

Students who had been observed to remain on task for more than 80% of the time on at least 75% of the lessons were the most likely to either accurately or under-estimate their time-on-task. Three students in this category overestimated their times once.

Conversely, those students who were observed to remain on task for less than 80% of the time on less than 75% of the lessons were very unlikely to estimate accurately or under-estimate and much more likely to overestimate their time-on-task.

I think the explanation for the disparity shown between groups when comparing reported and observed time-on-task is a fairly simple one. Those students who were on task for all or most of the time were most likely to estimate accurately because it is easy

to make an approximation that you worked all or most of the time if that's what you did. These students were also eager to report that they had stayed on task. Those students who did not stay on task for a majority of the time did not report accurately because it's much harder to approximate how much time you spent working when you know you were not on task for a significant portion of the time. I think this group tended to overestimate their time-on-task because they didn't want to appear to have been off task for a majority of the lesson.

When comparing these results to student grit scores, I found that students with higher grit scores were the most likely to accurately assess their time working. For the most part, these students reported they worked for all of the time, and they usually did. One student in this category overestimated her time on each assessment. Only once did one of these students under-estimate their time. I believe these students have confidence in their ability to persevere in their work and they usually do. That same confidence might also have led them to overestimate their work at times.

Students with grit scores in the mid-level were less likely to accurately assess their time working and were much more likely to overestimate than to under-estimate. These results could be due to the students still maintaining a fairly high confidence level without the actual ability to sustain the work level. They believed they were working more diligently than they truly were.

Students with lower grit scores were the least likely to accurately assess their time working and were about equally as likely to overestimate as under-estimate. Somewhat surprisingly, this group was the most likely to under-estimate their time working. A

number of these students lack confidence in their academic abilities and ability to persevere, and many of them do struggle with grade level work. These factors may have made it more difficult for them to stay on task or to accurately judge their time-on-task.

The most interesting comparison I found concerned two students who stayed on task for most of the time but severely under-estimated their time for almost every lesson. Both of these students also received grit scores below one standard deviation on the pre-treatment survey. I looked at the recorded lessons again and saw that both of these students truly stayed on task almost all of the time. Initially, I believed that both of these students had preconceptions of themselves having little perseverance and carried that notion on when reflecting on their work despite the fact that it disagreed with recorded evidence. After viewing the results, I spoke with both students one-on-one, and was surprised when they each gave the same explanation for the discrepancy. Both students stated that when the problems were difficult, they spent a lot of time thinking and didn't consider that "time working."

When looking at the figures and data relating to attention during Practice Not Quitting lessons, I saw no evidence that student attention spans during these lessons showed any significant change during the span of this treatment. Several students were consistently focused throughout all or most of the lessons. Several students were seldom focused much or any of these lessons. Several students fell somewhere in between. No one seemed to show any substantial change in ability to persevere.

Student Journal Sheets

I next reviewed journal entries concerning how students felt about each lesson and how hard they perceived the lessons to be. This information was shared in the form simple questions with various response options. They were:

How do you feel about the lesson (with so far added for the mid-lesson reflection)?

(happy, indifferent, frustrated, bored, interested, excited, angry, other _____)

and;

How hard was today's lesson? (easy, not too easy or too hard, pretty hard)

When reflecting about how they felt about the lesson, students were encouraged to circle all responses they had experienced during the lesson. This was important because an individual's feelings often change throughout the process of perseverance, and I wanted students to recognize that in themselves.

Figure 5 shows the compiled reflections of how students felt about each lesson. Responses of *happy*, *interested*, and *excited* were considered positive, while *frustrated*, *angry*, and *bored* were considered negative, and *indifferent* was neutral. For the majority of the lessons, positive responses outnumbered negative and neutral responses were well below them both. With the exception of the December 2nd lesson, each successive lesson resulted in a greater percentage of positive responses and lesser number of negative responses. The January 20th lesson was the only one with no neutral responses. It appeared that in the beginning, many students were unsure of what these lessons would entail or the expectations I would have of them would be. As students became more experienced with the lessons, their comfort level to increase, and they were able see them in a more positive light.

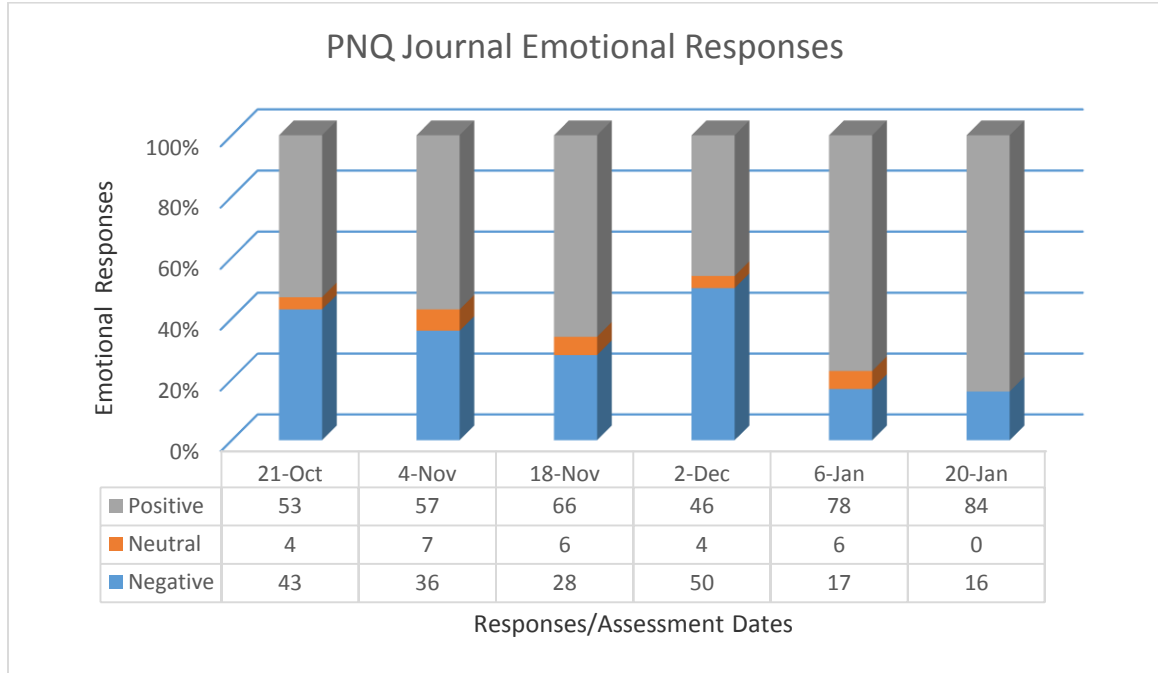


Figure 5. PNQ! journal emotional responses, (N=15).

Figure 6 represents data compiled to show student perception of lesson difficulty. For this data, journal responses of *not too easy or too hard* are considered neutral. The first four lessons followed a pattern in which the majority of the respondents saw the lesson as hard, the next largest group gave a neutral response, and the smallest group responded that it was easy. There was also a prevailing trend in which the number of *easy* and *neutral* responses grew steadily from one lesson to the next while responses of *hard* steadily decreased. Once again, this pattern was most notably broken by the December 2nd lesson. For that lesson, 2/3 of the respondents reported the lesson as *hard* while the remaining 1/3 responded neutrally. This was the only lesson that had no *easy* responses. The two January lessons showed the greatest percentage of responses were *neutral*, followed closely by *easy* responses. Responses of *hard* were close behind these two lessons. The December 2nd lesson was by far the most complex, so its results were fairly

predictable. There did seem to be a bit of a conflict in the fact that students viewed the lessons as getting easier as time went on, when in reality they became increasingly more challenging and complex. We discussed this after the treatment period was concluded, and students related that the lessons seemed easier as they became more familiar with the format and types of challenges being presented.

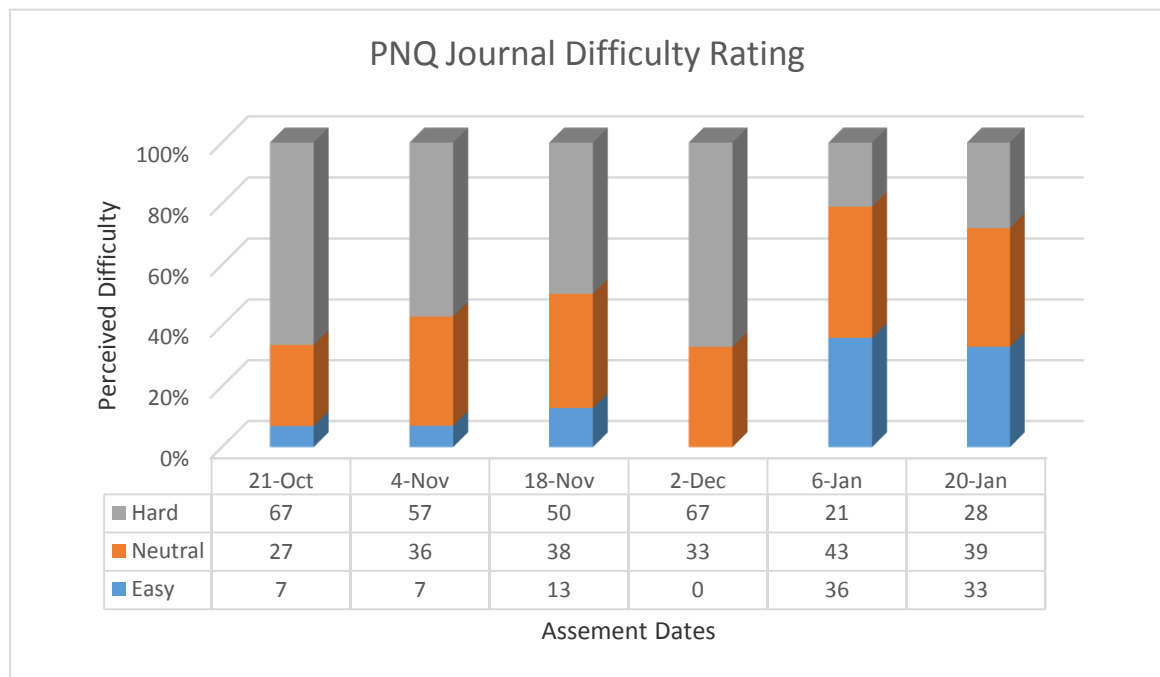


Figure 6. PNQ! journal difficulty rating, ($N=15$).

The next aspect of PNQ lessons I looked at were the comments students made on their journal sheets or during and after lessons. As would be expected, the majority of the comments connected to negative feelings were related to the work being difficult or not being able to solve the problems. The most common comment in this category was “because it was hard.” Other comments included sentiments like; “I thought I had it but I

didn't," "I'm angry because I can't get the last 1," "I felt like I was going to cry," and "I don't understand anything."

Most of the comments related to positive responses were related to success. Many students were happy when they thought of the work as easy or when they solved the problem, but even partial success led to positive comments. Those comments included; "I feel happy because I made it to the other side," "because I got one done," and "I felt happy because I almost got it right." Some students tied their positive feelings to having succeeded through hard work. Comments in this group included; "I felt happy that I figured it out because I worked real hard trying to get the puzzle together," "I felt happy that I got it all together because it was super-duper hard," "because I got through it and did not give up," and "because I worked really hard and went up and got some right."

Interestingly, some positive responses were tied to comments referencing the work being difficult. These comments included; "(I was) interested because I could not figure it out," and "I feel interested because it is hard," and "because it was hard for me and it makes me want to keep going."

When I asked how students felt when they saw classmates succeed before they did, there were only a few negative comments. They were all similar to, "I felt kind of frustrated because I couldn't get it." Surprisingly, there were many more positive responses to the question. They included; "I felt happy for them. I felt happy for them because we all worked really hard and they got it right and I felt happy for them," "I felt like since they could do it, it wasn't impossible," "I felt happy for them and I also felt

determined to do it,” and “When I heard they could do it, I worked hard until I could do it, too.”

During the November 18th lesson, I recorded a conversation between three third graders.

AB – “How is this possible?”

LB3 – “It’s possible. If I can do it, you can do it.”

CS – “And TA did it.”

AB – “It’s hard!”

LB3 – “That doesn’t mean it’s impossible.”

I was thrilled when I heard this exchange. It was exactly the type of thinking I was hoping the students would start to develop. Surprisingly, AB was always one of my most persistent students while LB3 was my biggest complainer about things being difficult or impossible. As teachers, we often press our students not to talk to each other during assessments or when we want to make sure they’re working on their own. After hearing these students support each other, I wondered if it might be better to encourage similar types of conversation during what are normally considered “quiet times.” It would be difficult to get students to engage in only specific types of dialogue, but reassurance from peers could be a great inspiration for those who might be struggling.

The final item on the PNQ journal asked students to explain one of the strategies they’d employed during the lesson. Early in the year we had discussed and practiced using problem-solving routines, strategies, and clue words and made large charts concerning each aspect. I would usually lead students through each of the charts before

we began the PNQ lessons. I would ask students to relate the strategies they used in detail and would give examples. Unfortunately, these tactics didn't seem to work. Most of the entries would only include a few words such as; "guess and check," and "subtraction and add." I had to come up with a different way of teaching students how to communicate their work in a written form. The new teaching strategy I employed wasn't directly tied to our treatment so I dropped this part of the student journals from my research.

After viewing each part of the PNQ lessons and student journal separately, I tried to combine everything and make connections by looking at it as a whole.

The first things that stuck out were the discrepancies regarding data collected from the December 2nd lesson. Six students had their lowest amount of time-on-task during this lesson. It also showed the highest percentage of negative comments, lowest percentage of positive comments, and was tied with the first lesson for the highest number of students who regarded it as *hard*. It was the only lesson no student considered *easy*. I looked back at the lesson and saw that it was the first *Genius* lesson we tried. All of the previous lessons centered around one problem. The *Genius* lessons, however, consisted of a packet comprised of several pages of related but increasingly difficult word problems. Students knew they were not expected to finish the assignment in one or even several lessons. There was also an extensive amount of text on each page. The 3rd graders who had been in class the year before were familiar with the format and began talking about how difficult the questions were and how great it felt to complete a packet. I believe these comments, when combined with the knowledge that it would not be

finished in one day and the size, style and difficulty of the assignment set students up to look at this work in a negative light before they ever started and led to the data compiled.

One student, ZR, struggled to stay on task during most of the lessons, but did exceptionally well on this one. He wrote in his journal that he found the lesson hard but felt interested and excited because of the difficulty. This student is very competitive. I believe he took the same influences that made others see the lesson in a negative light and turned it into a challenge.

I gave another *Genius* lesson to the 3rd graders on January 20th. The data for that lesson, however, followed the trends of the other lessons. I tried to make the lesson less intimidating by separating the packet and only giving it out one page at a time. I also allowed students to bring problems to be checked as each one was finished instead of making them complete the entire page before coming up. I tried to concentrate on making positive and encouraging comments whenever possible. I believe these changes influenced the way students approached the lesson.

Student comments and perceived difficulty figures both showed trends towards students feeling more positive about the lessons and believing the lessons were easier. In reality, the lessons were getting more complex. At the same time, there didn't seem to be a significantly positive reflection in either their observed or perceived time-on-task. Showing that while students didn't really change how well they persevered over the course of these lessons, they became more comfortable with the idea of, and feelings related to, struggle. This could signal a very important step in the development of

individual perseverance. If students can maintain positive attitudes and confidence when facing difficult problems, additional practice could lead to improved performance.

Other Assessments

Attention Rates

The Practice Not Quitting! lessons were very specialized and students knew the aim of those lessons was to practice perseverance. I was worried that students might not carry the idea of perseverance over from the PNQ lessons to their other work. Therefore, I started collecting data from other classroom assessments, too. I tried to keep track of student time-on-task in much the same way I had with the PNQ lessons, checking students every three to five minutes and recording their attention status. In addition to tracking attention, I recorded the types of questions students asked as a way of gauging how independently they were working. I encouraged students to ask for help if they needed it, but prompted them to try to figure things out on their own first. These additional assessments were from our Language Arts and Mathematics programs. They varied in length from 20 to 45 minutes.

Figures 7 and 8 relate the attention data collected for each grade. I separated the data by grade because the dates of their assessments did not always correspond. Students who were absent during an assessment do not show any data for the assessment on the figures. I also included error bars showing one standard deviation from the class average for each assessment.

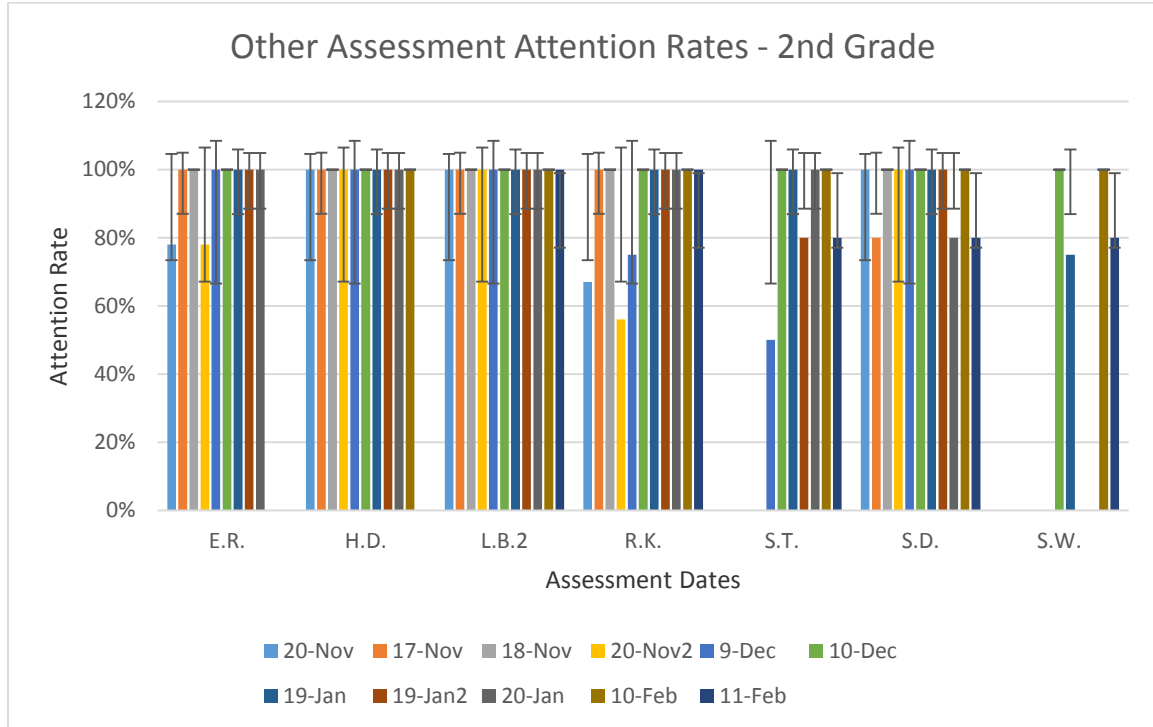


Figure 7. Other assessment attention rates – 2nd grade, (N=7).

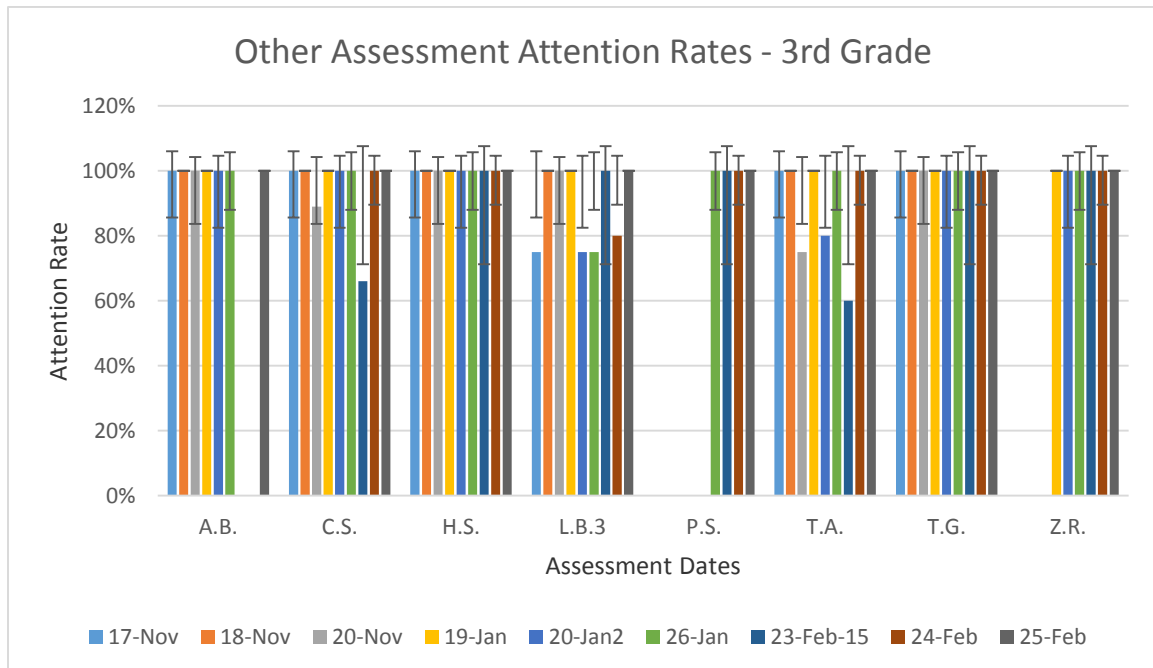


Figure 8. Other assessment attention rates – 3rd grade, (N=8).

Two students, ST and SW, were absent for prolonged periods over the course of the treatment. One student, PS, often took assessments in a one-to-one setting with specialists.

Overall, I thought the class showed a consistently high rate of attention on these assessments. Six students recorded better attention rates than they had on PNQ! Lessons, while seven more stayed about the same. I looked more closely at the data for students who fell below one standard deviation two or more times. Two third graders, TA and LB3, fell below the mark three and four times respectively. Both of these students also struggled with staying on task during PNQ lessons, so it was not surprising to see them have similar issues on other assessments as well.

The other three students in this category were second graders. One student, ST, was gone for a large portion of the treatment period and also struggled with off task behavior during the PNQ lessons. I noticed that he was often moving about in his chair. For the December 2nd assessment, I gave the students the option of staying in their seats or laying somewhere around the room while they took the assessment. All but one student chose to leave their seat. Remarkably, the entire group showed 100% time-on-task for that assessment. I gave them the same option for the assessment the next day, but this time the results were mixed. I have continued giving students this option and have found that when ST chooses to leave his seat he usually has an easier time staying on task. Another student in this category, SD, is a consistently focused and hard worker. When reviewing these assessments, this student had a knack for working hard most of the time but getting distracted right at the times I was checking for student attention. The

lowest rate of attention she ever had was 80%, but twice that was low enough to fall below one standard deviation. SD also had a high rate of attention during the PNQ lessons, and for these reasons I feel confident that she didn't actually have problems staying on task during these assessments. The final student in this group, RK, struggled to stay on task on three of the first five assessments, but scored 100% attention rate on each of the following six. This student also showed a lot of emotional growth over the same time span. I think his personal maturation and improved ability to stay on task are probably related.

When comparing attention data for PNQ! and other assessments, I noticed that students were able to stay more focused when completing the assessments. I surmised that this discrepancy was probably due to the fact that the PNQ! lessons were more difficult and unique while the assessments directly reflected work we'd been doing in class. After the treatment period had been completed, I asked students why they thought there was a difference. Four students thought it was because the assessments were so much easier; two students had no idea why; one said it might be because I allow students to lay down or move to more comfortable places during assessments; two said it was because PNQ isn't graded and doesn't show up on report cards; and four said they knew they would have to continue working straight through on PNQ! lessons and would stop for recess whether they were done or not, but if they finished assessments early they would be allowed to read or write silently, and they would have to stay in at recess to complete assessments if they didn't finish in time.

The last two groups really caught me off guard. First, while PNQ! doesn't show up on report cards, we never make a big deal out of grades or report cards. We don't use percentages or letter grades so students don't actually receive *grades* on anything. In the future, I might change my report card to include a section on perseverance. I'm not sure what can be done for the final group because I do want them to continue working for the entire time allotted. It might help to start the year with shorter, easier PNQ! lessons, increasing the length and difficulty as students build more stamina. If students complete the lessons before the time was up, I could also give them a choice of different types of PNQ! lessons to work on next. They might work more diligently and stay more engaged if they know they'll have some say in the work they do next.

Question Types

I got the idea for this project, in part, because I was tired of students saying "I don't get it," before even trying to understand the task they'd been given. For that reason, I decided to keep track of the types of questions students were asking during assessments. I initially categorized questions as: content based with a subset of *I don't get it*; decoding (help with reading); format/procedural (understanding the format of the question); equipment (asking for a tool such as a ruler or scrap paper); or self-answered (student answered their own question without my help).

I decided to focus on the content based questions because this was where I thought perseverance would mostly likely be a factor. If students had a high level of perseverance, they would be more likely to work to figure these questions out for themselves before asking for help. If they had a low level of perseverance, they would be

more likely to ask for help without trying to figure it out on their own first. I was particularly interested in *I don't get it!* questions.

Figures 9 and 10 relate the number of content questions asked during given assessments. Data in orange represents the number of standard content related questions asked by students during each assessment. Data in blue represents the number of “I don't get it,” questions asked by students during each assessment.

When I reviewed the data, I was mildly shocked by how few content questions students actually asked. Over the course of ten assessments, second graders only asked 17 content questions, four of which were of the *I don't get it!* variety. Three assessments had no content questions at all, and three others had only one. For the last four assessments, three had one content question and one had none at all.

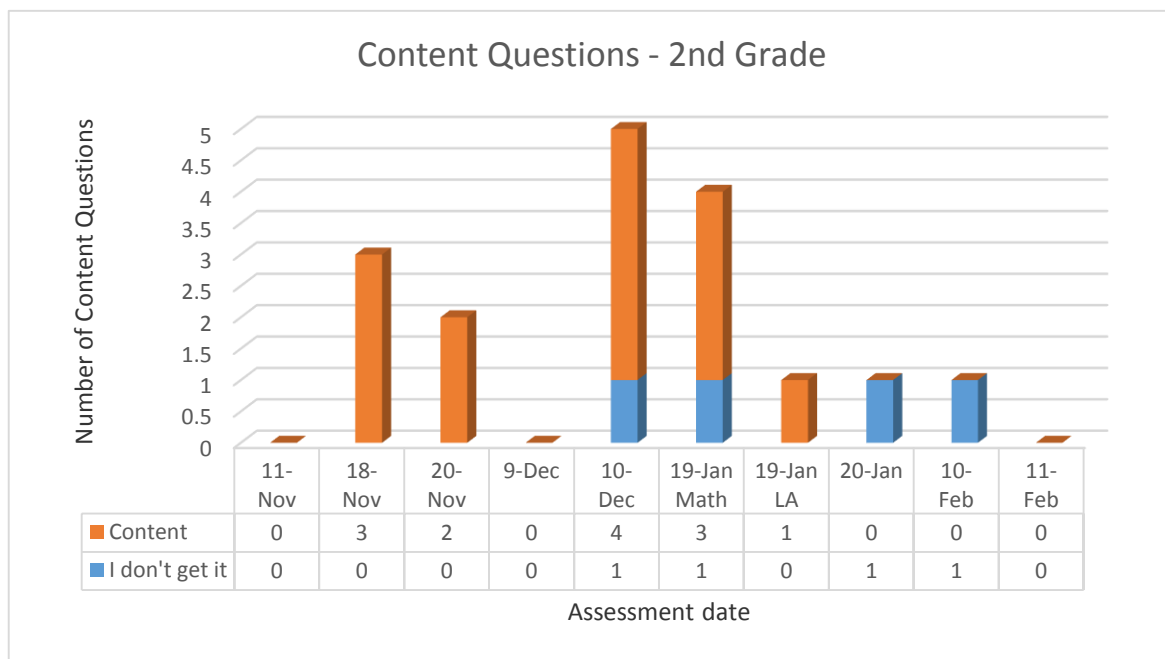


Figure 9. Content questions – 2nd grade, (N=7).

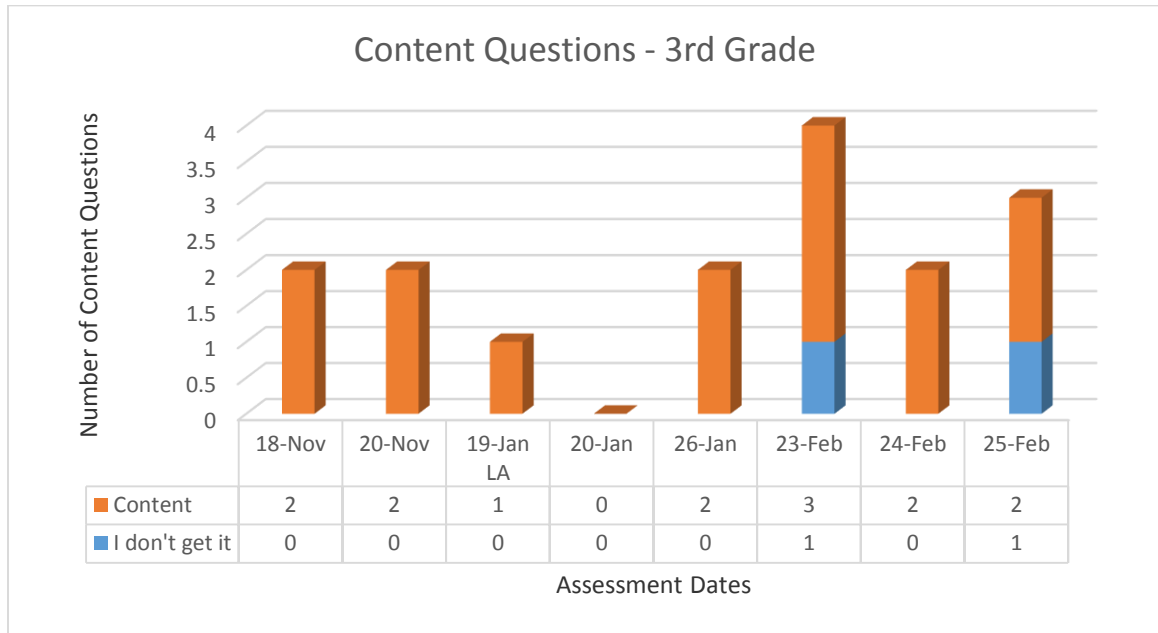


Figure 10. Content questions – 3rd grade, (N=8).

The data for the third graders showed 16 content questions over eight assessments, with only two *I don't get it!* questions. The third grade had one assessment with no content questions and no less than two in each of the other assessments.

While the second grade did show a possible trend toward fewer content questions being asked over the last two months of the treatment, the number of the *I don't get it!* variety stayed the same. The third grade data was also inconclusive with the number of content questions going up slightly at the end of the treatment and the number of the *I don't get it!* variety actually increasing.

It was difficult to make any conclusions based on this data for two reasons. First, the small number of questions asked on each assessment increased the statistical significance of each individual question. Second, this data was taken after the treatment

had been initiated. The fact that there was no pre-treatment data made it harder to determine if changes in questions asked were related to the treatment.

Teacher Journal

Over the course of this project, I made periodic entries into a personal journal. This did not end up being the brilliant, tidy, well organized piece of work I'd envisioned at the onset of this endeavor. There was no schedule, rhyme, or reason used to determine when entries were made, how they were made, or where they were made. I did purchase a small, blue, leather-bound journal, but that was about as close to my vision as I got. Some entries, usually the ones I woke up thinking about in the middle of the night, did make it onto the pages of my journal. Others were scrawled on scraps of paper or attached to other work I was doing when a thought came to mind. These random pieces of paper were usually crammed into my journal at some point but only after they'd spent days in my pocket, on my desk, or even next to my bathroom sink. Some entries were sent as emails to myself. I condensed my journal into two general themes: *tools and treatment*; and *student observations*. The most significant entries and notes have been included in Appendix D.

Tools and Treatment

Entries in this category pertained to my thoughts and observations in regards to the strengths and weakness of my instruments and treatment and any changes that needed to be made to either.

After some early doubts, I realized I was very pleased with the 8-Item Grit Scale used to survey student self-perception of their ability to persevere. My initial concerns

arose because I didn't agree with many of the grit scores students had given themselves on the pre-treatment survey. After talking it through with my support team, however, I realized that the survey wasn't about the accuracy of the scores. It was a baseline to student growth and understanding. After giving the post-treatment survey, this tool provided some very useful data. I did add some open-ended follow up questions and discussion to the post-treatment survey which helped clarify some of the data.

I also made several changes to the *PNQ!* lesson, observation and journal formats. A few questions were added to the journal entries while both the other tools scaled back a bit. Some of the post-lesson discussion had to be scaled back due to time constraints, and the observation sheets proved too cumbersome and were replaced with a simple seating chart/ checklist.

The biggest changes made were the addition of other assessment observations and the restructuring of my research questions. I was concerned that skills we were practicing in *PNQ!* lessons would not carry over into other curricular areas, so I started observing attention rates and questions asked during regular assessments. This turned out to be a very valuable tool, allowing me to better triangulate my data and make some significant comparisons.

Two of my other tools, *AIMSweb probes* and *Open Response questions*, proved to be much less successful. I hoped they could be used to make correlations between perseverance and improved academic success, but I realized I had no way of connecting student results to anything being done in this project. I ended up dropping both tools and

two of my initial research questions dealing with student academic improvement. I was able to add a different question:

How does teaching and practicing perseverance affect elementary students' appreciation of their ability to persevere over extended periods of time?

The results of the student surveys, discussions and journals led me to believe that most students were able to more accurately evaluate their ability to persevere and felt their ability had improved after the treatment period.

Student Observations

Entries in this category pertained to observations I made of students in regards to the treatment.

The biggest student problem I dealt with was their emotional response to the PNQ! lessons. By design, these lessons were difficult. I tried to prepare students for that fact when describing the reason for the lessons and goals we were hoping to achieve. For some students that wasn't always enough. One student who has great success academically, would break down and stop working at the first sign of difficulty. I was pleased to see that his ability to work through struggles improved considerably over the course of the year. Several others never seemed to get started. I believe this was because low confidence in their ability to succeed led them to give up quickly. One of these students showed noticeable improvement by the end of the treatment but several others did not.

One student started out with an incredibly skewed estimation of his ability to persevere. He gave himself a very high a grit score and always rated his effort high on journal entries, when in fact he was almost always the first to complain and give up.

During the treatment, I sat with him to discuss the situation. I told him I believed that he did have a lot of grit, but related what I saw and heard from him during lessons. I asked him if that sounded like someone with a lot of grit. He replied that it didn't. The discussion ended on a very positive note and he showed great improvement over the next few lessons. Eventually he went back to complaining, but in the post-treatment survey he gave a much more realistic self-evaluation.

I was pleased to see students relate the lessons learned through *PNQ!* to other areas. While learning coding during a Technology lesson, several students commented on working through early failures and enjoying the challenge of the tasks because they got harder as they went on and took more effort to complete. I also found students stopping themselves from saying "I don't get it," on assessments and either asking more specific questions or answering them on their own. These were the things I was hoping to see when I decided on this course of study.

My journal was intended to be a central instrument addressing the question:

What are the effects of teaching and practicing perseverance on me as a teacher?

This experience has left me more convinced than ever in the importance of teaching students the value of perseverance and helping them see that they can succeed regardless of challenges they encounter. The tools I use to achieve this will need to be refined and opportunities for group and individual discussion and reflection will have to be increased, but I certainly plan to continue giving them opportunities to face and overcome obstacles in a safe, nurturing environment.

I also plan to continue keeping a teaching journal. School days are often so fast-paced and fluid that there's little time for reflection and much of what we do look back on is soon forgotten. Keeping a journal and dedicating myself to using it could make it one of the most important teaching tools I ever use.

INTERPRETATION AND CONCLUSIONS

This classroom research study was conducted to determine if teaching and practicing perseverance would affect elementary students' capacity to work independently and their understanding and appreciation of their ability to persevere. A final question was asked to ascertain how teaching perseverance might affect me as a teacher. Data was collected in a combined second/third grade classroom of 15 students through classroom observations, surveys, journal entries and informal discussions.

Effects on Student Ability to Work Independently

In order to establish the effects of teaching perseverance on student ability to work independently, observations were made to record student time-on-task during lessons designed to practice perseverance as well as regular curriculum assessments. Data was also collected in regards to the types and number of questions students asked during assessments.

Lessons were designed to challenge students to persevere when presented with difficult tasks. We called these *Practice Not Quitting! (PNQ!)* lessons, and students knew the goal was to keep working throughout the lesson. They also knew that very little help would be provided, requiring them to work things out on their own. The lessons were given about every two weeks and lasted for approximately 30 minutes each. They ranged

in kind from geometric puzzles, to paper mazes, to increasingly difficult mathematics problems. When possible, video recordings were made during the lessons, and data was collected every three to five minutes to determine student attention to the task at hand. Due to camera failure and other logistical problems, data was only collected from four of these lessons.

Of the 15 students observed during these lessons, eight stayed on task for at least 80% of the time over at least 75% of the lessons, while seven students did not. There did not appear to be any significant differences between grades.

The standard deviation from the mean was calculated for each lesson. Eight students never fell below one standard deviation, five students fell below it once, and two students fell below it on two or more lessons.

Attention rates were best for the first lesson. This was the only entirely *hands-on* lesson, consisting of two geometric puzzles students had to put together. The fact that this was the first *PNQ!* lesson, along with the nature of the task, probably accounted for the high attention results. Students were excited to begin the lessons and those who struggle with Reading or Math concepts probably felt more comfortable with this format. There did not seem to be any discernible difference in attention rates between the other types of lessons.

After the first lesson, there didn't appear to be any significant change in overall student attention rates over the course of subsequent lessons. The final lesson was significantly more complex and included a relatively large amount of text. While I read

words or questions to students who asked, these factors did seem to negatively affect the attention rates of some students.

Most of the students showed no significant change in their ability to stay on task during these lessons. One student did show noticeable growth. LB3 considered himself a very diligent worker, but he was always quick to complain or give up and recorded an attention rate of only 67% on the second *PNQ!* lesson. A few days after the lesson, I talked to him privately about how his assessment of his ability to persevere differed from what I was seeing and hearing in class. After this discussion, his attention rates increased to 83% and 100% for following lessons.

Data was also collected during regular curriculum assessments. This was done to determine whether or not student ability to work independently was transferring to tasks beyond *PNQ!*.

Student attention rates were better on these assessments than they were on the *PNQ!* lessons. Almost half the students recorded better rates while most of the others stayed about the same. The students with the worst attention rates on these assessments also struggled with attention during *PNQ!*. I assumed these results reflected the facts that regular assessments tested material we had recently covered and individual questions were less challenging. When asked about this after the treatment period, some students agreed with my assumption. Others, however, were influenced by the facts that *PNQ!* lessons were not graded and that if students didn't finish regular assessments during class time they would have to complete them during recess. *PNQ!* lessons were followed by recess regardless of whether or not the work had been completed.

To help measure how independently students worked, I also tracked the number and types of questions asked during assessments. Particular attention was paid to content-based questions I felt students should have been able to figure out on their own. Within that category, special consideration was given to questions students asked by giving a general *I don't get it* statement. I was struck by how few content questions were asked, as each grade averaged fewer than two questions per assessment. *I don't get it* questions were asked on an average of about once every four assessments for each grade. Second graders asked fewer questions over the last four assessments, while third graders asked more than average over the same period. Both grades asked the majority of their *I don't get it* questions over the last half the treatment period.

Looking at these results, I was pleased with the independence my students exhibited over the course of the treatment. The small number of questions asked, however, made it difficult to say for sure whether or not there was any significant change over the course of the study. As stated earlier, data from these assessments was not collected until after the treatment had begun so there was no pre-treatment data to compare.

When it came to answering my primary research questions, overall results were inconclusive. While the majority of the students appeared to be fairly independent workers, there didn't seem to be many significant differences in either individual student attention rates or questions asked during assessments. Several factors may be responsible for this outcome. First, many students seemed to start out at a very high level of independence and didn't have room for a great deal of improvement. Second, there

probably weren't enough *PNQ!* lessons. Students weren't given ample opportunities to deliberately practice perseverance. In addition, the types of problems and progression of lesson difficulty were not presented in a manner that would best lead to student success. Finally, the lack of full class reflection on each assignment kept students from being able to properly monitor and modify their own effort as the treatment progressed.

Effects on Students' Appreciation of Their Ability to Persevere

Helping students understand perseverance and recognize their own ability to persevere were key components of this research as stated in the second research question;

How does teaching and practicing perseverance affect elementary students' appreciation of their ability to persevere over extended periods of time?

Data pertaining to this question were collected using the 8-Item Grit Scale for Children, student journal entries, and whole class and individual student discussions.

Pre- and post-treatment surveys were given to the students to measure their perceived ability to persevere over long periods of time, also referred to as *grit*. The pre-treatment data indicated that the class as a whole had a fairly high level of perceived grit. Four students scored at or above one standard deviation while four others scored below. When comparing my own observations with these eight students, two of the students scoring above one standard deviation seemed to be over-estimating their abilities while the other two were fairly close to what I'd seen. When considering those who scored below one standard deviation, one had scored lower than I would have predicted, but I was in agreement with the other three. Of these three, one had an IEP directed at several learning areas. I believed her score to be indicative of low self-confidence. The other two students in this category are my students most likely to be considered academically

gifted. I was initially surprised to see how low their grit scores were, but then realized they might never have been significantly challenged in any academic areas and had little experience with perseverance.

After studying this data, I gave myself the goals of helping students gain more insight into their own abilities and helping those who had scored below one standard deviation become more confident in their own ability to persevere. The second goal was particularly important because I'd seen how vital confidence could be for struggling students and how hard it could be for students who'd experienced early, easy success in school to cope with struggles when more complex academic demands arose. I hoped that students on both ends of this spectrum would develop a foundation for future success by learning to overcome obstacles and thrive at this early stage of their lives.

The post-treatment survey revealed that the overall grit level of the class increased slightly over the course of the treatment. Three of the students who had scored above one standard deviation on the first survey still scored in that range while one had dropped considerably. This student was one whom I felt had overestimated his ability on the original survey. His post-treatment survey results were much more in line with the effort I had seen.

Grit scores for each of the four students who had scored below one standard deviation improved after the treatment with all four scoring at or within one standard deviation on the post-treatment survey. The student with an IEP scored within one standard deviation. Her improved score was consistent with the increased self-confidence she'd displayed over the period. One of the high achieving students in this

group had raised his score to the lower level of one standard deviation on the second survey. Over the course of the treatment, he learned to continue working through difficulties without breaking down emotionally. I was very encouraged by the growth I'd seen in both of these students and the change in their survey results reflected that they better appreciated their ability, too.

The other high achieving student who scored low on the initial survey scored in the mid-range of one standard deviation on the second. Early in the treatment period, he appeared to be applying himself when challenged. Over time, however, he displayed more and more difficulty staying on task. His increased grit score did not coincide with any growth I had seen.

Two students' grit scores dropped to the lower level of the standard deviation or below on the post-treatment survey. I was surprised by this because both students tended to exhibit high grit in class, usually staying on task and applying themselves when challenged. I asked them about their grit scores individually, and both replied that on the first survey, they'd only considered their responses in regards to school. On the second survey, however, they included experiences outside the classroom, too. Although their scores had dropped considerably, I was thrilled to see that they'd started to think of perseverance from a more global perspective.

Along with the surveys, students also reflected on their ability to persevere through entries made on student journal forms completed with each *PNQ!* lesson. On these forms, students were asked to rate how they felt about the lesson, the difficulty level of the lesson, and how much time they'd spent working.

Data compiled from entries in regards to the first lesson showed a little more than half of the emotional responses were positive while about 40% were negative. Over the course of the treatment, positive responses increased steadily to over 80% on the last lesson while negative responses declined by more than half over the same period. When gauging perceived difficulty, two thirds of the students rated the first lesson as hard, and only 1 student rated it as easy. These percentages reversed progressively with less than one third of the students rating the final lesson as hard and one third rating it as easy. The fact that the data trended toward students feeling more positive about the lessons while also considering them easier as time went on would seem to make sense. Students probably would feel better about work they considered easier. However, this contradicted the fact that the lessons actually became much more complex as over time. When asked about this apparent inconsistency, students replied that as they became more familiar with the format and expectations of the work, it seemed easier. When it came to the increase in positive emotional responses, some felt encouraged after meeting even partial success, others became inspired by the success of others, and some enjoyed the fact that they were being challenged by what they considered more interesting tasks.

Data referencing perceived student time-on-task during these lessons was compared to data taken from video recordings of the same lessons. Students were most likely to overestimate their time-on-task. They were only slightly more likely to make accurate estimates than they were to under-estimate.

When comparing these estimates to individual grit scores, students with high grit scores were the most likely to accurately estimate their time-on-task. Most of these

students tended to work for all or most of the time. When this is the case, it's fairly easy to accurately estimate time spent working. Students within the mid-range of grit scores made fewer accurate estimates and were more likely to overestimate than under-estimate their times. Students with low grit scores were the least likely to make accurate estimates but were equally as likely to overestimate as under-estimate. It makes sense that the more time a student spends off task, the harder it would be to estimate the amount of time spent working. The tendency toward over-estimating time-on-task could have been due to a combination of actually believing or wanting me to believe that they had been working for more time than they had been.

I was particularly intrigued by results for two students, both of whom recorded low initial grit scores. These students tended to work for all or most of the time on every lesson but almost always significantly under-estimated their time-on-task. When individually asked about this, each student replied that they spent a lot of time thinking about the problems and didn't regard time spent thinking as work time. This made me realize that I hadn't done enough to define work and would need to focus more on it in the future.

When the treatment period ended, we had a full class discussion about the experience. Most students felt that they had improved in their ability to persevere. Several students cited times they'd persevered in other subject areas while others shared examples of perseverance outside school. A few students felt they hadn't seen any change in themselves, with most of them saying they'd always worked with a great deal of effort and continued to do so. When considering these comments in conjunction with the

growth shown by survey results and increased positive attitudes towards challenging work, I feel confident that many of my students, regardless of past academic success, grew to better appreciate their ability to persevere. The fact that some of them were also able to see the value of perseverance in a more universal perspective was especially encouraging and went beyond the expectations of this project.

Effects on Me as a Teacher

Throughout this research, I kept a journal of my experience. I categorized the entries into two broad groups based on topics concerning tools and treatment or student observations.

After reflecting on these entries and this project as a whole, I became more convinced than ever in the importance of teaching perseverance. In the future, I will have to improve the delivery and types of work in *PNQ!* lessons so each student has a better opportunity to succeed. Most importantly, I'll need to be able to create a balance between students' emotional and academic needs when challenged. It helps that I have students for two consecutive years. This should allow the third graders to go into this work with a better understanding of themselves and the required work. They should also be able to provide guidance and positive role models for incoming second graders. I firmly believe that helping students learn to persevere might be the most important thing I ever do as a teacher. To make this happen, I will need to learn exactly what I'm trying to teach... perseverance.

VALUE

We are fortunate to live in a time and place in which our children have unprecedented access to information and communication. It sometimes seems as if the answer to every question or problem can be found with just a few deft keystrokes. Unfortunately, the most important problems in life can rarely be addressed this way. Most critical issues our students have to face are complicated and perplexing and unexpected obstacles frequently arise. Whether or not our students succeed in these situations will often be predicated on their willingness to persevere. By teaching students the value of perseverance and providing them with opportunities to recognize achievement as the result of their own hard work, educators could be giving students the means for not only lifelong learning but for lifelong success.

This classroom research project was developed with this goal in mind. It was my hope that introducing students to the importance of perseverance and giving them opportunities to practice it within the confines of the classroom would help improve their ability to work independently through complex challenges and appreciate their individual perseverance.

I analyzed data referencing how well students stayed on task during difficult activities as well as regular classroom assessments, and monitored the questions asked by students during assessments. I had hoped this data would show an increase in the students' ability to stay on task and work independently through increasingly challenging tasks. While a couple students did show an increased capacity to work with greater independence, the majority of students showed no significant change in ability to persevere.

Students were required to complete journal sheets during some of the lessons, recording information in regards to the difficulty of the lesson and how well they thought they'd persevered. They also took pre- and post-treatment surveys to determine their perceived grit, or ability to persevere over extended periods of time. This data was collected to help determine whether or not students gained a better appreciation of their ability to persevere.

The growth in appreciation of perseverance seen in students who began the treatment with low grit scores was particularly encouraging as these students spanned the entire range of previous academic success. In addition, students learned to face challenging work with more positive attitudes. Together, these developments indicate that self-awareness and self-confidence in this area can be enhanced and suggest that student understanding of the value of perseverance and belief in their ability to persevere did indeed improve over the treatment period.

I had a strong personal belief in the importance of teaching perseverance before I decided to conduct this research. I didn't, however, realize how passionate I was about it until the research had been done. Viewing and reviewing videos of students working on the lessons, reading and listening to their thoughts and comments, helping them through the sometimes painful process of struggling and sharing the joy of their success made me realize just how deeply invested I am in this idea. I firmly believe it is as much my duty to help students learn to persevere as it is to help them learn to read and write. I intend to do this in several ways.

I will definitely continue teaching my students about perseverance and giving them opportunities to practice it and recognize it in themselves and others. The first thing I'll have to learn is how to appropriately support students before and during their practice. In addition to individual practice, I'll also provide opportunities for students to work on collective projects directed at teaching and increasing perseverance. Students will also be taught to recognize when continued perseverance is futile. Along with increased perseverance-based lessons, more time will be set aside for classroom review of the lessons. I will also meet with individual students to discuss their perceptions of their own skills and how they can be improved. More time and opportunities will also be set aside to practice and share problem-solving strategies.

I am lucky to work with a very open and progressive group of educators. I will continue to share what I'm doing in my class and encourage them to pursue similar goals for their own students. As a long term goal, I would like our school to adopt a program of teaching perseverance using common language and teaching skills that build on each other in a deliberate progression from grade to grade.

I also plan to share my work with teachers and administrators outside our school through presentations at professional conferences across the state and encourage them to introduce and teach perseverance to their own students. I would suggest that teachers of primary grade students begin talking about perseverance with their students and initiate academic stamina building activities and individual goals. I would like to see that work extended to more strenuous perseverance practice as students progress through school. Eventually, that practice could tie directly into regular classwork. I think this work has

particularly valuable implications for gifted students and those with learning difficulties and intend to learn more about teaching perseverance to students in both categories.

The amount of research being done in regards to the value of perseverance appears to be increasing, and the topic seems to be referenced more and more often in professional conferences and literature. This classroom research project could be expanded upon in a number of ways. Better tools could be created to help students practice perseverance. The lessons we used are worthwhile but could certainly be improved. Perseverance practice could also be incorporated into all areas of the regular classroom curriculum or in conjunction with full-class and individual project-based learning models. Others could also develop better methods for assessing perseverance. The scale used in this research provided an excellent measure of individual perceived grit but isn't intended to measure changes in one's ability to persevere over time as it was used here. It would also be helpful to have a more valid means of measuring true as opposed to perceived perseverance. This research could then be extended to see if improved perseverance could lead to improved academic success. Ideally, this research could also be conducted with students of all ages, from pre-school through college, to see if there is a critical time when mindsets tend to become more fixed. This knowledge could help teachers create strategies for best creating growth mindsets based on students' developmental stages. Finally, research could be done to promote and investigate student perseverance outside the school by involving parents and other community members.

Our job is to prepare students for success throughout their lives, so the ultimate goal of any learning experience should never be confined to the classroom. While many of the

tasks in life seem to be getting easier, life itself continues to become more and more complex. Teaching students to persevere through these complexities could be the most important thing we do.

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APPENDICES

APPENDIX A

8-ITEM GRIT SCALE FOR CHILDREN

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

8- Item Grit Scale

Directions for taking the Grit Scale: Please respond to the following 8 items. Be honest – there are no right or wrong answers!

1. New ideas and projects sometimes distract me from previous ones.*

- ☐ Very much like me
- ☐ Mostly like me
- ☐ Somewhat like me
- ☐ Not much like me
- ☐ Not like me at all

2. Setbacks (delays and obstacles) don't discourage me.

- ☐ Very much like me
- ☐ Mostly like me
- ☐ Somewhat like me
- ☐ Not much like me
- ☐ Not like me at all

3. I have been obsessed with a certain idea or project for a short time but later lost interest.*

- ☐ Very much like me
- ☐ Mostly like me
- ☐ Somewhat like me
- ☐ Not much like me
- ☐ Not like me at all

4. I am a hard worker.

- ☐ Very much like me
- ☐ Mostly like me
- ☐ Somewhat like me
- ☐ Not much like me
- ☐ Not like me at all

5. I often set a goal but later choose to pursue (follow) a different one. *

- ☐ Very much like me
- ☐ Mostly like me
- ☐ Somewhat like me
- ☐ Not much like me
- ☐ Not like me at all

6. I have difficulty maintaining (keeping) my focus on projects that take more than a few months to complete. *

- ☐ Very much like me
- ☐ Mostly like me
- ☐ Somewhat like me
- ☐ Not much like me
- ☐ Not like me at all

7. I finish whatever I begin.

- ☐ Very much like me
- ☐ Mostly like me
- ☐ Somewhat like me
- ☐ Not much like me
- ☐ Not like me at all

8. I am diligent (hard working and careful).

- ☐ Very much like me
- ☐ Mostly like me
- ☐ Somewhat like me
- ☐ Not much like me
- ☐ Not like me at all

Duckworth, A.L, & Quinn, P.D. (2009). Development and validation of the Short Grit Scale (GritS). *Journal of Personality Assessment*, 91, 166-174.

<http://www.sas.upenn.edu/~duckwort/images/Duckworth%20and%20Quinn.pdf>

APPENDIX B
REVISED ATTENTION CHART

Attention Chart

Date _____

✓ = attentive and working

— = inattentive

O = out of room

Lesson _____

? = unsure

F = finished

Check times

1.	4.	7.	10.
2.	5.	8.	
3.	6.	9.	

The Attention Chart consists of several trapezoidal sections, each representing a different student or group. Each section contains a 5x4 grid of check times (1-10) for two students. The sections are labeled with student initials:

- TA, AB:** A large section on the left, tilted. It contains two columns of check times (1-10) for TA and AB.
- HD, LB3:** A section in the middle, tilted. It contains two columns of check times (1-10) for HD and LB3.
- HS, ER:** A section on the right, tilted. It contains two columns of check times (1-10) for HS and ER.
- SD, 7R:** A section below HS/ER, tilted. It contains two columns of check times (1-10) for SD and 7R.
- ST, LB2:** A section below HD/LB3, tilted. It contains two columns of check times (1-10) for ST and LB2.
- SW, TG:** A section below SD/7R, tilted. It contains two columns of check times (1-10) for SW and TG.
- CS, RK:** A section below ST/LB2, tilted. It contains two columns of check times (1-10) for CS and RK.

APPENDIX C

PRACTICE NOT QUITTING! STUDENT JOURNAL SHEET

Name _____

Date _____

Practice Not Quitting! Journal

Lesson name _____

Mid-lesson reflection

1. How do you feel about the lesson so far?

happy indifferent frustrated bored interested excited angry

other _____

2. I have worked hard for _____ of the time so far.

all most about half less than half hardly any

Describe a problem solving plan you have used today.

End of lesson reflection

1. How hard was today's lesson? *easy not too easy or hard pretty hard*

2. How did you feel about today's lesson?

happy indifferent frustrated bored interested excited angry

other _____

Why did you feel that way?

3. I worked hard for _____ of the time.

all most about half less than half hardly any

Describe a problem solving plan you have used today.

APPENDIX D
IRB EXEMPTION



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

960 Technology Blvd. Room 127
 c/o Immunology & Infectious Diseases
 Montana State University
 Bozeman, MT 59718
 Telephone: 406-994-6783
 FAX: 406-994-4303
 E-mail: cherylj@montana.edu

Chair: Mark Quinn
 406-994-5721
 mquinn@montana.edu
Administrator:
 Cheryl Johnson
 406-994-6783
 cherylj@montana.edu

MEMORANDUM

TO: Jerald James Brunt and Walt Woolbaugh
FROM: Mark Quinn, Chair *Mark Quinn Chy*
DATE: December 3, 2014
RE: "The Effects of Teaching Perseverance on Student Independence and Success in Mathematical Problem Solving" [JB120314-EX]

The above research, described in your submission of December 3, 2014, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- X (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- X (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX E
SIGNIFICANT TEACHER JOURNAL ENTRIES

Sept. 30, 2014 – *I gave the 8-Item Grit Scale to the class today. My initial thought was that it was a big mistake. They all seemed convinced that they were the grittiest people ever. (I walked them through each question, showing what each answer would look like. Did they understand?)* This was not the start I was hoping for. This instrument was vitally important to my project, and with-in minutes of using it I was sure it was useless. Luckily, most of my support team works with me. I went over to Nikki's room at lunch and started to talk to her about my failure. I had brought the surveys with me, and the more I looked at them and talked about them the more I realized that the instrument had worked perfectly. The purpose of the survey was to measure their perception of their ability and any changes in it over the period of the treatment. It had given me a solid baseline to start with. It was at this point that I first realized what an emotional process this was going to be for me. After submitting my data to my advisor, he suggested that I add opportunities for students to explain why they responded the way they did. In the post-treatment survey I did add an open-ended question concerning if and how students thought they had grown through this treatment and why they felt that way. It was very enlightening.

October 1, 2014 – *RK got very upset because he missed some addition questions during math practice with one of our aides. I talked to him about this being an example of Practice Not Quitting.* This student is exceptionally capable, but really struggled with failure of any kind. Another student, PS, had a very little confidence. I realized that I was going to have to be very supportive with them when it came to the PNQ lessons. I had to

remember that they were children, but at the same time I knew they had to go through the pains of struggle if they were going to learn the value of perseverance.

October 7, 2014 – *We did our first real PNQ today. The lesson was putting together puzzles to make rectangles. Most finished the 5 piece. None finished the 7 piece.*

This was a pretty successful start. Kids did have to work hard, and most found some success. I had scheduled a 45 minute block of time, but after reviewing our problem-solving plan and the aim of PNQ lessons, they only had about 20 minutes to work. Some students chose to stay in for recess to keep working. I was very excited about their enthusiasm. I ended up having to take another 20 minutes I hadn't planned on to do an after-actions review. The logistics of these lessons was tougher to work with than I'd anticipated. I wanted the work time to be long enough to be meaningful and often ended up counting on student journal sheets instead of getting into any in-depth after-actions discussion. I had also hoped to include time where we could have students demonstrate the strategies they had used in the lesson, but realized there just wasn't enough time.

October 8, 2014 – *I am going to add a section on the PNQ journals to rate how hard the students thought the lesson was. This might be valuable when comparing results to other PNQs.* I had to make several changes to my paperwork. I considered changing the wording to the survey to make it easier for my students to comprehend but worried about compromising the tool. Prior to beginning the treatment, I developed a sheet to use when completing classroom observations. Its main purpose was to track student attention, but also included areas to make comments, and track the times and number of times each student asked for help or presented an answer to be checked. I quickly found that this was

way too complicated a form. I thought it would work well because I had planned to record the lessons. I was able to record some, and while it was an invaluable help, the sound quality of our cameras wasn't good enough to pick up student questions and comments during the lessons. Also I was not able to cover the entire class with one camera and had to set up two. I was able to see everyone this way, but students would often walk out of shot of the camera, and I wouldn't be able to tell if they were asking a question or presenting an answer when I reviewed the video. For these reasons, I resorted to using a much more rudimentary form, basically a seating chart, on which I would record student time-on-task, and a piece of paper for taking notes on student questions and comments or other observations.

October 28, 2014 – *Showed draft graphs/tables to LeeAnn and Nikki.* I shared my preliminary work from the 8-Item Grit Scale results with some of my support team. My figures were ok, but my table was really complicated. I struggled with data organization throughout this project. I had a lot of paper collected but no real idea what to do with it. I let a lot of it sit for way too long when I should have been reviewing it.

October 31, 2014 *AB started crying when she wrote she used guess and check, but I asked for more detail. She said she was crying because she didn't remember. I sent her for a drink of water and said, "Ok. You can't remember right now so what should you do?" She replied, "Think." She did and could remember more detail.* This was exactly the worry I had earlier. I hated having a student go through such a tough time emotionally, but she was able to think and work her way through it. I was sorry it was so

hard on her, but this was exactly the kind of experience that teaches kids they can succeed if they persevere.

October 31, 2014 *LB3 is so quick to give up and spew negative comments. I can deal with kids with low confidence that should be higher. I don't know what to do with kids who have such an overrated idea of themselves.* I ended up having a private conversation with this student. I told him that I believed he could persevere, but related some of the negative comments he'd been making during our lessons. I asked him if that sounded like someone who persevered. He looked dismayed and said that it didn't. For the next few weeks he was able to work more diligently and maintain a more positive attitude. Unfortunately, he wasn't able to sustain the change and before long had reverted back to his previous attitude.

October 31, 2014 *I'm really excited about ZR. Last year he gave up so easily. This year he's really into it all. He even gave a great explanation of his work today.* Unfortunately, this student wasn't able to maintain this new work ethic. He was fine on regular assessments which really didn't challenge him, but he did very little work on most of the PNQ lessons.

October 31, 2015 *For most kids it was a real struggle to get good written explanations of their work. I'm going to have to figure out how to teach it.* This actually turned out to be a major problem in this project. One of my original research questions was related to students' ability to communicate their work in writing. The PNQ Journals had a section asking to students to write about something they had tried during the lesson. I was continually getting one and two word responses. I asked students to be specific and

provided examples of the types of things they could write about. Next I tried having them talk through their problem-solving processes. Neither of those things worked. Towards the end of the treatment period, I started from scratch with this. I took several of the problems they'd worked on and together we wrote out explanations for solving them on the whiteboard. I stressed that they were to use time-order words such as first, next, then, after that, and finally. I also focused on writing what we had done and why we had done it for each step. After that, I gave students a page of 10 to 15 straight forward, two-part math word problems. These problems were not particularly challenging. Next, I had them take one of the problems and show explain how they solved it using the Explain Everything app on an iPad. This app allows students to record their voice while showing their work on the iPad. After I had gone over their recordings with them, I had them write the explanation on paper. All the while I reminded them to use time-order words and to tell what they did and why they did it for each step. We have practiced this same routine several times now, and the results were very encouraging.

November 11, 2014 *I woke up early this morning filled with self-doubt about my project. Am I measuring what I need to be? What I should be? Should I be measuring independent work during regular assessments? Is it too late to start? Should I be keeping track of student grades on observed assignments?* This turned out to be an even bigger question for me at the end of the treatment. At this time, however, I was afraid that students would treat the PNQ lessons differently because they knew that the point of the lesson was perseverance. How could I be sure they would carry those skills over to their other work? I asked my support team and advisor about this, and everyone agreed that I

should keep data on those assessments, too. I used these assessments to track student attention and the types of questions they asked. This data turned out to be very important when addressing my primary research question. I decided not to keep track of individual grades on each assignment because the focus of my study was on the ability to persevere whether successful in the task or not.

December 2, 2014 *Worked on Genius Lessons for PNQ today. Prior to starting the lesson I told them it wouldn't be done today. Did this affect them? Positively or negatively? I tried having them come up after completing each page. Coming up after each problem would have led to too many in line. I didn't tell them about the certificates kids earned on these lessons last year. Should I have? Would the idea of a reward inspire them?* This was the first time we worked with really challenging word problems and this packet consisted of four pages of them. As I described the lessons, a few of the kids seemed excited, but many looked pretty down. I tried to explain that I realized the work was very hard, but reminded them that the purpose of the lesson was to keep working through the difficulties. I thought I would be taking some of the pressure off them by mentioning that I didn't expect anyone to finish in the first day. I think my attempt to reassure the students actually had a reverse affect for many of them. My build-up of the work might have caused most of them to decide they wouldn't be able to succeed before they even started. I would have been better off saying nothing at all or stressing that I knew they could all succeed. I've been trying to use a lot of positive individual reinforcement during these lessons, but this discussion may have backfired. I also wondered if the format of this lesson, with four pages stapled together was a little

imposing. The next time I gave the lesson, I only handed out one sheet at a time and let students bring their work up to be checked after completing each problem instead of each page. My hope was that the students would be less overwhelmed.

December 9, 2015 *Jason (our technology teacher) had the kids work on the Hour of Code website today. The kids had to use a simple coding method to make characters on the screen complete increasingly complex tasks. After the lesson I asked the kids what they thought it. Some comments stood out in relation to this project.*

I like that it's tricky, but it's fun.

I liked that it got challenging at the end.

I like it because I tried the first time and didn't get it. Then I worked a little bit more and a little bit more and did it.

We went on to talk about how this was just like the PNQ lessons we do. Everyone was very excited and positive, and it was a great way to tie what we'd been learning into different types of tasks and life beyond the classroom.

December 9, 2015 *I wonder if laying/sitting around the classroom will make it easier for ST to focus? Seems to struggle in his chair. Will try tomorrow.* One of my support team members teaches our k/1 class. She had recently gotten rid of all her chairs and replaced them with an assortment of pads, cushions, and beanbag chairs. That got me thinking about how my students' ability to stay on task might be related to their physical comfort level. I did let kids move around the classroom after that with mixed results. ST chose to lay down and did stay much more the focused during the next day's assessment. Subsequent results for him were mixed, too.

December 10, 2015 *During today's assessment, one student started to ask an "I don't get it" question but suddenly stopped and continued on to task a very specific question about a word problem. Another student did ask an "I don't get it" question concerning a word problem. I had her go through our problem-solving routine. First she read only the particular question they wanted answered, then we reread the entire problem. At that point she said she had a plan and could solve it by herself.* These incidents were very encouraging and also brought to mind another assessment when a different student raised her hand to ask question. I was working with someone else at the time, and it took me several minutes to get to her. By the time I did, she told me that she kept working while she waited and was able to work it out herself. I was excited when these things happened because this is exactly the direction I want these kids to grow in.

January 20, 2015 *Tried hard to make encouraging statements and congratulations to kids when checking their work.* I had tried to do this all along, but on this day I strove to make sure every kid who brought their work up felt as good about their work as possible. I was worried that some of them have no expectation of success with these PNQ lessons. If students truly don't believe they can succeed, where is their incentive to keep working? I didn't want to make the problems too easy, and I tried to differentiate the types of problems different students received. I tried to work up to harder problems, but maybe I didn't do a good enough job of that. I may have jumped up to too difficult a level too soon. I think I felt a time crunch because of this project. I think it work better if I just started slowly at the beginning of the year and worked up to more challenging work over the course of the entire year.

January 20, 2015 *Grrrr*. When reviewing the recording for this lesson, I found that most of the students were standing in line for most it. I tracked one student and found he worked for a total of 3 ½ minutes and stood in line for 11 ½ minutes. So few kids were in their seats at the times I was checking to see if they were on task that I really had no usable data. I thought that having kids get their work checked one problem at a time would make them feel the lessons were more manageable, and it seemed to work. Unfortunately, it really destroyed the idea of having them work for sustained periods of time

January 28, 2015 *I had a sub today and asked him to give a math problem-solving assignment where the students were to write out their plan to solve a pretty complex problem. Unfortunately, I didn't do a good enough job of writing out my instructions.* I wanted the kids to practice communicating their thought processes in written form. I really didn't care if anyone solved the problem or even if their plans would actually work. I just wanted them to come up with a plan and communicate it. Instead of doing this, the substitute saw the students struggling to come up with a viable plan and walked the entire class through it together. Nothing was written down. This was really the most important thing I had for the day, and I was pretty steamed at the sub for not getting it done correctly. After I calmed down, I went back to my sub plans and realized I had explained what I wanted done but not why. I failed at exactly the same thing I was asking my students to do. It was pretty humbling but funny, too.

March 11 – *I've really been struggling to put my data together. I realized that I don't have enough data from the Open Response questions and that even if I did, there is*

no way that any of my data is really valid for testing my 2nd and 3rd questions. I can't prove that any of my data from the AIMSweb probes or Open Response questions is connected to my treatment. I did find that I had data that could address student attitudes concerning perseverance and that might actually be a question I should be looking at. I conferred with Walt and decided to scrap my 2nd and 3rd questions and add a new one. In doing so I also removed the Open Response and AIMSweb instruments from my matrix.

When I started putting my data together, I looked at what I had in reference to my 2nd and 3rd research questions:

What are the effects of teaching and practicing perseverance on elementary students' performance on solving complex word problems on math assessments?

What are the effects of teaching and practicing perseverance on elementary students' ability to explain problem-solving strategies employed?

and realized that I had no way of tying my results on student achievement to my treatment at all. I had some data to compare AIMSweb results to previous years, but I wouldn't have had any other means of triangulation for these questions. I did, however, find I had data that could be directed toward a question on student attitudes about perseverance. After discussing my concerns with my advisor, I decided to pull out the earlier research questions and replace them with the question:

How does teaching and practicing perseverance affect elementary students' appreciation of their ability to persevere over extended periods of time?