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Parental Beliefs on the Efficacy of Productive Struggle  
and their Relation to Homework-helping Behavior

A thesis submitted in partial satisfaction  
of the requirements for the degree Master of Art  
in Education

by

Salvador Roberto Vazquez

2016

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## ABSTRACT OF THE THESIS

### Parental Beliefs on the Efficacy of Productive Struggle and their Relation to Homework-helping Behavior

by

Salvador Roberto Vazquez

Master of Art in Education

University of California, Los Angeles, 2016

Professor Gerardo Ramirez, Chair

Productive struggle is expending effort to make sense of something that is beyond one's current level of understanding. Research shows that productive struggle aids in learning math concepts and procedures. The goal of this investigation was to understand parental beliefs regarding productive struggle and how these beliefs are associated with parental homework involvement. One hundred and ninety-seven parents with children in the first to fifth grade were recruited and surveyed online. Parental beliefs about productive struggle were assessed via questionnaire and rating of a video portraying instruction involving productive struggle. Parents also reported on the extent to which they helped with math homework, their child's ability in math, and their views on the affective nature of homework-helping interactions with their child. Results indicate that parents have diverse beliefs about the efficacy of productive struggle, with fathers favoring

productive struggle more than mothers. A significant relationship was found between parents' beliefs about productive struggle and reports of their child's ability at math and affect of the homework-helping interaction.

The thesis of Salvador Roberto Vazquez is approved.

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2016

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## Parental Beliefs on the Efficacy of Productive Struggle and their Relation to Homework-helping Behavior

The disfluent process that characterizes the experience of struggle is something that people try to avoid and often consider an impediment to learning, but recent research is showing that struggling can be productive towards enhancing learning (Kornell & Son, 2009). Productive struggle is defined as expending effort to make sense of something that is beyond one's current level of understanding (Hiebert & Grouws, 2007). With roots in Piaget's and Vygotsky's theories of cognitive development, productive struggle is based on the notion that destabilizing a child's knowledge of the world and exposing him or her to scaffolded activities that are just beyond his or her individual level of understanding drives learning. Productive struggle has become a prevalent topic in education circles recently because the Common Core State Standards (CCSS) in Mathematics are heavily influenced by the notion of struggling and persisting with math problems (Common Core State Standards Initiative, 2009).

Although there are a growing number of investigations on the value of productive struggle in the school setting, much less is known about parental beliefs regarding productive struggle and how this impacts how parents work with their children on homework. To better understand what parents think about productive struggle, in this investigation parents were asked what they think about productive struggle using a questionnaire and video of a classroom lesson engaging in productive struggle. Also, parents were asked how often they help their children with math homework, what their perceptions of their child's ability in math were, and what the affective nature of the homework-helping interaction was like.

## **Productive Struggle in School**

Research on persistence in learning dates as far back as John Dewey (Hiebert & Grouws, 2007). However, only recently have studies begun to provide empirical evidence for the benefits underlying productive struggle during learning. Evidence of a relationship between productive struggle and achievement in mathematics initially came from the Third International Mathematics and Science Study (TIMSS) video study. TIMSS was conducted to assess how math and science was being taught in eighth grade math classes in countries around the world and, in doing so, help unravel which teaching practices facilitated student achievement (Hiebert et al., 2003; Hiebert & Stigler, 2000). In high performing Japan, for instance, students were asked by their teachers to spend more time engaging in struggle inducing activities such as creating their own methods for solving problems based on previous lessons, writing their own proofs, and applying concepts to new types of problems (Stigler & Hiebert, 1997). In contrast, students in the United States and Germany spent more time doing rote activities like practicing the procedures that had just been demonstrated by the teacher (Stigler & Hiebert, 1997).

More recent evidence for the benefits of productive struggle come from classroom studies showing that engaging in effort when solving math problems that are just beyond a student's current ability leads to better retention of the material, better conceptual understanding, and the creation of more possible solutions to the problem (Kapur, 2008, 2010, 2014). Studies done in Singapore by Manu Kapur, for instance, have built on this area of work by introducing elements of productive struggle, which he calls productive failure, in the classroom. Kapur (2010) assigned two groups of 7<sup>th</sup> grade students to one of two 2-week curriculum designs on rate and speed: a struggle inducing curriculum design and a lecture and practice design. Students in the struggle inducing curriculum condition were instructed to work in groups to solve complex rate

and speed problems without any support or scaffolds until they received a consolidation lesson at the end of the 2-week curriculum. In contrast, students in the lecture and practice condition received teacher led lectures and were asked to practice example problems in class and for homework as well as problems with clear parameters and predictable solutions and strategies.

In spite of most of the struggle inducing students' failure to solve the complex problems they were given, they still outperformed the lecture and practice students on a post-test of less complex math problems and higher order application problems. Additionally, the struggle inducing students performed better on well-scaffolded problems based on higher-level concepts that were not previously taught to any of the participants. These results suggest that there is more to learning than simply coming up with a correct solution to a problem. How that solution is reached seems to be as critically important as reaching the solution itself. Much like the activities that math students in Japan engage in, by having to generate solutions to the problems without any guidance and scaffolds other than any previous knowledge that the student may already have, students in the struggle inducing condition were engaging in productive struggle.

Productive struggle has also been illustrated in case studies about teachers who document the process of switching instruction from a traditional lecture and practice mode to a more student-centered approach that forces students to grapple with the material and redefines the role of the teacher to that of the facilitator (Ermeling, 2010; Reinhart, 2000; Smith, 2009). For instance, in the course of developing an inquiry based professional development program for science teachers, Ermeling (2010) found that promoting struggle helped teachers to better assess what misconceptions students held about important concepts in physics, biology, and chemistry. In instances when the participating teachers failed to adhere to the struggle promoting lesson plans, students responded to the lesson as if they understood the material but still failed to grasp

the concept that was being taught. What is evident in the examples cited here is that engaging students in activities that lead to struggle requires a shift in how teachers define success but leads to students gaining conceptual fluency in the topic that they are studying.

Some of the research on exploratory learning has also been useful here as it suggests that giving students the opportunity to explore math problems before receiving instruction improves students understanding of the material (DeCaro & Rittle-Johnson, 2012). DeCaro and Rittle-Johnson (2012), for instance, randomly assigned 2<sup>nd</sup> through 4<sup>th</sup> grade students to receive instruction on mathematical equivalency concepts. Students in the explore-instruct group were allowed to work on the math equivalency problems before receiving direct instruction on the concept of math equivalency while students in the instruct-practice group received direct instruction on math equivalency concepts before being given equivalency problems to practice on. Explore-instruct students performed poorly on the first set of practice problems in comparison to the instruct-practice group, however they outperformed the instruct-practice group on the post-test. Interestingly, on a measure of perceived understanding of math equivalency, the explore-instruct students seem to have had a better sense of their limited understanding of math equivalency than the instruct-practice students, thus indicating that struggling with a set of math problems before receiving direct instruction may help students attend more closely to their “gaps” in knowledge rather than attending to the entire lesson.

What much of the aforementioned evidence for productive struggle has in common is the notion that expending effort can lead to deeper memory and elaboration of material. This premise is actually well supported by research from cognitive psychology. Work by Robert Bjork, for instance, illustrates that introducing elements that make instruction difficult for the student often results in better retention and understanding of the material being taught (Bjork &

Bjork, 2011; Clark & Bjork, 2014). These desirable difficulties often force students to work within their Zone of Proximal Development thus allowing them to build slowly on previously learned material. Roediger & Karpicke (2006) demonstrated that one such desirable difficulty, the testing effect, improves learning outcomes on long-term retention tests. Participants in this study were asked to study passages and either take a test on the passage or study the passage again before taking a final test. Those who took tests instead of restudying the passage forgot less information and performed better on a retention test one-week after initial administration.

There is clear evidence from the domains of education and cognitive psychology illustrating the positive impact that productive struggle has on enhancing the learning experience for students in the classroom. Next I will discuss how parents can also have an impact on whether or not their children engage in productive struggle.

### **The Role of Parents in Productive Struggle**

One factor that previous studies on productive struggle have yet to explore is the role that parents play in either facilitating or hindering the benefits of productive struggle in their children. Although education in the United States originated in the home, as education transitioned into the public institution that it is today, parents began to withdraw from the educational process and placed the onus of their children's achievement on the schools and teachers (Jeynes, 2014). Parental involvement became relevant in research circles around the 1970's when researchers began to notice the correlation between declining SAT scores and an increase in divorces and women entering the workforce (Jeynes, 2014; McLanahan & Sandefur, 1994; Wirtz, 1977). This observation heightened focus on the role that parents play in shaping learning opportunities for their children.

Since then, a plethora of studies have shown the effects that parental involvement can have on student achievement (Crane, 1996; Jeynes, 2005; Muller, 1998; Shaver & Walls, 1998; Zdzinski, 1996) as well as various aspects of social-emotional well being such as self-esteem and parent/child relationships (Brown, 1989). Additionally, the importance of parental involvement has become more relevant as the federal government has taken it upon itself to legislate parental involvement into educational reform policies like Goals 2000 and No Child Left Behind (Epstein, 2005; Kohl, Lengua, & McMahon, 2000) which have encouraged school districts to engage parents in the education of their children. In light of all the research showing the benefits of parental involvement in education and its implementation into policies, it is now considered an essential component of any child's education.

With an increase in policies and initiatives meant to encourage parental involvement in children's education, there has been some concern that there may be some forms of parental involvement that are more harmful than helpful. For instance, studies in the area of homework-helping indicate that parents can transfer their own negative attitudes and beliefs to their child while helping them and this in turn has an effect on how the child learns (Bhanot & Jovanovic, 2005; Gonida & Cortina, 2014; Pomerantz, Wang, & Ng, 2005). Pomerantz and colleagues were interested in mothers' affect while interacting with their children during homework. Using a daily interview method for collecting data, Pomerantz et al. (2005) found that mothers reported more negative affect in the form of annoyance and frustration on days that they assisted their children with homework. The authors concluded that the negative affect was not a result of the mothers having to help their child, but instead was a consequence of the mother perceiving the child as being helpless. This negative affect reported by mothers was not predictive of their children's emotional and motivational functioning six months later as long as the mothers were

able to maintain positive affect during the homework-helping interaction. When mothers were not able to maintain positive affect during the interaction and reported heightened levels of negative affect, children reported poor positive emotional functioning six months later. This study lends evidence to the notion that homework interactions can be a vehicle for transferring more than academic knowledge from the parent to the child. Most importantly, this study touches upon the notion of perception; how a parent perceives the child not only impacts how the parent chooses to approach the homework interaction, but also influences the child's emotions and motivations.

Bhanot and Jovanovic (2005) examined if parental beliefs about academic gender stereotypes had any effect on how children perceived their own ability in math and English. More specifically, the authors were interested in knowing whether or not the frequency with which a parent intruded during homework-helping situations was associated with the parent's gender stereotyped belief. Using surveys that measured children's perceptions of their ability in math and English, parent's perception of their child's ability in math and English, parent's academic gender stereotyped beliefs, and parent's intrusive support during homework-helping situations, the authors found results on the effects of parent's gender stereotypes about math and girl's perceived math ability. Parents who reported strong math gender stereotypes were more likely to intrude when their children, both boys and girls, were working on their math homework. Additionally, parents who reported lower perceived abilities in their children displayed more intrusive support. All three variables – parental math gender stereotypes, perceived ability of child, and intrusiveness – correlated with the child's perception of their own ability in math such that children who perceived their own math ability to be low had parents with strong math gender stereotypes, who perceived their children's math ability to be low, and were more



intrusive when their children were doing math homework. These results were only significant for girls and this gave the authors the opportunity to test for possible mediating factors. Their findings suggest that parental intrusiveness mediates the effects between parental math gender stereotypes and girl's perceived math ability.

According to Bahnot and Jovanovic (2005), it is possible that parental attitudes and beliefs may be influencing how parents interact with their children when helping them with homework. The children then pick up on these behaviors and make attributions about their own ability. In this case, the girls may be interpreting the intrusions from their parents during their math homework as their parent's belief that math is difficult for girls. Perceiving that their parents promote the stereotype may result in the girls applying the stereotype to their own math abilities thus resulting in possible deficits in their motivation to achieve in math.

Gonida and Cortina (2014) studied whether different types of parental involvement during homework (i.e., autonomy support, control, interference, and cognitive engagement) are predicted by the parent's mastery goal orientation (a focus on understanding concepts and skill acquisition) and performance goal orientation (a focus on gaining favorable judgment and higher grades) for their children and their beliefs about the efficacy of their children. They also examined if the different types of parental involvement predicted student achievement goal orientations, efficacy beliefs, and achievement. Findings relevant for this study indicate that parents who possessed a mastery goal for their children also supported autonomy and interfered less during their children's homework. Contrary to this, parents who had performance goals for their children were more likely to interfere and exhibit controlling behaviors when helping with homework. Parent autonomy support was found to be a mediator of parent mastery goals and student mastery goals, such that parents with a mastery goal were more likely to support

autonomy and this in turn resulted in students also having a mastery goal perspective in their studies.

In terms of efficacy beliefs, student academic efficacy was predicted to be higher when parents interfered less and when parents were more cognitively engaging during the homework interaction. There was also a mediating effect such that parents who believed their children to be efficacious were more likely to be cognitively engaging and less likely to interfere leading to children also feeling efficacious about their own academic abilities. These findings not only imply that having a belief that your child has low efficacy in academic situations can be detrimental to the child, but it also implicates cognitive engagement and interference as parental behaviors that mediate whether or not a child feels efficacious about their school work.

The aforementioned studies help illustrate that the attitudes and beliefs a parent brings to the homework-helping interaction can significantly impact not only how the child approaches homework but also how they approach their academic work in general. Of course, many parents go into these homework interactions with the intent of helping rather than hurting children's learning and disposition. Yet, the researched outlined thus far suggests that parents who prevent students from experiencing productive struggle, perhaps by providing frequent homework help, may disrupt children's learning. Another study that provided evidence for the negative effect of parent homework helping on children's learning looked at the impact of frequent homework helping on growth in math learning as a function of parent's own math anxiety. To test this hypothesis, the researchers measured children's math achievement at both the beginning and end of the school year. Children's parents were also asked to report how frequently they helped with homework and their anxious response in regards to situations that involve math. Surprisingly, the researchers found that, for parents with higher math anxiety, a higher frequency of help with

homework was associated with lower gains in their own children's math achievement across the school year. For parents lower in math anxiety, a higher frequency of help with homework was not associated with children's learning which is in line with meta-analysis reporting that direct homework instruction among parents provides little to no benefit to children (Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015). Despite parents having noble intentions when helping their children with math homework, it is important to assess whether their belief in productive struggle may be subverting any potential gains in learning.

### **Using an Indirect Measure of Parents' Beliefs in the Efficacy of Productive Struggle**

Many parents today face a different way of learning math than when they were in school. This way of learning math is sometimes referred to as "drill and kill" because students would have to repeatedly solve math problems until they had the procedures memorized. Some parents may be so engrained in the "old way" of learning math that although they may self-report that they believe in the efficacy of productive struggle, their implicit attitude of distrust towards new methods of teaching math may persist (Dovidio, Gaertner, Kawakami, & Hodson, 2002; Wilson, Lindsey, & Schooler, 2000). For example, the Dual Attitude Model proposed by Wilson, Lindsey, and Schooler (2000) suggests that when an individual changes their attitude, it is still possible for their original attitude to persist implicitly and come out indirectly. Although most evidence for dual attitudes comes from studies about prejudice and race, I reason that parents who were generally taught math using a "drill and kill" approach may think that that is the correct way of learning math. However, with new educational reforms dictating that students ought to be challenged more often, it is likely that even parents, who in theory subscribe to the new beliefs about productive struggle being efficacious, in practice may still have deeply held positive attitudes about the "drill and kill" style of teaching math. Hence, this study will ask

parents to evaluate a video of a classroom lesson that engages students in the disfluent process of productive struggle to assess what parents think about productive struggle when seeing it in practice. I hypothesize that by using an actual classroom lesson as an instrument to measure parental beliefs about the efficacy of productive struggle in addition to a questionnaire, I will be able to capture parents' explicit and implicit beliefs on the efficacy of productive struggle.

### **The Current Study**

Although there is growing evidence of the utility of productive struggle in learning, much less is known about what parents believe regarding the efficacy of productive struggle. It is possible, for example, that parents might find the notion that struggle enhances learning to seem very counterintuitive. For instance, Kornell & Bjork (2007) have shown that despite the opportunities that disfluent learning provides, most college students incorrectly assume that fluent study opportunities are more beneficial. Hence, it is critical to understand what parents believe about the efficacy of struggle as it relates to students math learning.

The current study was guided by the following questions:

1. What are parents' beliefs about the efficacy of productive struggle?
2. Do parents' beliefs about the efficacy of productive struggle differ by SES or gender?
3. Is there a relationship between parents' beliefs in the efficacy of struggle and how often they help with math homework?
4. Do parents' perceptions of their child's ability in math and the affective nature of the homework-helping interaction relate to parents' beliefs about the efficacy of struggle?

Question one is explorative and I expect to find that there will be variability in how parents feel about the efficacy of productive struggle. Question two is also explorative but there is literature suggesting that with regards to schooling, parents treat children differently

depending on their gender and parents of different socioeconomic status may vary in how involved they are in their children's education (Lytton & Romney, 1991; Pew Research Center, 2015). For question three, I hypothesize that there will be a relationship such that parents who believe in the efficacy of struggle will be more likely to help less often with math homework. Finally, much of the homework helping literature often includes parents' perceptions of their child's ability and reports of the affective nature of the homework-helping interaction as potential moderators for explaining parental involvement and academic achievement (Bhanot & Jovanovic, 2005; Gonida & Cortina, 2014; Pomerantz et al., 2005). Therefore, for this study I hypothesize that both of these variables will have significant relationships with parents' beliefs about the efficacy of productive struggle.

In summary, the goal of this study is to address whether or not parents endorse the use of productive struggle. I intend to address this question by measuring parents' disposition around productive struggle using a questionnaire and perceptions of a video of a classroom lesson engaging students in the act of productive struggle. I will also address whether responses on the questionnaire and video predicts how often parents help their child during math homework interactions. Also, I address what other factors may be influencing how parents feel about productive struggle. This study hopes to add to the body of work supporting the use of productive struggle in math and problem solving situations as well as sparking new work on how to help parents create better learning environments at home for their children.

## **Method**

### **Participants**

A total of 286 participants were recruited from Amazon Mechanical Turk (MTurk) for this study. MTurk is an open online marketplace for getting work done by others and contains

essential elements for conducting research, such as an integrated participant compensation system, a large participant pool, and a streamlined process of study design, participant recruitment, and data collection (Buhrmester, Kwang, & Gosling, 2011). Using this online platform, parents were recruited to answer questions regarding their beliefs about the efficacy of struggle, about interactions with their child during homework, and watch an example of productive struggle in the classroom and respond to questions about the classroom lesson.

In order to qualify for participation in the study, participants had to answer two qualifying questions asking them if they had a child who was currently enrolled in the first through fifth grade and whether or not that child's teacher assigned homework. Potential recruits who failed to answer either of the two questions affirmatively were skipped to the end of the survey and thanked for attempting to participate. Participants who were permitted to participate were also asked to answer several questions about their child's age and birthday at the beginning and at the very end of the survey as a way to check that they were not misrepresenting their parent status and were paying attention to the questions. Those who completed the survey received \$2 for their participation.

After omitting participants who did not qualify for our study either because they had no children or they were not consistent on the birthday, there were a total of 197 individual parents who reported having children attending elementary school in either the first through fifth grades within the United States. Of the 197 parents, 101 were female and there was a mean age of 34.2 ( $SD = 6.91$ ) and of the 197 children that the parents were asked to answer questions about, 108 were male and there was a mean school grade level of 2.72 ( $SD = 1.48$ ). (See Table 1 for participant demographics.)

## Measures

**Belief in the Efficacy of Struggle Questionnaire (BESQ).** Parental attitudes towards productive struggle were measured using a scale that was designed to tap into the operational definition of productive struggle which is expending effort to make sense of something that is beyond one's current level of understanding (Hiebert & Grouws, 2007). The specific items asked parents to express their agreement with learning situations that vary in the extent to which they might promote productive struggle as described in the literature. For example, parents were asked to rate "*Children will learn more if they are given math problems that take a long time to think through and solve*" on a 5-point Likert scale ranging from *Strongly Disagree* to *Strongly Agree*.

Survey construction began by generating a total of 49 items. Items that were redundant, not clear, and too simple to answer were modified or eliminated. The initial reduction of items resulted in 23 items that were then categorized into the following three broad categories that are based on the understanding of behaviors that influence productive struggle as described in the literature: 1. Enable Extended Struggle vs. Provide Immediate Assistance, 2. Encourage Conceptual Inquiry vs. Teach/Review Known Procedures, and 3. Foster Tolerance for Mental Angst vs. Act to Reduce Mental Angst. Experts in the field of math education were asked to review each of the 23 items and decide if the items captured the construct of productive struggle and categorize the items into one of the three broad categories. After expert review, the set of items were reduced to 18 items that were subsequently pilot tested with a sample of 333 parents. The goal of this pilot test was to further reduce the scale by eliminating items that did not show variability. Items that did not show a normal distribution of responses from the participants were

excluded from the scale. A final set of 12 items ( $\alpha = .857$ ) was used for this study (see Appendix A for all items).

**Homework-Helping Interaction Questions.** Items within this questionnaire focused on assessing how often the child was being helped, the affective nature of the homework-helping interaction, and parent's perception of the child's ability in math (adapted from Hyde, Else-Quest, Alibali, Knuth, & Romberg, 2006). Parents were asked to respond to the following items: How often do you help your child with their math homework? (1 = *Never* – 6 = *Every day*), When you help your child with math homework how frustrating is the interaction? (1 = *Not at all frustrating to me* – 7 = *Very frustrating to me*), and In terms of math my child's current performance is (1 = *poor* – 5 = *excellent*). All homework questions asked about both math homework and language arts homework, but this study will focus on responses given to math homework questions. (see Appendix B for all items).

**Classroom Instruction Video.** The classroom video was administered to participants using a video-based learning platform called Zaption. Zaption was the ideal platform for presenting the video to participants because it allows users to add paused periods where participants could read additional information that added context to the video they were watching and also allows for questions to be inserted immediately following the video without requiring participants to leave the Zaption website.

The Classroom Instruction Video came from a collaborator who filmed lessons in Japan where teachers were implementing practices that are in line with Common Core principles in the United States. The original video clip was approximately 10 minutes long but the video was reduced to a total of 3 minutes and 35 seconds and separated into three segments. The segments were designed to illustrate the progression of productive struggle during a math lesson and were



captured from the beginning of the lesson, the middle of the lesson, and towards the end of the lesson. The three segments were shown sequentially with short descriptions before each segment explaining the context of the lesson. Before each segment participants were also asked to imagine that what they were watching was happening in an American classroom and to think about how they would feel if this lesson was taking place in their child's math classroom.

At the conclusion of the video, participants were asked to answer three questions that asked the parents if the lesson was long enough, if it was appropriately difficult, and if it was effective at engaging students to learn (see Appendix C for all items).

The lesson in the video consisted of a teacher posing the following challenging math problem to a class of 2<sup>nd</sup> grade students: Solve the following equation by placing “+” and “-“ signs in between the numbers on the left side, 1 2 3 4 5 6 7 8 9 = 100. The teacher explicitly stated that for the first portion of the class the students would have to try and solve the problem on their own. Students were allowed to ask questions and the teacher offered feedback without ever explicitly stating the answer to the problem.

## **Procedures**

Participants who responded to the advertisement on MTurk and met all qualifications for participation were directed to the study at Survey Monkey. During the survey, participants were asked to click a link that opened a new window in their browser with the video at Zaption.com. The survey took approximately thirty minutes for most participants to complete. Participants who completed the study were paid \$2 at the completion of the study.

## **Results**

To understand parental beliefs about the efficacy of productive struggle, data from the BESQ and responses to the Classroom Instruction Video were first explored using descriptive

statistics, correlations and mean comparisons. After these initial analyses, relations between parental beliefs about the efficacy of productive struggle on both the BESQ and the Classroom Instruction Video, math homework helping frequency, parent's perception of their child's ability at math, and the affective nature of the homework-helping interaction were examined using correlational analysis.

### **Parents' Beliefs Regarding Productive Struggle**

**Belief in the Efficacy of Struggle Questionnaire.** Descriptive data for the main variables can be found in Table 2. Responses from the twelve-item BESQ were computed into a mean score for every respondent. Mean responses on the BESQ ( $M = 2.92$ ,  $SD = 0.70$ ) were normally distributed (Kolmogorov-Smirnov test  $p > .05$ ). As seen in Figure 1, parent's beliefs in the efficacy of struggle were widely distributed with 28% of parents believing that struggle is not efficacious for their children when doing math (i.e., responses at 2.5 on a 5-point scale and below).

Responses on the questionnaire differed as a function of parent's gender,  $t(195) = 2.127$ ,  $p < .05$ , and the gender of the target child,  $t(195) = 2.828$ ,  $p < .05$ , such that fathers ( $M = 3.03$ ,  $SD = 0.62$ ) and parents with sons ( $M = 3.05$ ,  $SD = 0.73$ ) reported a stronger belief in the efficacy of struggle than mothers ( $M = 2.82$ ,  $SD = 0.76$ ) and parents with daughters ( $M = 2.77$ ,  $SD = 0.63$ ), respectively. In comparing mothers who had a son ( $M = 2.99$ ,  $SD = 0.81$ ) versus those who had a daughter ( $M = 2.67$ ,  $SD = 0.68$ ) those who had a son reported a significantly stronger belief in struggle,  $t(99) = 2.168$ ,  $p < .05$ . Father's mean scores on the BESQ did not differ as a function of the target child's gender,  $t(94) = 1.289$ ,  $p > .05$ . A 2 (Parent Gender) x 2 (Child Gender) factorial ANOVA on mean scores on the BESQ did not reveal a significant interaction,  $F(1,193)$

= .570,  $p > .05$ . These results indicate that parents may have different expectations for how efficacious struggle can be based on the child's gender.

In order to examine the relationship between the BESQ and socioeconomic status (SES), I first computed SES by standardizing self-reported gross income and maternal education level and then taking an average across both measures. The relationship between the BESQ and SES was not significant,  $r(192) = -0.073, p > .05$ .

**Classroom Instruction Video.** Responses to the three items about the Classroom Instruction Video were computed into a mean score for every respondent ( $M = 2.90, SD = 0.83$ ). Parents who had a low mean score believed that the lesson was ineffective at engaging students in learning whereas parents who had a high mean score believed that the lesson was effective at engaging students in learning. Mean responses to the Classroom Instruction Video were not normally distributed according to a Kolmogorov-Smirnov test ( $p < .05$ ), however a visual inspection of the distribution (see Figure 2) and the Q-Q plot confirms that parents' responses to the video appear to show a normal distribution of responses. Over 30% of the parents rated the classroom lesson as being ineffective, indicating that there are a portion of parents who do not agree with productive struggle being used in the classroom setting to help children learn (i.e., responses at 2.5 on a 5-point scale and below).

As with the BESQ, responses to the video differed as a function of the parent's gender,  $t(195) = 2.434, p < .05$ , but did not differ as a function of the child's gender,  $t(195) = .891, p > .05$ . Fathers ( $M = 3.05, SD = 0.83$ ) believed the classroom lesson to be more effective than mothers ( $M = 2.76, SD = 0.82$ ). With regards to SES, there was no significant relationship with parents' responses to the video,  $r(192) = -0.036, p > .05$ .

Findings from both the BESQ (explicit measure) and the Classroom Instruction Video (indirect measure) indicate that there is a lot of variability in how parents feel towards productive struggle being used as a method to help enhance student learning. Although there was no relationship between SES and parent's belief in productive struggle, there were significant differences in how fathers and mothers feel about struggle. Those differences also seem to depend on whether the target child was male or female. Next, I look at how often parents are helping with math homework and if there is a relationship between how often they are helping and their beliefs about struggle.

### **Math Homework Help Frequency**

A single item was used to measure how often parents help their children with math homework. The distribution of responses was negatively skewed (see Figure 3), indicating that a large proportion of the parents in the sample help their children often with math homework ( $M = 4.85$ ,  $SD = 1.08$ ). Approximately 70% of parents reported helping their children with math homework at least 2-3 times per week.

Frequency of help with math homework differed as a function of parent's gender,  $t(195) = -2.179$ ,  $p < .05$ , with mothers ( $M = 5.01$ ,  $SD = 1.07$ ) reporting helping their children with math homework more often than fathers ( $M = 4.68$ ,  $SD = 1.07$ ). There were no significant differences in how often parents helped with math homework as a function of the child's gender,  $t(195) = -.073$ ,  $p > .05$ . SES was not significantly correlated with how often parents were helping with math homework,  $r(192) = .046$ ,  $p > .05$ .

In order to assess my question of whether belief in the efficacy of struggle relates to how often parents help with math homework, I first ran a correlation between the mean score on the BESQ and parents' self-reports on how often they help with math homework (see Table 3). I

found no significant correlation,  $r(197) = -.001, p > .05$ , indicating that parents who explicitly report believing in the efficacy of struggle are not helping their children with math homework less often than parents who explicitly report not believing in the efficacy of struggle. Next, I examined the relations between my indirect measure of parent's belief in productive struggle, the Classroom Instruction Video, and math homework help frequency. There was a significant correlation,  $r(197) = -.200, p < .05$ , supporting the hypothesis that parents who believe in the efficacy of struggle will help less often with math homework.

Despite most parents reporting that they help often with math homework, there was still an indication that some parents, mostly mothers, are helping more than fathers. The data also indicates support for the hypothesis that parent's who believe in the efficacy of struggle will help less often with math homework, although this was only true for the Classroom Instruction Video and not for the BESQ. I now turn to look at what other factors may be influencing parents' belief of productive struggle.

### **Factors Potentially Related to Productive Struggle Beliefs**

Two variables that are often mentioned in the homework literature are parents' perception of their child's ability in school and the affective nature of the homework-helping interaction (Bhanot & Jovanovic, 2005; Pomerantz et al., 2005). For this set of analyses, I was interested in knowing whether these two variables relate to a parent's belief in struggle. In order to assess this relationship I ran correlations between the variables in question (see Table 3).

**Perception of Child's Ability in Math.** I first ran a correlation between parents' perception of their child's ability in math and the BESQ. There was a significant correlation,  $r(197) = .228, p < .005$ , indicating that parent's who perceive their child to have a high ability in math are also more likely to report a strong belief in the efficacy of struggle. Conversely,

parent's who perceive their child to be bad at math are less likely to endorse a strong belief in the efficacy of struggle.

Next, I ran a correlation between parent's perceptions of their child's ability in math and the Classroom Instruction Video. Once again, there was a significant correlation,  $r(197) = .234, p < .005$ , indicating a positive relationship between a parent's perception of their child's ability in math and how they feel about productive struggle.

**Affective Nature of the Homework-Helping Interaction.** In order to address whether the BESQ relates to the affective experience of helping with math homework I examined the relation between the BESQ and a mean score of four measures of the affective experience of helping the child with math homework. A low mean score of affect during the homework-helping interaction indicates a positive experience while a high mean score indicates a more negative experience. There was a significant correlation between homework affect and the BESQ,  $r(197) = -0.155, p < .05$ , indicating that parents who reported strong beliefs in the efficacy of productive struggle were more likely to indicate that their math homework-helping interactions with their children were affectively positive.

Next, the relationship between parents' mean affect scores and the Classroom Instruction Video was significant,  $r(197) = -0.433, p < .01$ , such that parent's who reported strong beliefs in the efficacy of productive struggle were more likely to report positive experiences when helping their child with math homework.

These findings with regard to parents' perception of their child's ability and the affective nature of the homework-helping interaction are important in guiding future work in the hope of finding potential mechanisms for how a parent's belief in productive struggle could impact their child's academic achievement.

## Discussion

Research in the areas of education and cognitive psychology back up the notion that expending effort to make sense of something that is not immediately apparent leads to better retention and understanding of the material being taught (Bjork & Bjork, 2011; Clark & Bjork, 2014; Hiebert & Grouws, 2007; Kapur, 2008, 2010, 2014). Yet, many parents may be unfamiliar with these benefits so it is important to get a better understanding of how parents regard productive struggle and whether or not that relates to how they help their children with math homework.

### Parents' Beliefs on Productive Struggle

Parents' responses to the BESQ and the Classroom Instruction Video indicated that parents' opinions on productive struggle are very diverse. Interestingly, findings indicate that approximately 30% of parents feel that productive struggle is not something that they believe will benefit their children. It is important to figure out why so many parents hold such negative attitudes towards productive struggle considering the bigger consensus in the literature about the benefits of allowing for disfluent learning experiences.

One way in which parents may have been introduced to the concept of productive struggle is through the implementation of Common Core State Standards (CCSS) in their child's math homework. It is possible that parent views on productive struggle reflect, at least in part, the current climate regarding the implementation of CCSS in mathematics in the United States. The first of eight *Standards for Mathematical Practice* in the *Common Core State Standards for Mathematics* states that students ought to be able to "Make sense of problems and persevere in solving them" (Common Core State Standards Initiative, 2009). However, the *46th edition of the PDK/Gallup Poll of the Public's Attitudes Toward the Public Schools*, for instance, found that of

the 1,001 adults polled, 80% had heard about Common Core and 60% opposed it (Camera, 2014). These findings are backed up by reports on popular media outlets and social media websites. It is not uncommon to find news stories about parents posting their children's math problems on Twitter and Facebook in an attempt to show other people just how ridiculous they think the new math curriculum is (Kircher, 2015; Torres, 2014). In addition to this, celebrities have begun to chime in on the merits of CCSS in mathematics thus shining a brighter spot light on the issue (Mead, 2014; Summers, 2014). Louis C.K., a popular comedian who's comedy is often based on his experience as a father of two daughters, is credited with starting a movement among celebrities that challenge CCSS and its math curriculum for being too challenging (Summers, 2014).

One complaint parents have about CCSS math curriculum is that math problems now require solution methods that parents are unfamiliar with and this renders them incapable of helping their children with math homework (Boser, 2015). This is important because Hoover-Dempsey and Sandler (1997) found that one way that parents determine to take part in their child's education is by determining if their participation is efficacious. It is also worth noting that the CCSS approach to learning mathematics is in contrast to older methods often termed "drill and kill" in which students were often tasked with solving problems repeatedly until the procedure was memorized. For many of today's parents, "drill and kill" is often viewed as the proper method of learning math because it is how they were taught. I reason that because CCSS in mathematics relies on principles of productive struggle in order to facilitate the understanding of conceptual math knowledge, parents may inadvertently hold negative attitudes towards productive struggle.



There is also the potential that other aspects of the homework-helping interaction can be impacting parents' beliefs about productive struggle. For instance, Pomerantz and colleagues (2005) implicated both the affective experience of the homework-helping interaction and the parent's perceptions of their child's ability to perform well. Although this study was not designed to deduce causal relationships between variables, there were significant relationships between parents' perceptions of their child's ability at math, the affective nature of the homework-helping interaction, and parents' belief in productive struggle (on both the BESQ and the Classroom Instruction Video). With regards to parents' perceptions of their child's ability in math, parents who perceive their children to be good at math may find that productive struggle is an effective method for their child to learn because the child has the necessary prior knowledge to persist during difficult math problems. There are studies that support this interpretation by indicating that having relevant prior knowledge prepares students to infer unstated information when faced with challenging problems (McNamara, Kintsch, Songer, & Kintsch, 1996). This interpretation is also consistent with the notion that in order for productive struggle to be effective, tasks must fall within a child's Zone of Proximal Development. Any math problem that fails to meet this basic requirement may discourage the child from persisting with the task. As a result, parents who perceive their children to not be good at math may be more inclined to avoid struggle altogether out of fear that struggle will lead the child to feel frustrated or disengaged. I argue that these parents would be justified in avoiding struggle-oriented curriculum if it falls outside of their child's Zone of Proximal Development. However, parents who have positive experiences when helping their children with math homework may be more receptive to productive struggle because they know that their child will maintain good behavior even while facing a challenging math problem.

## **Homework Help Frequency and Productive Struggle**

Overall, of the parents assessed, 70% reported helping their children with math homework at least two to three times a week. These findings are not surprising considering that parents are currently facing a climate that encourages their involvement in their child's education (Epstein, 2005; Kohl et al., 2000). Also, the sample for this study focused on parents with children between the first and fifth grade mainly because that is a time period in a child's development when a parental involvement is still normative (Brumariu & Kerns, 2010).

The literature on inducing productive struggle to help students learn math emphasizes the notion of a student-centered approach to teaching. For productive struggle to be effective, teachers must facilitate the classroom and this is often evident in the use of exploratory or delayed instruction, having student led question and answer sessions, and having students reason through failed attempts (DeCaro & Rittle-Johnson, 2012; Kapur, 2010, 2014; Reinhart, 2000; Smith, 2009). Although parents are not always trained teachers, they are often the only person that children can depend on when it comes to homework. A student-centered approach to homework might be an efficacious approach towards ensuring that frequent interactions between parents and children leads to beneficial academic outcomes for the child. Yet, a student-centered approach could involve a parent who limits their interaction with the child in order to facilitate explorative processes before giving help. Therefore, I hypothesized that a parent who held strong beliefs in the efficacy of struggle would be less likely to help their child with math homework.

Data from the Classroom Instruction Video supported this hypothesis while data from the BESQ did not. Overall, parents who rated the classroom lesson to be an effective way of teaching children math also reported helping less often with math homework. While this gives some evidence to the notion that parents' attitudes towards productive struggle may be having an

impact on how they interact with their child during homework-helping interactions, there is still concern to be had with the many parents who may be helping too often. For instance, Maloney and colleagues (2015) reported that children of parents with math anxiety were learning significantly less math over the course of a school year only when the parents were helping too frequently with math homework. Although this study does not attempt to find a mechanism for explaining how parents' attitude toward productive struggle directly impacts children's math achievement, there is evidence in the literature suggesting that when a parent holds a negative trait or attitude, be it a stereotype or anxiety, an increased frequency of help with homework may lead to parents unintentionally disrupting their child's learning.

### **Gender Differences**

Data analysis revealed significant differences between fathers and mothers on the BESQ, Classroom Instruction Video, and the frequency of math homework help. Results from both the BESQ and the Classroom Instruction Video, for instance, indicate that fathers may value productive struggle more than mothers do. It is difficult to say exactly why that may be, there is evidence in the literature suggesting that parent's gender stereotypes may influence how they interact with their child during homework (Bhanot & Jovanovic, 2005). This is especially relevant with mathematics, which is still considered to be a male domain and parents are known to enforce gender-typed activities (Lytton & Romney, 1991). Indeed, when reporting on the BESQ, parents with sons were reporting a stronger belief in productive struggle than parents with daughters. It is likely that these differences can be due to parents believing in gender stereotypes about math in general. It is also possible that gender stereotypes unrelated to math may be influencing fathers to feel more comfortable with the notion of productive struggle and

parents in general to feel that productive struggle is more suitable for boys because of the connotative baggage the word struggle carries with it.

A quick search in a thesaurus reveals struggle being associated with words such as fight, grapple, wrestle, and brawl; all words that are usually associated more with males than females. If parents are carrying these associations with them when being assessed about their views of productive struggle with regards to their own children, they may be more likely to ascribe productive struggle as being more appropriate for males than females. Similarly, the results also indicate a gender difference in how often parents were helping with math homework. Mothers overall held weaker beliefs in productive struggle and helped most often with math homework while fathers held stronger beliefs in productive struggle and helped less often than mothers. These results confirm my hypothesis that parents who believe in productive struggle will help less often with homework in order to encourage their children to reason through the math problems on their own. Interestingly, this was only the case when separating parents by gender.

Knowing how beneficial productive struggle can be for conceptually understanding math, it is important that future studies attempt to disentangle how mothers and fathers are treating their sons and daughters differently when it comes to their math homework. If encouraging our daughters to persist and struggle with math can lead to a better understanding of it, productive struggle may be a useful tool for closing the gender gap in math.

### **Explicit versus Indirect Measure of Belief in Productive Struggle**

Both the BESQ and the Classroom Instruction Video were used in order to have both an explicit measure of the parents' belief about productive struggle and an indirect measure. Based on the literature, it was my hope that the Classroom Instruction Video would allow parents to report on their beliefs about productive struggle by having a less abstract representation of what

productive struggle looks like. This was an attempt to look at how parents truly feel about a style of learning that is, in most instances, very different from the “drill and kill” style of learning math that many parents today experienced when they were in school. As expected, the BESQ and the video correlated with each other and the correlation was not very strong (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). The Classroom Instruction Video did correlate with homework helping frequency and supported the hypothesis that a stronger belief in productive struggle would relate with a lower frequency of help with math homework, while the BESQ did not support this correlation. This could be an indication that the Classroom Instruction Video serves as a better measure of parents’ beliefs in productive struggle, but that assertion cannot be made without further studies.

### **Limitations**

There are several limitations in this study that should be taken into consideration before drawing any conclusions. First, this investigation was not designed to find causal relationships. For instance, I do not suggest that having a strong belief in productive struggle will lead to better homework interactions with your child. Many of the findings in this study will require further investigation before any causal conclusions can be made. Second, all measures were self-reported by the participants. Despite a reliance on self-reported data, there were significant relationships between the variables of interest and future studies can begin to investigate these relationships using more externally valid measures such as observing parents and children work on math homework together. Finally, there is no data on how parents chose to help their children with homework in this investigation. There might be more relevance to knowing how parents help in addition to how often they help with homework because much of the literature on productive struggle focuses on different techniques such as exploration with the problems sets

and using open ended questions that encourage the student to explain how they solved a math problem. Future studies can gather data about the specific strategies being used by parents when helping with math homework in order to assess any differences between parents who support productive struggle and those that do not.

## **Conclusion**

The goal of this study was to learn more about what parents think about productive struggle in math. Research backs up the efficacy of productive struggle in math, yet some parents remain skeptical about its use with their children. There is some evidence from this study that suggests a relationship between a parent's beliefs in productive struggle and how often they help with homework. There is also an indication that mothers and fathers do not agree on the efficacy of productive struggle and this could be having an impact on how often boys and girls are being helped with math homework. Finally, there is need to look at what other factors may be influencing how parents feel about productive struggle. Future studies should look to the role of gender stereotypes, parent's perceptions of their child's ability at math, and the affective nature of the homework helping experience in order to learn more about how parents can change their attitudes towards productive struggle and learn to incorporate it in their homework-helping routines.

Table 1

*Participant Demographics (N = 197)*

Variable	Frequency	Percent
<b>Ethnicity</b>		
Native American	2	1.0
Asian	12	6.1
African American	21	10.7
Latino	16	8.1
White	132	67.0
Other	14	7.1
<b>Income (US\$)</b>		
Less than 15,000	4	2.0
15,000 to 34,999	35	17.8
35,000 to 49,999	45	22.8
50,000 to 74,999	57	28.9
75,000 to 99,999	26	13.2
100,000 or more	30	15.2
<b>Education</b>		
Less than HS	1	0.5
HS or GED	20	10.2
At least 1 year college	43	21.8
AA or equivalent 2-year undergrad degree	31	15.7
Bachelor's or equivalent 4-year undergrad degree	69	35.0
Some graduate training (not completed)	7	3.6
Graduate degree	26	13.2

Table 2

*Descriptives for Measures of Interest*

Measures	N	Mean	SD
Belief in the Efficacy of Struggle Questionnaire (BESQ)	197	2.92	0.70
Classroom Instruction Video	197	2.90	0.83
Math Homework Help Frequency	197	4.85	1.08
Homework Affect	197	2.83	1.53
Perceived Ability in Math	197	3.76	0.89
SES Standardized	192	0.0076	0.81

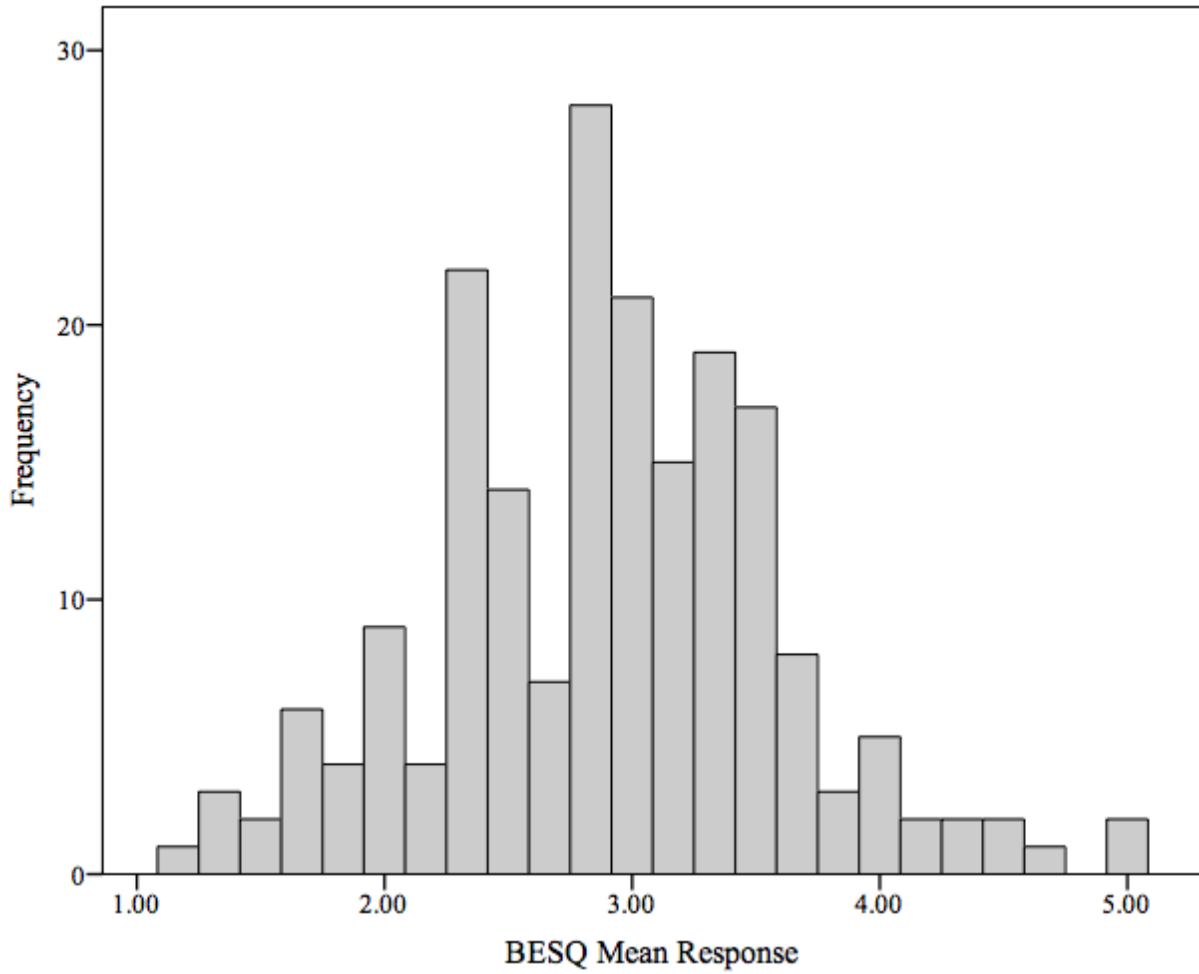


Table 3

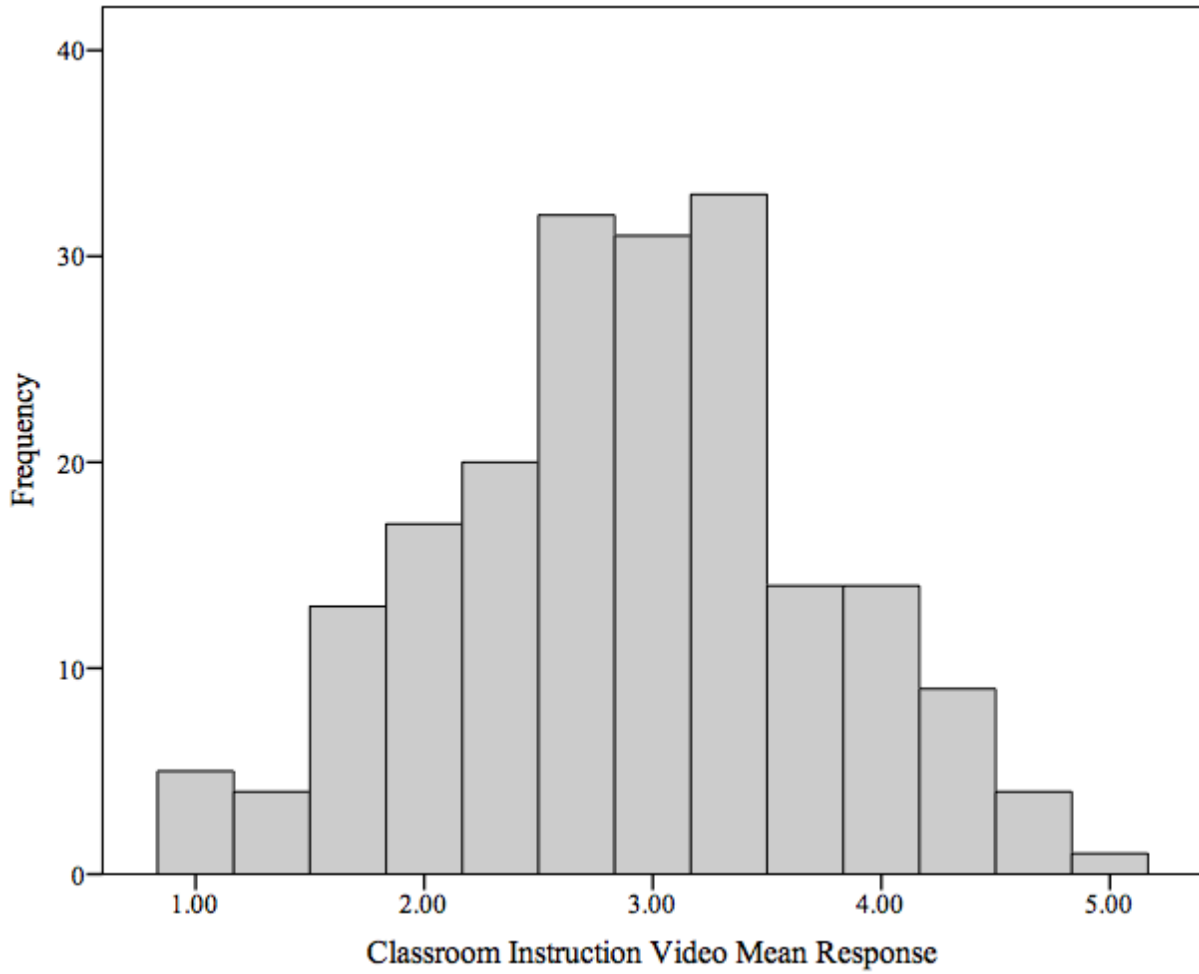
*Correlations Between Measures of Interest*

Measure	1	2	3	4	5
1. Belief in the Efficacy of Struggle Questionnaire (BESQ)	-				
2. Classroom Instruction Video	0.231**	-			
3. Math Homework Help Frequency	-0.001	-0.200**	-		
4. Homework Affect	-0.155*	-0.292**	0.042	-	
5. Perceived Ability in Math	0.228**	0.234**	0.067	-0.391**	-
6. SES Standardized	-0.073	-0.036	0.046	-0.063	0.029

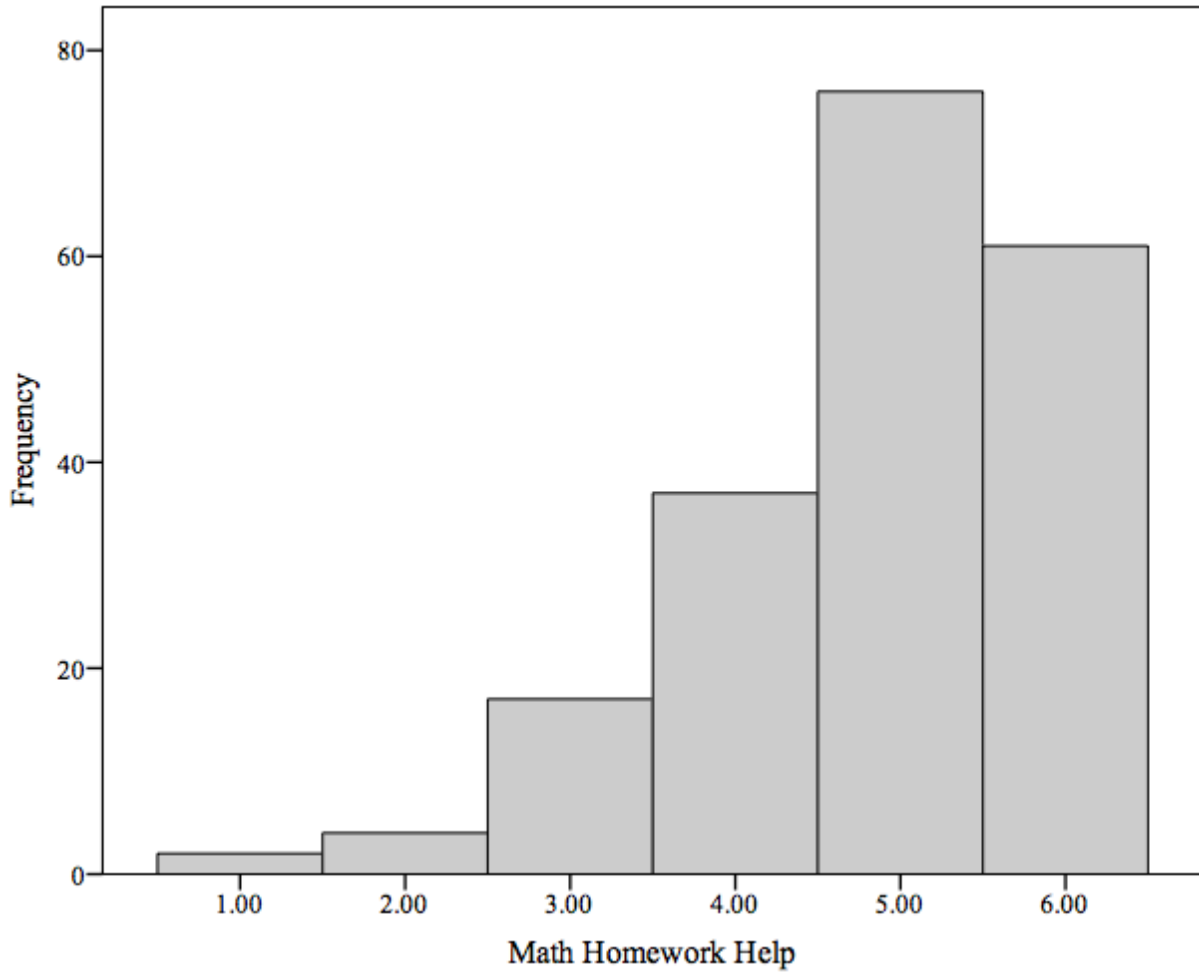
\*p < .05, \*\*p < .01



*Figure 1.* Distribution of the mean responses to the Belief in the Efficacy of Struggle Questionnaire (BESQ)



*Figure 2.* Distribution of the mean responses to the Classroom Instruction Video.



*Figure 3.* Distribution of parents' response to how often they help their child with math homework.

## Appendix A

### Belief in the Efficacy of Struggle Questionnaire (BESQ)

1. Children will learn more if they try to make sense of their math homework on their own even if they don't get many of the problems correct
2. Children will learn more if they are allowed to make mistakes and receive delayed feedback
3. Children will learn more if they are encouraged to stick with a math problem even when they are not sure how to solve it
4. Children will learn more if they are asked to wrestle with challenging problems even if they don't remember how to solve them
5. Children will learn more if they are given difficult math problems to solve even if they didn't get a chance to practice them in class
6. Children will learn more if their teacher gives them math problems that are a little too difficult for them to solve
7. Children will learn more if they attempt to solve demanding math problems on their own
8. Children will learn more if they attempt to come up with additional math solving strategies without any help from their teachers
9. Children will learn more if they are asked to use unfamiliar methods for solving math problems
10. Children will learn more if they are given math problems that take a long time to think through and solve
11. Children who don't yet have a complete understanding of the material can learn more from attempting difficult math problems

12. Children will learn more if they are taught math solution strategies that are different from what their parents were taught

## Appendix B

### Homework Interaction Questions

1. How often do you help your child with math homework?
  1. Never
  2. Once a month
  3. 2-3 times a month
  4. Once a week
  5. 2-3 times a week
  6. Every day
  
2. When you help your child with math homework, how frustrating is the interaction?
  1. Not at all frustrating to me
  - 2.
  - 3.
  - 4.
  - 5.
  - 6.
  7. Very frustrating to me
  
3. When you help your child with math homework, how much conflict is there between you and your child?
  1. No conflict
  - 2.
  - 3.
  - 4.

- 5.
  - 6.
  7. A lot of conflict
4. When you help your child with math homework, how stressful is the interaction?
1. Not at all stressful
  - 2.
  - 3.
  - 4.
  - 5.
  - 6.
  7. Very stressful
5. How do you emotionally feel about your interactions with your child during math homework?
1. Feels close or warm
  - 2.
  - 3.
  - 4.
  - 5.
  - 6.
  7. Feels distant or cold
6. In terms of math, my child's current performance is
1. Poor
  2. Fair



3. Good
4. Very good
5. Excellent

## Appendix C

### Classroom Instruction Video Questions

1. The students worked for about 10 more minutes. They spent a total of 30 minutes working on this problem before the teacher stopped to discuss some possible solutions. After introducing the problem, how long would you allow students to work before you stopped to explain the solutions?
  1. 1-5 minutes
  2. 5-10 minutes
  3. 15-20 minutes
  4. 20-25 minutes
  5. 30 minutes or more
  
2. On a scale of 1-5, how appropriate is the level of difficulty in this lesson?
  1. Not at all appropriate
  - 2.
  - 3.
  - 4.
  5. Very appropriate
  
3. This teacher gave children a difficult math problem without first providing them with a lesson on how to solve it. Children spend a total of 30 minutes on this problem before the teacher stopped to discuss some possible solutions. On a scale of 1-5, how effective is this approach for engaging students in learning?
  1. Not at all effective
  - 2.

- 3.
- 4.
5. Very effective

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