Motivating Student Learning in the Middle School Math Classroom

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Abstract
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Motivating Student Learning in the Middle School Math Classroom

One of the most difficult challenges faced by middle school mathematics teachers is that of motivating their students to learn. Motivation becomes an important factor in student learning, especially at the middle school level. The transition from elementary school to middle school, in addition to the onset of adolescence, results in a decline of student motivation. It is imperative for teachers to understand how their students are feeling in regards to their education.

Some students enter the classroom with intrinsic motivation. They are ready to learn and do not need much effort from the teacher in order to engage in their learning. Other students have some motivation, but at times, need a little push from their teacher to get involved. These students might be motivated by a game, a challenge, group work or even grades.

There is a smaller group of students who seem to be lost and sometimes seem to go unnoticed. These are the students who are unmotivated to learn and are at risk of failure. These students are often a source of frustration for teachers. Not because they are bad kids, but because they are so difficult to motivate and engage. These are students that are often tuned out during class, have trouble completing homework, are lacking parental support and do not use learning strategies. They might present behavioral problems and often refuse to put forth effort because they are accustomed to failure.

It is imperative that educators understand why these students lack motivation. Having a good understanding of the different kinds of motivation can increase a teacher’s ability to influence their students’ desire to learn. When students are motivated to learn, they are more likely to be successful.
The purpose of this literature review was to aide in the understanding of academic motivation. Some students are intrinsically motivated while others require some external factors in order to influence their learning. The following research will distinguish between these motivations and explore the relationships between the two. Some researchers believed that extrinsic rewards undermine intrinsic motivation and should be eliminated from classroom use. Others have claimed that extrinsic rewards are necessary to motivate those who are not otherwise intrinsically motivated. The following literature review will pay close attention to these conflicting views.

The research that follows will evaluate the effectiveness of strategies that could potentially motivate the most unmotivated students; those who are completely disengaged and are in the mindset of learned helplessness. In particular, the research conducted in this study looked at the effects of collaborative group work and problem based learning on student engagement and motivation. The hypothesis is that student-centered, problem based learning could serve as a very powerful tool when it comes to motivating at-risk, middle school math students to learn. Giving students some control over their learning, the freedom to be creative, and mathematics that is applicable to real life has the potential to capture student interest and increase their desire to learn and engage.
When a child has the desire to learn, they are more likely to be successful in their studies. Unfortunately, “Student resistance to learning has become a central, endemic problem of educational systems” (McFaraland, 2001, p. 612). The following literature review will look into the differences between intrinsic and extrinsic motivation and the varying views of researchers on their effectiveness. It will also present the pros and cons of possible strategies that can be used to motivate students who seem, otherwise, unmotivated. Some such strategies include collaborative group work, teaching self-regulation strategies, high stakes testing and the threat of retention. These strategies come into play as students begin to experience changes in their levels of academic motivation.

At a young age, children are naturally inquisitive. However, research shows that as children begin to reach their adolescent years their motivation to learn begins to decline rapidly. As teachers, it is important to understand what causes this drop in motivation and what we can do to negate it. If students are not self-motivated, it is our job as teachers to motivate them to succeed.

Changes in Motivation

Several studies have looked into changes in student motivation during their adolescent years. Dolezal, Welsh, Pressley and Vincent (2003) wrote, “There are well documented declines in academic motivation as students advance through the elementary grades” (p. 240). Research done by Gad Yair showed that high school students are even less motivated than middle school students. Many educators are aware that their students are unmotivated, but do not understand the reason why. Besides the obvious fact that adolescence is a major turning point in the lives of our students, the change from
elementary school to middle school is a large transition. Dembo and Eaton (2000) wrote, “For many individuals, this transition represents the beginning of a general deterioration in academic performance, motivation, self-perceptions of ability, and relationships with peers and teachers” (p. 473).

One reason for the decline in motivation is that the atmosphere in most middle schools is very different than that of elementary schools. “A sense of relatedness and of belonging at school is associated positively with students’ expectancies for success and intrinsic value for school- both indicators of motivation” (Ryan & Patrick, 2001, p. 438). The more comfortable a student feels with his or her teachers and peers, the better their chances of success. Because middle schools are generally larger and less personal than elementary schools, “teachers must interact with so many more students which makes it more likely that emerging motivational problems will go unnoticed” (Eccles, Wigfield, Midgley, Reuman, Maclver, & Feldlauffer, 1993, p. 560).

Not only is the change in social environment an adjustment for students, but classroom instruction in middle schools also greatly differs from that of elementary schools. Yair (2000) wrote, “The bureaucratic structure of instruction lowers students’ intrinsic motivation, and, consequently, their achievements” (p. 193). Results of the study by Eccles et al. (1993) indicated that middle school math teachers “control students more, provide them fewer decision-making opportunities and feel less efficacious” (p. 553). When students have the option of choice, research shows they are more likely to be motivated and engaged.

Another difference between elementary and middle/high school math classrooms is that upper level math classes become heavily focused on content and standards. The
study by Schiefele and Csikszentmihalyi (1995) showed that “having the students become interested in mathematics and having them become aware of the importance of mathematics in daily life were among the least emphasized objectives of senior high school teachers” (p. 178). It is important for teachers to know and remember that when students are interested in what they are learning and see its value, they are more likely to be motivated to learn. “Therefore, educators should be encouraged to focus more strongly on facilitating interest” (Schiefele & Csikszentmihalyi, 1995, p. 179).

**Interest and Motivation**

Research has shown that student interest is strongly linked to their performance in the classroom. Hidi and Harackiewicz (2000) concluded that student interests and goals are “two of the most important motivational variables that impact individuals’ academic performance” (p. 151). It is true that not all students will be interested in the content that they are learning, but teachers need to plan lessons that will keep students engaged despite their lack of interest.

The study done by Samuelowicz and Bain (2001) observed teachers and then conducted interviews about their views on motivation and interest. One teacher “emphasized the importance of engaging student interests and motivation through the use of engaging learning tasks” while another teacher “saw it as his responsibility to motivate and interest students by demonstrating his own enthusiasm for the subject” (Samuelowicz & Bain, 2001, p. 319). Another study that videotaped teachers’ lessons suggested that, “the teacher’s expression of enthusiasm conveys the message that they are eager for students to learn and will persist in helping them” (Bettencourt, Gillett, Gall, & Hull,
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1983, p. 446). In fact, several studies agree that both methods, teacher enthusiasm and use of engaging activities, are the most effective ways to increase student interest.

At this point, it is important to discuss what exactly is meant by the term interest. Most studies on interest and motivation differentiate between two different kinds of interest, individual or actualized interest and situational interest. Actualized interest refers to the student’s own interest in the content being learned. The student sees some value, purpose or use to what he or she is learning. “Situational interest is generated by external stimuli” (Koller, Baumert, & Schnabel, 2001, p. 449). Although the student may not be interested in the content they are learning, the particular situation or activity may interest them enough to become engaged in the lesson. An example of situational interest might be when a student is actively involved in a game during class for the sake of competition, as opposed to the desire to learn the material being covered. “By focusing on the enhancement of situational interest in classrooms, educators can find ways to foster students’ involvement in specific content areas and increase levels of academic motivation” (Hidi & Harackiewicz, 2000, p. 153). Situational interest should be viewed as a powerful tool by teachers because once a student is involved in an enjoyable activity, they might discover an actual interest in the content and therefore be more motivated to learn it in the future.

Research on classroom environments showed that “the most effective classrooms were defined, in part, by high student engagement” (Dolezal et al., 2003, p. 240). When students are engaged in something that interests them, whether it is an actual interest or a situational interest, they are more motivated to learn. The research of Dolezal et al. was based on teacher and student questionnaires. The results of the study yielded an extensive
list of effective ways to actively engage students. Some of these include: utilizing cooperative learning, holding students accountable, scaffolding, making cross-curricular connections, encouraging student autonomy and allowing them to make choices, having a gentle and caring manner, positively interacting and connecting with students, supporting appropriate risk-taking, encouraging creativity, providing work that is appropriately challenging, and developing game-like lessons and activities. Teachers can decide which of these methods works better in their classroom for their particular students. In the end, research shows that keeping students engaged will lead to greater student interest and, as a result, it will increase motivation and academic achievement.

In addition to high student engagement, “the effectiveness of any teaching method depends on the enthusiasm and interest of the teacher” (Rosenfield, 1978, p. 163). This means that, not only should the teacher have a positive attitude in the classroom, but it also means that teachers need to be passionate and believe that their subject is important. Then, they need to convey this passion and value to their students. One video study showed that in classrooms, “the students received few signals that what they were learning matters and that working hard pays off” (Roderick & Engel, 2001, p. 197). In a similar study, “none of the teachers were observed making the types of overt attempts to motivate their students by stressing that mathematics can be personally fun and exciting” (Middleton, 1995, p. 275). Teachers spend so much time and energy trying to ensure that they are meeting the high level standards that have been set for them that they sometimes neglect to take the time to demonstrate the true importance of what students are learning. When students see value, purpose and something exciting about what they are learning, they will be more willing to engage.
On the subject of student interest, one last thing to consider is that teachers ultimately cannot force students to be interested in their content. For example, it is impossible to force a middle school student to like mathematics. “This does not imply that teachers should ignore students’ interests but they should be aware that increasing the academic interest of all students in a specific domain is not a desirable goal” (Koller et al., 2001, p. 466). Instead, the goal should be to create situational interest for these students. Research shows that “students’ interest in what they learn, and their sense of enjoyment while learning, are highly correlated with the outcomes of learning (Yair, 2000). Maybe the previous student likes football instead of math. Then perhaps, the teacher can create a football math game, or a lesson involving integer operations and football yardage or statistics. When teachers create an opportunity for an uninterested student to become situationally interested, that teacher is successfully engaging his students in mathematics.

Self-Efficacy and Ability

When used in an educational context, self-efficacy refers to a student’s thoughts and beliefs about his or her own ability to meet learning goals. “Research on self-efficacy proposes that students have beliefs about their abilities to apply the skills and knowledge they have to learn something new. These beliefs influence how much effort students expend” (Dole, Brown, & Trathen, 1996, p. 75). There is an important partnership between students and teachers in the classroom, however, based on their research, Dembo and Eaton (2000) wrote that “no one has more control over a student’s success than the student himself” (p. 487). If a teacher gives a large assignment and says it needs to be completed in five minutes, some students may see this as an impossible task. These are
the students who might not even begin to try the assignment because they see the goal as impossible. For a student to be motivated to learn, he or she has to truly believe that the goal or learning outcome is attainable.

When students experience failure, their self-efficacy and motivation begin to decline. Middleton (1995) found that, “less motivated students lacked confidence in tackling mathematics problems” (p. 273). Especially at the middle school level, students are overly sensitive to failure, demonstrate lower self-efficacy and are afraid to make mistakes. If failure continues, a student could take on the behaviors typically referred to as learned helplessness. “Helpless individuals believe that success is out of their grasp. They tend to show little motivation for challenging tasks. In fact, when facing a challenging task, they display lower achievement than can be attributed to ability” (Middleton & Spanias, 1999, p. 71).

Teachers need to be aware of and be sensitive to their students who are in the mindset of learned helplessness. A study by Roderick and Engel (2001) showed that, “Teachers rarely recognized the possibility that the students’ low motivation was a reflection of their low skills, problems, or lack of external support. Students with the lowest skills face the greatest task and at the same time often have the fewest resources to accomplish that task” (p. 219). Unmotivated students are often unmotivated because they do face the most daunting task. They have the furthest to go and the hardest to work in order to be successful. In addition, they most likely lack the strategies needed to help them succeed.

Educators need to be aware of their students with low self-efficacy. They need to help them set goals that are attainable, teach them strategies, and encourage them to
succeed. It is also beneficial to these students to allow them to experience success, even if the task is a small one. The feeling of success will help that student begin to re-develop his or her own self-efficacy. When students have confidence in their abilities and believe they will be successful, they are more likely to be engaged and motivated by their learning.

**Self Regulation**

Another way for teachers to help their students to be successful is to understand the difference between learners and non-learners. Successful learners seek help and are able to advocate for themselves. “Research indicates that learning self-regulatory skills can lead to greater academic achievement and an increased sense of efficacy” (Dembo & Eaton, 2000, p. 474). Students who are able to self–regulate are motivated. They use effective strategies, manage their time wisely, are not distracted by their environment and are in control of their own learning. Pennel (1985) wrote:

Children who perceive themselves as “learners” do learn and change; those without that personal perception do not. In problem-solving situations, the “learners” reveal their assurance as they plan, implement, and evaluate strategies. “Non-learners” attempt to follow direction without knowing why, utilize random strategies, and cannot express what thinking they employ. The variable that separates children in special education from those in regular education may be one person convincing a child that he can learn, as opposed to direct or subtle implications that he cannot. (p. 131)

Students with the ability to self-regulate are able to convince themselves to do work, even when the task is boring or they do not feel like doing it. Teachers can
encourage their students to be self-regulated learners by moving from a teacher centered to a more student managed learning environment. “Academic independence occurs when students learn how to regulate their own behaviors so they can control the outcome of their performance” (Dembo & Eaton, 2000, p. 484). Educators should allow their students to develop these self-regulatory skills by structuring their classrooms such that students take charge of their own learning and are held accountable for their performance.

“An important component of academic success is students’ motivation and ability to take responsibility for their own learning. One way to increase academic performance is to teach students how to become self-regulated learners” (Dembo & Eaton, 2000, p. 473). One research study created a summer program for students with special needs in order to teach them specific self-regulatory skills and strategies. They focused on strategies for recording and completing homework assignments. “Whenever a large group of at-risk students becomes motivated to acquire the needed low order skills, a straightforward intervention such as the one proposed is an effective route” (Eilam, 2001, p. 719).

Researchers agreed that, “when given a learning task, successful learners monitor and control their behavior by setting goals, using their prior knowledge, considering alternative strategies, developing a plan of attack, and considering contingency plans when they run into trouble. In contrast, less successful students have little awareness of the factors affecting learning and are less likely to take charge of their own learning” (Dembo & Eaton, 2000, p. 474). Teaching students these self-regulatory skills can give them strategies to be successful, motivate them to become more involved in school work and increase their confidence as they transition into high school.
Intrinsic and Extrinsic Motivation

Research on motivation clearly differentiated between two types of motivation; intrinsic motivation and extrinsic motivation. These are two very different types of motivation. They come from different sources and each has different effects on a child’s engagement and effort in the classroom. For this reason, intrinsic and extrinsic motivation have both been studied in depth by researchers.

“Intrinsic motivation is typically defined as the motivation to engage in activities for their own sake” (Hidi & Harackiewicz, 2000, p. 157). Intrinsic motivation is self motivation that is usually brought into the classroom by students. Students who are intrinsically motivated are able to self-regulate and they tend to naturally put forth more effort. “Research has shown that when children are motivated intrinsically to perform an academic activity, they spend more time engaged in the activity, learn better, and enjoy the activity more than when they are motivated extrinsically. Clearly, getting children to engage in learning for its own sake is a primary goal of educators” (Middleton, 1995, p. 254).

Teachers have the ability to motivate their students intrinsically by providing them with challenges. “Most educators believe that students need to be challenged. Challenge gives students the intrinsic rewards that come from setting goals and working strategically to attain them” (Meyer, Turner, & Spencer, 1997, p. 501). When students feel a sense of accomplishment or pride in completing work that was difficult, they are more likely to strive for that feeling again in the future. “Studies on intrinsic motivation have shown that individuals enjoy and choose to engage in tasks that are moderately difficult, vary in format, and are personally meaningful” (Stipek, Salmon, Givven,
Kazemi, Saxe, & MacGyvers, 1998, p. 468). If an assignment is too easy, a student might not take it seriously; if it is too difficult, then the student might give up. Finding an appropriate level of difficulty proves to be an effective method of motivating students. Since intrinsic motivation is such a powerful kind of motivation, researchers agree that “Designing intrinsically motivating activities is of paramount importance in developing lifelong learners” (Middleton, 1995, p. 254).

If students are not intrinsically motivated, then extrinsic motivation seems to be the next best thing. Extrinsic motivation is when students are motivated by some other external factor or reward. Extrinsic rewards are usually offered or given by teachers, parents or coaches as a method of engaging their students. Some examples of extrinsic motivation include stickers, star charts, pizza parties, verbal praise, candy and threats of retention or detention. Research shows that, “extrinsic motivation tends to be short lived, dissipating when the threat or reward is removed” (Roderick & Engel, 2001, p. 200).

Some researchers believe that because academically unmotivated children are often uninterested in learning, teachers should provide external rewards and plan activities that allow for situational interest. Hidi and Harackiewicz (2000) believed that this might be the most effective ways to motivate these students. They wrote, “If students become engaged in academic tasks, there is at least a chance that genuine interests and intrinsic motivation will emerge” (p. 159). Studies have also been done to determine the effects of incentives on employees in the work force. “A central tenet of economics is that individuals respond to incentives. Incentives have been shown to promote effort and performance in the work place” (Benabou & Tirole, 2003, p. 489). There was some
debate among researchers, however, as to whether or not offering rewards and incentives undermines intrinsic motivation. It is to this debate that we now turn.

*The Great Debate*

Over the past several years, educators have really tried to reduce external motivational influence and focus on intrinsic sources. Some go so far as to say that we should eliminate extrinsic motivation completely. “The often casual use of a variety of classroom systems of reward to control disruptive behavior or to increase academic achievement has recently been criticized as being one of the chief threats to the desire to learn” (Bates, 1979, p. 557). The Over-Justification Hypothesis is one reason for this belief. It states that, “In the presence of external controls, people attribute their behavior to an external agent; when this is removed, future motivation and performance decrease” (Cameron & Pierce, 1994, p. 370). Simply stated, if you reward a child for completing a task, from that point on, he or she will always expect or want that reward. There have been countless research studies performed to determine whether or not this is true.

One such study dealt with monkeys. The monkeys were given a toy puzzle that they really enjoyed playing with. Then, they monkeys were deprived of food for a period of time. The next time they were given the puzzle, it was filled with food. The monkeys grabbed the puzzle and devoured the food. After that, the monkeys showed little interest in the puzzle unless there was food involved.

Another study enlisted college students to complete math problems. Some subjects were told ahead of time that they would be paid for completing each problem, others were not. The results of the study showed that “the subjects who were paid to solve the problems typically chose easier ones than those who did not expect any
payment” (Benabou & Tirole, 2003, p. 495). The students who were not told about the payment chose more difficult problems to solve. Studies like this demonstrate the idea that rewards lead to inferior performance and decreased interest simply because the subjects merely wanted to finish the task. “The fear is that the supplying of a student with extrinsic incentives for learning may be an artificial procedure, unlikely to be paralleled outside the classroom, which may ultimately undermine the inherent human desire to learn for the sake of learning” (Bates, 1979, p. 557).

Other studies led their readers to believe that extrinsic motivators are good because they effectively engage students who are otherwise unmotivated. Since most teachers strive to engage all of their students simultaneously, rewards seem to work for the short term. These studies “suggest that creating incentives for low-achieving students through goals that provide an opportunity for feedback, a tangible reward, and a way to construct meaning regarding learning may have a positive impact on their motivation and effort in school” (Roderick & Engel, 2001, p. 219).

Points of Confusion

There are literally countless studies that have been done on motivation theory, intrinsic and extrinsic motivation. So many, in fact, that those reading the research are likely to become overwhelmed or even confused by the results of these studies. Some say extrinsic rewards are good, others say they undermine intrinsic motivations and yet others say the effects depend on other variables like time, and interest. “Terms such as tangible, expected, unexpected, contingent and non-contingent become very confusing to a reader sorting through this literature” (Cameron & Pierce, 1994, p. 395). Throughout research, these terms are use inconsistently or are sometimes not even included in the details. “This
has led to a great deal of misunderstanding about the overall effects of reward and reinforcement on intrinsic motivation” (Cameron & Pierce, 1994, p. 395).

Ultimately, when researching motivation, it is important to be very clear what variables you are dealing with. “Although the results of laboratory investigation into the effects of reward and reinforcement on intrinsic motivation appear contradictory and confusing, a general contention in many textbooks and journal articles is that reward and/or reinforcement is detrimental to an individual’s intrinsic motivation” (Cameron & Pierce, 1994, p. 370). There are many factors that go into motivation and it is very difficult to track all of them simultaneously.

One piece of information that may potentially clear up some of the debate is that incentives are reinforcers in the short run, and negative reinforcers in the long run (Benabou & Tirole, 2003), which makes logical sense. An extrinsic reward will most likely motivate a child to be engaged in a learning task at that particular moment. However, this may prove detrimental in the future because the child may require the reward in order to complete a similar type of task again.

Tangible rewards are rewards that a child can receive, such as toys or candy. “Rewards do not necessarily undermine intrinsic motivation but the expectation of tangible task-contingent rewards tends to weaken the intrinsic desire to learn” (Middleton & Spanias, 1999, p. 69). Again, the fact that the reward is expected is a key part of this study. If a tangible reward is given, but was unexpected, this would yield different results. Research by Cameron and Pierce (1994) indicated that “negative effects appear when expected tangible rewards are given to individuals simply for doing a task. Under
this condition, there is a minimal negative effect on intrinsic motivation as measured by time spent on task following the removal of reward” (p. 363).

**Incentives for Performance**

This brings up another important aspect of motivation research. When a child receives an incentive, one must carefully consider the reason for the reward. Researchers must clearly differentiate between giving rewards for task completion or participation and giving rewards for a job well done. Studies show that, “Tangible rewards produce no change in attitude when they are given for doing, completing, or solving a task; a positive effect is evident when rewards are contingent on a specific level of performance” (Cameron & Pierce, 1994, p. 396).

Giving rewards simply for engaging or participating in a task has actually shown to be detrimental to student learning. “First, when rewards have been made contingent only on participation in an activity, this has generally led to a decreased interest in that activity, especially if it was, in itself, an entertaining or stimulating enterprise” (Bates, 1979, p. 573).

A scenario of this type might be; instead of giving a class a pizza party for doing their homework, one might give the pizza party if the entire class completes their homework with at least 90% accuracy. Giving a party simply for completing the homework would encourage students to do a fast, sloppy job on their homework. They might not even care if they get the answers correct. As a result, your extrinsic motivation is actually reducing their efforts. However, rewarding them for doing a good job would encourage students to take their time on the assignment and possibly get something out of
it. When rewards are offered based on performance rather than task completion, most students are more motivated to put forth effort and produce quality work.

**High Stakes Testing**

Roderick and Engel (2001) looked into the effects of high stakes testing and the threat of retention on students’ motivation. In particular, the Chicago Public Schools use the threat of retention in order to motivate students and also to encourage parents to monitor their child’s performance.

Some educators feel that high stakes tests and the threat of retention will motivate students to work harder, and therefore increase achievement. “Opponents argue that these policies set up low-achieving students to fail, looking to research on motivation for evidence that extrinsic and negative incentives such as the threat of retention will undermine students’ engagement” (Roderick & Engel, 2001, p. 197). These students can end up feeling that the goals they need to achieve are too high. When goals seem unattainable, at-risk students tend to give up altogether.

As a result, teachers and school districts need to be careful about their position on retention and the way high-stakes tests are presented to their students. Roderick and Engel found that, “the way teachers manage high-stakes testing policies—whether they create environments that make low-achieving students feel supported and efficacious in responding to new demands and whether they direct students’ efforts in productive ways—has an important impact on student motivation and passing rates” (Roderick & Engel, 2001, p. 197). It is important to understand the mixed message that research provides about high stakes testing and the threat of retention. They have the ability to motivate some students, but could negatively impact others.
Synopsis

After reading the various literature on intrinsic motivation, extrinsic motivation, expected rewards, contingent rewards, unexpected rewards, tangible rewards, student goals, individual interest and situational interest, the reader is likely to be confused and overwhelmed by the sheer amount of information. The terminology used by authors is somewhat unclear and there is such a large number of variables involved with motivating student learning.

As a result, the meta-analysis conducted by Cameron and Pierce (1994) is very helpful to readers because they provided a concise summary of their results. They wrote:

When rewards are broken down into reward type, expectancy, and contingency, results indicate that, on the free-time measure, verbal reward produces an increase in intrinsic motivation; tangible rewards produce no effect when they are delivered unexpectedly, and they are not detrimental when they are expected and contingent on level performance or completing or solving a task. Expected tangible rewards produce a decrease in intrinsic motivation as measured by free time on task when they are given to individuals simply for engaging in an activity.

Overall, the present analysis suggests that teachers have no reason to resist implementing incentive systems in the classroom. (p. 394)

In short, some rewards are good for motivation and others are not. This is, of course, dependent upon whether or not the reward is expected, and whether the reward is presented for participation or for good performance. Teachers should not necessarily avoid extrinsic rewards altogether because there are students who really do need that external source of motivation.
**Effective Motivational and Instructional Strategies**

There is no magical wand that a teacher can wave to automatically have all of their students engaged and motivated to learn. There is no single answer to the question: What is the best way of teaching this lesson so that every student is motivated? The best we can do, as educators, is to know our students. Know which students bring intrinsic motivation with them, which students are motivated by a game or challenge, which students are motivated by group work and collaboration and which students will only be motivated by rewards and punishments. Rosenfield (1978) wrote, “No one method of teaching will be best for every student/teacher/subject combination, let alone for the mass of students any given teacher instructs” (p. 163).

The more teachers know about their students, the more effective their strategies will become. Middleton (1995) observed teachers to determine how well they knew what motivated their students, and also to chart which motivators these teachers were using in their classrooms. The study showed that most teachers were very aware of factors that motivated their highest and lowest achieving students, but they paid the least attention to the students that fell in between. One way for teachers to obtain a comprehensive list of motivational strategies that work for their particular students is to have a common planning time with other team teachers. This way, teachers can discuss the strategies they have implemented and their effectiveness. “In general, results indicate that when teachers are able to predict their students’ beliefs, they are better able to fine tune their instruction to turn kids on to mathematics” (Middleton, 1995, p. 254).

Ultimately, teachers want to know what instructional strategies are the most effective in motivating their students. (Dolezal et al., 2003) “In general, practices that
emphasize effort, learning and working hard enhance learning goals” (Stipek et al., 1998, p. 467). Other practices seen as normal, everyday, good teaching strategies have been shown to improve motivation as well. Some of these strategies include decreasing anxiety in the classroom, pre-teaching, using alternative assessments, and using small group or peer tutoring, “With a small group of students, tutoring has the potential of providing an instructional intensity that many in the field think is necessary for students with learning disabilities” (Woodward, Monroe, & Baxter, 2001, p. 34). When students receive this personalized attention and instruction, studies show an increase in their confidence and self-efficacy, which in turn, increases their motivation.

A study by Yair had students wear wrist watches that beeped. Every time the watch beeped, the students filled out a form about what they were doing and feeling at the time. This method of research is called the Experience Sampling Method (ESM). Results of study showed:

Intrinsic motivation is highly correlated with the structure of instruction. The sense of voluntary participation, or choice, is highly correlated with intrinsic motivation. This suggests that the more choices students have in learning, the higher their enjoyment from and interest in learning. Similarly, the more authentic or personally relevant the instruction, the higher the level of intrinsic motivation. (Yair, 2000, p. 203)

Another study by Dole et al. (1996) took a different route. Instead of analyzing the effects of instructional methods, they examined the effects of directly teaching students learning strategies to apply to their work. Students were directly instructed on
how to use different reading, writing and math strategies such as highlighting, underlining and note-taking. All students were expected to use these strategies.

The researchers then noted how the strategy instruction effected student motivation and achievement. The results of this study were quite interesting. Low achieving students who used the strategies showed academic improvement. Their responses were clear, correct and showed details. The downside to this strategy instruction occurred with the higher performing students. These students were forced to use the strategies on work that they were already completing successfully using their own personal methods. They were extremely discouraged by the amount of effort needed to put forth in order to change their routines into these new strategies that they were being forced to use. As a result, these students became frustrated and bored and their motivation for learning actually decreased. Dole et al. (1996) noted, “Neither skill nor will alone is sufficient; rather, good strategy users know how to use strategies and choose to put forth the effort to do so. Thus, while students’ motivation can influence their responses to instruction, we know that instruction can also influence students’ motivation” (p. 75).

When it comes to instruction and its effects on student motivation, the most important thing to remember is that all students are different and need different types of instruction. Educators need to be knowledgeable of their students and strategies that are most effective for those students. Middleton and Spanias (1999) provided an encouraging remark when they wrote, “Achievement motivation in mathematics is highly influenced by instructional practices, and if appropriate practices are consistent over a long period of time, children can and do learn to enjoy and value mathematics” (p. 82). In the end, any
Motivating Student Learning

An instructional strategy that effectively increases student self-confidence and/or instills a sense of pride will have a positive effect on student motivation and learning.

**Collaborative Group Work and Student-Centered Classrooms**

Studies have shown that, “students’ learning experiences are optimized when instruction is authentic, challenging, demands skills, and allows for student autonomy” (Yair, 2000, p. 191). “Experts have argued that didactic, teacher-controlled instruction that emphasizes performance undermines young children’s intrinsic motivation and their willingness to take academic risks” (Stipek, Feiler, Daniels, & Milburn, 1995, p. 209). As a result, researchers have spent a good deal of time looking at more student-centered methods of teaching. Collaborative Group Work and Problem Based Learning have been shown to be effective ways of motivating students without resorting to extrinsic rewards.

Problem Based Learning (not to be confused with Project Based Learning) tasks are “collaborative learning tasks that are in general designed as complex, challenging and authentic problems. Such problems motivate students to attempt different strategies and co-construct and justify solutions” (Dekker & Elshout-Mohr, 2004, p. 40). This type of collaboration “can support students in trying out ideas, learning from mistakes and persisting” (Meyer, Turner, & Spencer, 1997, p. 517). The problems that students are asked to face are considered ill-structured and open-ended. Emphasis is placed more on student interaction and the process they chose than the specific product/solution itself. Students are encouraged to try different strategies and clearly explain their thought processes.

Mathematics programs such as Realistic Mathematics Education (RME) and the Connected Math Program (CMP) are two examples of investigations based, student-
centered learning. They help students to understand mathematics through the use of authentic, story-like problems. Schiefele and Csikszentmihalyi (1995) wrote:

If a higher level of interest is desired, then instruction should involve more active and student-centered activities, such as mathematics laboratory activities or mathematics projects. In addition, learning about the application of mathematics concepts in the real world could facilitate increased interest in the subject, which in turn should lead to higher levels of involvement and achievement in mathematics. (p. 179)

Middleton (1999) studied a group of teachers as they switched from the traditional didactic, teacher-centered style of teaching to the more student-centered RME program. One teacher from the study indicated that, “For the first time her students knew why they should understand graphing and algebraic symbolization, and this practicality, more than the regular text, stimulated them to learn the content” (Middleton, 1999, p. 356). The results of the study showed that the RME program has positive effects on student learning. Middleton (1999) wrote, “assessment, questioning, and planning strategies became more attuned to the individual contributions of students- their strategies, explanations, and products. Teachers became more responsive to individual students and engaged classes in more discussion. Students became more confident in tackling difficult material and, as a result, more students became successful” (p. 352).

Overall, studies have shown that children in student-centered classrooms select more challenging tasks, are less dependent, exhibit more pride in their work and were more motivated than those in didactic settings (Stipek et al., 1995). Since motivation is clearly linked to academic risk taking, achievement goals and self-efficacy, it makes
sense that group work and collaboration would have a positive impact on the motivation of our students.

Summary

Because motivation begins to decrease as our students transition from elementary school into middle school, middle school teachers have the difficult task of keeping their students interested and engaged. “Scholars have repeatedly shown that many students are bored with school, and lack intrinsic motivation to engage in learning. Many students have been found to be extrinsically motivated (at best), and enjoy little from and while learning” (Yair, 2000, p. 192). When all hope seems to be lost, it is important to remember, “There is no such thing as an unmotivated child. Children are motivated” (Middleton & Spanias, 1999, p. 67). Ultimately, if a student is not intrinsically motivated when he or she enters the classroom, it is the job of the teacher to determine what will effectively motivate and engage that child.

Countless studies have been done by researchers in order to determine the best way to motivate students. In general, researchers agreed that student motivation is most strongly affected by student feelings of self-efficacy, individual and situational interest, ability and self regulation. Teacher enthusiasm, group work/collaboration, allowing for choice, allowing appropriate risk taking and demonstrating the value and purpose for learning have also shown to have a positive effect on student motivation. Many researchers agreed that “Students are motivated when they believe they are encouraged to know, interact with, and help classmates during lessons; when they view their classroom as one where students and their ideas are respected and not belittled; when students
perceive their teacher as understanding and supportive; and when they feel their teacher does not publicly identify students’ relative performance” (Ryan & Patrick, 2001, p. 456).

Researchers did not all agree on the relationship between intrinsic and extrinsic motivation. Some claimed that extrinsic rewards undermine intrinsic motivation, while others believed that extrinsic rewards are necessary to motivate students who are not otherwise motivated. Most of the literature regarding these types of motivation was found to be quite contradictory. The truth of the matter is that Motivation Theory is complicated. Each study contains specific variables which pertain to that particular study. The difference in dependent variables makes it difficult for the reader to come to any sort of clear conclusion.

In general, researchers agreed that intrinsic motivation is much more powerful than extrinsic motivation and, in the case of extrinsic rewards, incentives should only be given based on performance rather than participation or completion. Finally, and most importantly, each and every child is different. This means that what works for one student might not work for another. Ultimately, when students are motivated to learn, whether intrinsically or extrinsically, they have the greatest potential to succeed.
Methodology

Elementary school students, for the most part, still have a spark glowing inside of them. They are inquisitive and interested in the unfamiliar. As these students make the transition into middle school they tend to become bored, uninterested and unmotivated. This is caused in part by adolescence and in part by the transition and changes in environment from elementary school into middle school.

Middle schools are often larger and less personal. Students have more classes, more teachers and more social issues to deal with. Teachers have more students and a large curriculum to plow through. As a result, some children lose interest and struggle to meet standards.

Good teachers do everything they can to motivate these students and get them on the right track. Common strategies include changing seats, extra help, parental contact, after school study sessions, rewards and even detentions for incomplete assignments. Some of these strategies are just enough to push some students to engage.

There remains a much smaller group of students that is even more difficult to reach. Depending on the class size and location, each classroom probably has at least one of these students in attendance. For these students, even the most common instructional strategies seem ineffective. These are the students that are at risk for failure, and some day possibly even dropping out of school. They have low skill levels, lack parental involvement, and do not see the value in schoolwork. These students often zone out during lecture, rarely complete homework, and probably have not passed an exam all year. They are most likely unproductive in classes, detentions and study halls and their
parents are unreachable, or unhelpful. There is nothing more frustrating to a teacher then a student whose genuine response to anything is: I don’t care.

The research that follows evaluated the effectiveness of one particular instructional strategy in hopes that it could potentially motivate the most unmotivated students. Student engagement and motivation was studied during several lectures and during two different types of projects; one individual, and one group. The hypothesis was that student-centered, problem based learning could serve as a very powerful tool when it comes to motivating at-risk, middle school math students to learn. Giving students some control over their learning, the freedom to be creative, and mathematics that is applicable to real life might have the potential to capture the interest of the most unmotivated students and increase their desire to learn and engage.

**Participants**

The participants in this research included 59 middle school math students between the ages of 12-13 years old. The students were split into three class sections as described in Table 1. Throughout the research, each class section will be referred to by color, as listed below.

Table 1.

<table>
<thead>
<tr>
<th>Class Name</th>
<th>Total Students</th>
<th>Number of Males</th>
<th>Number of Females</th>
<th>Class Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Class</td>
<td>23</td>
<td>6</td>
<td>17</td>
<td>Accelerated 7th Grade Math</td>
</tr>
<tr>
<td>Green Class</td>
<td>19</td>
<td>10</td>
<td>9</td>
<td>7th Grade Math</td>
</tr>
<tr>
<td>Blue Class</td>
<td>17</td>
<td>8</td>
<td>9</td>
<td>7th Grade Math</td>
</tr>
</tbody>
</table>
Throughout the course of the research, all 59 students were observed in regards to their engagement and motivation. Special attention was paid to a group of five students who typically are the most difficult to engage. They will be referred to as Students 1, 2, 3, 4 and 5. Student 1 was a male from Blue class, Student 2 was a female from Blue class, Students 3 and 4 were females from Green class and Student 5 was a male from Green class.

Prior to the beginning of this research, these students were failing math class and not meeting standards according to New York State. All five students rarely completed homework, had very little parental support and were often disengaged and distracted during class. The purpose of this research was to determine whether or not a completely different instructional strategy could reach out and motivate these five students.

**Instruments and Materials**

This research did not utilize any questionnaires or surveys. All of the data that was collected was a result of direct observation. Classroom materials that were used include approximately 300 sheets of graph paper, markers/colored pencils, and student worksheets (see attached). The second project required 500 plastic straws, 500 paperclips and several rolls of masking tape.

**Data Collection**

Student motivation is difficult to measure, in that it is clearly subjective. This research measured student motivation based on student engagement (time on task). Student engagement demonstrates the desire to be involved and ultimately shows motivation to learn. Data was also recorded/collection from teacher grade books for
homework completion and overall grade. The purpose of collecting this data was to see the effect that student engagement had on homework completion and grades.

Throughout the duration of the research, student motivation and engagement was directly observed during several lectures and during two different types of projects (one individual, and one group project). General comments were made based on direct observation of each class’ engagement as a whole. Engagement was determined by the amount of time spent on/off task. Special notes were made when students demonstrated interest, excitement or pride in their work.

More specifically, the five unmotivated students were monitored very closely. It was noted each time one of these students was off task. When possible, the student’s reason for being off task was also recorded. Based on their level of engagement and overall success in the course, we can see which of the three instructional strategies had a positive impact on the motivation of these students.

*Procedures*

This study used projects, problem based learning and cooperative group work in attempt to motivate and engage students. In order to determine their effectiveness, this research followed 59 middle school math students through three mini-units, each three to five periods in length. These classes were part of a Math Enrichment course taught in our building to build upon students’ basic knowledge and understanding of mathematics.

The first unit was a review of probability. Each class was delivered by lecture and accompanied by student worksheets. Very few connections were made to real life and students completed several practice problems. These problems were straight forward problems as opposed to word problems requiring comprehension.
The second unit was called the Big Picture Project. Its purpose was to help students better understand the concept of proportionality. Students created a small cartoon, listed out the ordered pairs, multiplied them by a scale factor of four and then created a large scale drawing of their cartoon. When completed, students could see that their drawings were proportional; four times wider and four times taller. They also looked at examples of pictures that were not proportional. During each class period, students were given a very brief set of instructions for the day and then worked on their project for the remainder of the time. Students were allowed to talk to each other and ask each other questions. The project allowed for student creativity, concrete understanding of proportions, and student-centered learning.

The third unit was called the Building Project. This project was designed as a problem based learning activity where students were presented with a problem and challenged to come up with the most cost effective solution. There was also an aspect of competition. The purpose of this activity was to strengthen student understanding of money, measurement, estimation and creating scale drawings.

Groups of students were to act as building contractors who needed to create a building that was 250 cm tall but cost the least. The materials available were plastic straws, paper clips and masking tape. Students chose their own groups of four or five and were instructed to create a blueprint of their building. Then, they had to request the materials they would need and provide a cost estimate for their building. The group that created a free-standing structure that fit height requirements and was the most cost effective was to be selected as the contractors of the project.
Throughout all three units, classes were observed in regards to their overall engagement in each activity. Also, five individual students were observed more closely. Each time one of these students was off task the time, activity and reason, when applicable, was noted. Final grades, homework completion and effort were also taken into consideration at the end of each unit. The goal was to see which, if any, of the three units would have a positive impact on the motivation of these typically unmotivated students.
Results

In this study, the effect that different instructional strategies had on student motivation were measured according to time on/off task, homework completion, overall grade, and student comments/behavior. The results are displayed on the tables that follow. Task 1 refers to the lecture based unit, Task 2 refers to the Big Picture Project which was a project completed individually, and Task 3 refers to the Building Project which was completed in groups of four. Each unit was progressively more collaborative.

Time on Task

Each mini-unit was three 55 minute class periods long. Out of a possible 165 minutes, Table 2 shows the approximate number of minutes each student spent off task and the reason, where applicable. Also, note that the reasons were determined by the researcher and not volunteered by the students themselves.

Homework Completion

This research directly observes student motivation within the classroom setting. However, it is also important to take into consideration whether students carried this motivation with them outside of the classroom. This factor was determined based on completion of student homework assignments. Table 3 displays the percentage of student homework that was actually completed throughout the duration of this research.

Overall Grades

Because student motivation has been said to have a positive impact on overall academic achievement, student grades were recorded at the end of each mini-unit. Table 4 displays these student grades as they progressed through the three units.
<table>
<thead>
<tr>
<th>Student</th>
<th>Task 1</th>
<th>Reason</th>
<th>Task 2</th>
<th>Reason</th>
<th>Task 3</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>10</td>
<td>Basic chatter with peers</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Student 2</td>
<td>15</td>
<td>Did not know how to do the math. Needed further explanation</td>
<td>10</td>
<td>Discussing ideas with other students</td>
<td>10</td>
<td>Seemed afraid to contribute, but still participated</td>
</tr>
<tr>
<td>Student 3</td>
<td>15</td>
<td>Did not know how to do the math. Needed further explanation</td>
<td>10</td>
<td>Discussing ideas with other students</td>
<td>20</td>
<td>Was very quiet and did not contribute much. Afraid of having a ‘bad’ idea</td>
</tr>
<tr>
<td>Student 4</td>
<td>10</td>
<td>Distracted by other students</td>
<td>15</td>
<td>Was doing impressions of her cartoon character to entertain her peers</td>
<td>10</td>
<td>Talking to friends</td>
</tr>
<tr>
<td>Student 5</td>
<td>20</td>
<td>Bathroom, distracted by other students, bored with worksheets</td>
<td>20</td>
<td>Very distracted by other students, also discussed the project</td>
<td>5</td>
<td>Sword fighting with straws, spying on other teams</td>
</tr>
</tbody>
</table>
Table 3.

*Homework Completion*

<table>
<thead>
<tr>
<th>Student</th>
<th>Prior to start</th>
<th>During Task 1</th>
<th>During Task 2</th>
<th>During Task 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>50%</td>
<td>50%</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>Student 2</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Student 3</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>25%</td>
</tr>
<tr>
<td>Student 4</td>
<td>50%</td>
<td>75%</td>
<td>50%</td>
<td>75%</td>
</tr>
<tr>
<td>Student 5</td>
<td>75%</td>
<td>100%</td>
<td>25%</td>
<td>50%</td>
</tr>
</tbody>
</table>

*Student Comments and Behaviors*

This research observed students as they worked through several mini mathematics units. Student comments that were made either directly or indirectly were recorded, as well as any relevant student behaviors. Table 5 shows some of the relevant comments that students made, as well as some of their specific behaviors throughout each unit. Table 5 includes specific information about the five unmotivated students as well as the general behavior of each of the classes as well.
Table 4.

*Overall Grades*

<table>
<thead>
<tr>
<th>Student</th>
<th>Initial Grade</th>
<th>After Task 1</th>
<th>After Task 2</th>
<th>After Task 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>D</td>
<td>C</td>
<td>C+</td>
<td>B</td>
</tr>
<tr>
<td>Student 2</td>
<td>F</td>
<td>C</td>
<td>C</td>
<td>C+</td>
</tr>
<tr>
<td>Student 3</td>
<td>D</td>
<td>C</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Student 4</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C+</td>
</tr>
<tr>
<td>Student 5</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C+</td>
</tr>
<tr>
<td>Student</td>
<td>Task 1</td>
<td>Task 2</td>
<td>Task 3</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Student 1</td>
<td>&quot;I'm actually good at this.&quot;</td>
<td>Was chatting with his friends, but</td>
<td>Was very involved and contributed to his</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>still intensely working. Showed an</td>
<td>group.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>interesting ability to multitask.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 2</td>
<td>Worked slowly, but did a good job</td>
<td>Said she was, &quot;doing bad&quot; but</td>
<td>Was withdrawn and seemed afraid to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>after some individual explanation.</td>
<td>everything on her paper was</td>
<td>contribute ideas.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>excellent!</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very focused on her work.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 3</td>
<td>Asked for help and came in for extra</td>
<td>Was proud of her picture and went</td>
<td>Was quiet when working with her group, but</td>
<td></td>
</tr>
<tr>
<td></td>
<td>help during lunch!!</td>
<td>out of her way to make sure it was seen.</td>
<td>did contribute on occasion.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enjoyed opportunity to be</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>creative.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 4</td>
<td>&quot;I like this!&quot;</td>
<td>Asked for help when needed.</td>
<td>Was more interested in chatting with</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>people than contributing to her group and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the challenge.</td>
<td></td>
</tr>
<tr>
<td>Student 5</td>
<td>&quot;This one looks like fun.... Nope. I</td>
<td>Showed a marked improvement in</td>
<td>Was very distracted by everything going on.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>don't feel like doing it.&quot; Student</td>
<td>effort.</td>
<td>Felt the need to sword fight with straws</td>
<td></td>
</tr>
<tr>
<td></td>
<td>was easily distracted by his partner.</td>
<td></td>
<td>and see what random shapes he could</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>build. He was more interested in playing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>than completing the challenge with his</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Classes were engaged enough to get</td>
<td>It was really neat to step back and</td>
<td>There were times when students were off</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the work done but still didn’t seem</td>
<td>see the students spread out all over</td>
<td>task, but overall students were engaged</td>
<td></td>
</tr>
<tr>
<td>All class</td>
<td>very interested or excited about what</td>
<td>the room intensely working on their</td>
<td>and excited to be working together to</td>
<td></td>
</tr>
<tr>
<td>classes</td>
<td>they were doing. Room was louder,</td>
<td>projects. The 'air' of the room was</td>
<td>solve a problem.</td>
<td></td>
</tr>
<tr>
<td>in general</td>
<td>students were talking (off task),</td>
<td>one of students being very engaged.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>distracting each other.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students seemed motivated to keep</td>
<td>More accelerated students made</td>
<td>Students seemed to like the opportunity to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>working because they experienced</td>
<td>their artwork challenging, including</td>
<td>think for themselves, solve an open ended</td>
<td></td>
</tr>
<tr>
<td></td>
<td>success. Their confidence increased</td>
<td>coordinates with decimal values.</td>
<td>problem and work with their hands.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>but not necessarily the desire to</td>
<td></td>
<td>It was good to see students working</td>
<td></td>
</tr>
<tr>
<td></td>
<td>learn.</td>
<td></td>
<td>together and communicating their ideas</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>mathematically.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&quot;Triangles are a strong shape and would</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>use less straws.&quot;</td>
<td></td>
</tr>
</tbody>
</table>
Discussion

This research observed students’ level of motivation throughout three mini mathematics units. In particular, the students’ time on task, homework completion, overall grades, behavior and comments were paid particular attention. In most cases, the results of this research agreed with the motivational strategies presented in other works of literature.

*Time on Task*

When it comes to motivating student learning, a major sign of motivation is the amount of time spent on task. This research observed students during three different types of lessons and recorded the amount of time spent on/off task for each. When appropriate, the reason for being off task was also noted.

As shown in Table 2, four of the five typically unmotivated students were off task the most during the lecture/practice based unit. The students were not interested in the content and also did not demonstrate situational interest. The worksheets completed were lacking real life applications and a clear purpose. As a result, they became bored and distracted during the lessons. Two of the students demonstrated learned helplessness. They immediately felt the content was too challenging and as a result, did not really try. In agreement with the literature, when material is too difficult, students tend to give up (Dembo, & Eaton, 2000, Hidi & Harackiewicz, 2000, Rosenfield, 1978, Schiefele & Csikszentmihalyi, 1995).

The literature also suggested that collaborative group work and problem based learning have been shown to be effective ways of motivating students without resorting to extrinsic rewards (Meyer, Turner & Spencer, 1997, Stipek, Feiler, Daniels & Milburn,
During the Building Project, these students were still slightly distracted, but spent the most time on task. They were excited by the opportunity to solve an open ended problem, by the aspect of a challenge and by the opportunity to work in a hands on, collaborative environment. This research agreed with the literature on motivating student learning which said that students are most motivated by real life applications, collaborative learning, and open ended problems (Meyer, Turner & Spencer, 1997, Stipek, Feiler, Daniels & Milburn, 1995, Yair, 2000).

The fact that the lesson was organized as a competition made for game-like situational interest and also provided the students with a challenge. The literature said that allowing students to make choices, supporting appropriate risk-taking, encouraging creativity, providing work that is appropriately challenging, and developing game-like lessons and activities are all effective methods of motivating students (Bettencourt et al., 1983, Eccles et al., 1993, McFaraland, 2001, Meyer, Turner & Spencer, 1997, Ryan & Patrick, 2001, Stipek, Feiler, Daniels & Milburn, 1995, Yair, 2000). In regards to time spent on task, this research finds this to be a valid claim.

Homework Completion

An interesting aspect of motivation was student motivation outside of the classroom. This research briefly looked at whether or not student motivation within the classroom was carried with them outside the classroom in the form of homework completion. The data collected was a simply a percentage of homework completed during each unit of the research. According to the results shown on Table 3, students were most motivated during the collaborative Building Project; however, their completion of homework throughout the three units was inconsistent. There was no real correlation
between student time spent on task in class, and the amount of homework they completed outside of class. It is important to mention that the homework assignments were consistently typical practice problems. The content aligned with class topics, but the assignments were not directly related to the activities taking place in the classroom. For example, during the Building Project, homework was not dealing specifically with the project, but with other problems relating to estimation, proportions and money. The lack of homework completion suggests that students were probably participating during class time due to situation interest, as opposed to a genuine interest and desire to learn.

The literature that was reviewed did not pay close attention to homework completion, but it should be an important factor in determining the extent to which students are motivated to learn. It makes sense to think that if students are truly motivated to learn, this motivation would be carried with them into their personal lives. The one thing the literature did suggest was that over time students could eventually develop enough interest to carry the motivation outside of the classroom (Benabou & Tirole, 2003, Koller, Baumert, & Schnabel, 2001). Since this research observed students during short mini-units, it was not relevant to measure student motivation outside of the classroom. However, future research could be done over a longer period of time to determine whether or not this truly occurs.

Overall Grades

When students are motivated to learn, their effort and participation in class should naturally increase their abilities and their overall performance in the classroom. This research briefly looked at the effect of student motivation on their overall grades in the classroom. The student grades shown on Table 4 grades were determined by a
combination of things; class participation and class work completion, homework completion, test and quiz grades, and warm-up scores. Of the five students, some made more progress than others but in all five cases, grades did improve as the lessons progressed from teacher-centered to more student-centered learning.

The findings of this research were again in alignment with the literature in the sense that student motivation and performance increased during the student centered, collaborative lessons (Meyer, Turner & Spencer, 1997, Stipek, Feiler, Daniels & Milburn, 1995, Yair, 2000). As the students’ time on task increased, so did their overall performance in the classroom. This direct correlation simply suggests that some students who are typically unmotivated by lecture can be motivated by other types of instruction, such as collaborative group work.

It is important to note here that there were some students in the class who prefer lecture based instruction and their performance actually decreased during the project based learning; however, these students were not included in the five students that were studied more in depth. When a teacher changes his or her instructional strategies in attempt to include their unmotivated students, there is a possibility that some students in the class will not prefer the new type of instruction. This supports all of the literature which states that all children are motivated; they are simply motivated by different things (Bates, 1979, Benabou & Tirole, 2003, Cameron & Pierce, 1994, Hidi & Harackiewicz, 2000, Koller, Baumert, & Schnabel.2001, Middleton& Spanias, 1999).

Behavior and Comments

Observing student behavior and recording their comments can tell a lot about student motivation and involvement in a lesson, as well as specific reasons for why they
feel that way. During this research, the behaviors that students demonstrated and the comments that they made (Table 5) typically justified the amount of time they spent on task (Table 2). They also provided insight into the reason the student was or was not motivated to learn during the particular unit.

During the lecture based unit, students made comments such as “I like this!” and “I’m good at this!” Because the worksheets were repetitive in nature, these students were able to experience success. When unmotivated students feel like they are capable of completing a task, they get a confidence boost and are more likely to continue working. Student 3 actually came in during lunch and asked for help. This type of behavior was unexpected but occurred because she saw that there was a possibility of actually being able to complete her assignment. As a result, it is important for teachers to keep an appropriate difficulty level in their classrooms in order to prevent this type of student from giving up.

Also, during this part of the research, it was noted that the entire class as a whole was completing their work; but at the same time they were talking and seemed bored and uninterested. It was as if they were completing their work because they had to; it was like a chore for them. The increased confidence and opportunity to experience success increased student motivation and likelihood to complete work, but not necessarily their excitement or desire to learn. Therefore, an appropriate difficulty level can only be a small part of what teachers need to do to genuinely motivate their students.

During the individual project, this claim was put to the test. Students were given the opportunity to be creative, as well as the opportunity to determine the difficulty level of their own project, based on how complex they made their design. The effect this had
on the entire class, not just the five students, was surreal. It was really neat to step back and see the students spread out all over the room intently working on their projects. The air of the room was one of students being very engaged. The five students who would normally complete minimal amounts of work during class time were hard at work. Three of them made an added effort to discuss their drawing with me and demonstrated pride in their work.

Because this unit was more student-centered than usual, a few of the students were slightly tentative to work without direct teacher instruction. Two of the girls needed individual assistance to get started. Also, being left to work independently allowed Student 2 to show her fear of making a mistake. She was unsure as to whether or not her work was correct and she claimed that she was “doing bad.” In actuality, the work she had completed was correct. Her willingness to continue working despite her insecurities suggests that with continued progress and success, she could really increase her confidence level over time.

During the collaborative group project there were times when students were off task, but overall students were engaged and excited to be working together to solve a problem. Students seemed to like the opportunity to think for themselves, solve an open ended problem and work with their hands. This unit combined several of the ideas from the literature about motivating student learning. Students were presented with a challenge, allowed to be creative, collaborate, and solve an open-ended problem that was similar to a real life situation. By far, students were most engaged during this portion of the research.
One particular behavior that should be noted was that a few of the students were hesitant to contribute to their groups. It is possible that their lack of confidence caused them to be afraid that their contributions would be looked down upon by their teammates. If a class of students was accustomed to working together in groups like this over a longer period of time, it is likely that they would learn to trust each other and be comfortable that their ideas would be valued and respected. As the literature says, an important aspect in motivating student learning is creating a classroom environment where students are not afraid to take risks and one where students feel that their ideas and opinions are valued (Bettencourt et al., 1983, Eccles et al., 1993, McFaraland, 2001, Ryan & Patrick, 2001 Yair, 2000). From this research, this claim appears to be true; however, research over a longer period of time would be necessary to truly see whether or not these students would be more motivated to contribute in a different type of environment.
Conclusion

Throughout all three units of this research, the five typically unmotivated students demonstrated one common characteristic which seemed to contribute to their lack of motivation. They were all lacking mathematical confidence. Each type of lesson addressed this in a different way. The lecture based lesson motivated these students by presenting an appropriate difficulty level and allowing students to experience success. The individual project motivated these students by allowing them to be creative and to choose the difficulty level of their own project. The collaborative group project motivated these students by presenting them with a challenging, real-life, open-ended problem and allowing them to work with others.

The literature suggested that all of the aforementioned strategies are effective ways of motivating student learning (Bettencourt et al., 1983, Eccles et al., 1993, McFaraland, 2001, Meyer, Turner & Spencer, 1997, Ryan & Patrick, 2001, Stipek, Feiler, Daniels & Milburn, 1995, Yair, 2000). According to this research, this is a valid claim. However, it is important to recognize that different students reacted differently to each strategy. Also, when multiple strategies were used at the same time, there was an even greater increase in student motivation.

Since some students are motivated by a challenge, others are motivated by group work, and yet others are motivated by real life applications, it makes sense to combine all of these motivational strategies into one instructional strategy in attempt to maximize the number of students who are motivated and engaged in their learning. One such instructional strategy that does just that is called Problem Based Learning. During this
research, the Building Project is an example of Problem Based Learning. This research shows that students were most motivated by this type of unit.

This research observed five students in depth. It is important to note that the other 54 students in the class each had their own unique reactions to each type of unit. Some students were most motivated by the problem based learning unit, while others genuinely preferred the lecture based unit. In agreement with most of the literature, all students are motivated; they are simply each motivated by different things (Bates, 1979, Benabou & Tirole, 2003, Cameron & Pierce, 1994, Hidi & Harackiewicz, 2000, Koller, Baumert, & Schnabel, 2001, Middleton & Spanias, 1999). Changing the type of instruction is only one small way teachers can attempt to motivate their students.

There still remain other intrinsic and extrinsic motivational variables such as rewards, consequences, high stakes testing and games. Each of these has been researched before, but it would be valuable to the field of education to continue researching each and their effect on student learning. Students are continuously changing, times are continuously changing, instructional technology is continuously improving and the motivational variables that effect student learning will also continue to change. It is only when educators remain current and aware of their students that they can best reach them in the classroom. When one strategy does not work with a particular student, there is always something else that one can try. The more a teacher knows about his or her students, the more likely that teacher will be able to engage and motivate them to learn.

This research has shown that when instruction allows for creativity, risk taking, collaboration and real life application, it has the potential to increase the motivation of even the most unmotivated students. However, this research occurred over a brief period
of time and therefore only measured student motivation over that period of time. The length of the research did not allow for data collection about students’ long term motivation, or whether or not this motivation was carried with them outside of the class. Future research could look into these same instructional practices when applied consistently over a longer period of time, in order to see if it has a more lasting impact on student motivation. Ultimately, the goal should be to instill students with motivation and a desire to learn mathematics that they will take with them for the rest of their lives.
References


Appendix A: Probability Unit

Name: _____________________  Color: _________
What Do You Expect? Day 4

Reference Notes

**Probability:** The likelihood that an event will occur. The highest probability is ______ and the lowest is ______. Every other probability falls in between ______ and ______.

**Experimental Probability:** The probability that an event actually occurred during an experiment.

**Theoretical Probability:** In a perfect world, the probability that an event SHOULD occur, in theory.

Ex. Pretend you flipped a coin ten times. Three were heads and seven were tails.

The experimental probability of getting tails is: ______
The theoretical probability of getting tails is: ______

1.) Flipping a quarter:  \( P(\text{heads}) = \) ________   \( P(\text{tails}) = \) ________

2.) Rolling a dice:  \( P(\text{getting a 2}) = \) ________
\( P(\text{getting an odd}) = \) ________
\( P(\text{getting a prime}) = \) ________
\( P(\text{getting a 3 or 4}) = \) ________

3.) Spinning this spinner:  
   \( P(1) = \) ________
   \( P(2) = \) ________
   \( P(3) = \) ________
4.) Choose a card from a deck of cards. (There are 52 cards in a deck).

\[ P(\text{getting an Ace}) = \_\_\_\_\_ \]
\[ P(\text{getting the 7 of hearts}) = \_\_\_\_\_ \]
\[ P(\text{getting a diamond}) = \_\_\_\_\_ \]
\[ P(\text{getting the 2 of clubs}) = \_\_\_\_\_ \]
\[ P(\text{getting a red card}) = \_\_\_\_\_ \]

5.) There are 12 marbles in a bag. Three are red, four are blue, one is green and four are yellow.

\[ P(\text{getting a red}) = \_\_\_\_\_ \]
\[ P(\text{getting a blue}) = \_\_\_\_\_ \]
\[ P(\text{getting a black}) = \_\_\_\_\_ \]
\[ P(\text{getting a green or yellow}) = \_\_\_\_\_ \]

Tell whether each of the following is an experimental probability or a theoretical probability.

1.) If John flipped a coin, the probability of getting heads is \(\frac{1}{2}\).
2.) Jerry flipped a coin twenty times. He got tails 12 times.
3.) Sandy rolled a number cube (dice) ten times. She rolled 3 sixes.
4.) If Sherry rolled a number cube, the probability of getting a 5 is 1/6.
5.) The odds of winning the lottery are 1 out of 1,000,000,000.

What are some things in our everyday lives that involve probability? List as many as you can think of.
What Do You Expect? Day 6

Reference Notes

*Sample Space:* A sample space includes all of the possible outcomes of an experiment.

*List:* List out all of the possible combinations that could occur during the experiment.

*Tree:* Make a tree of all of the possible outcomes that could occur during the experiment.

1.) Jessica flips a coin and rolls a number cube. List the sample space.

2.) Scott rolls two number cubes. List all of the possible outcomes.

3.) Duane flipped a coin and then rolled a number cube. Make a tree of all of the possible outcomes.

4.) Rocco flipped a quarter three times. Make a tree of all of the possible outcomes.
5.) Adam is looking at the lunch menu below:

<table>
<thead>
<tr>
<th>Meal</th>
<th>Drink</th>
<th>Dessert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Dog</td>
<td>Water</td>
<td>Cookies</td>
</tr>
<tr>
<td>Hamburger</td>
<td>Juice</td>
<td>Ice Cream</td>
</tr>
</tbody>
</table>

A.) Make a tree that represents all of Adam’s possible lunch choices.

B.) List the sample space that includes all of his possible options.

6.) Heather is trying to choose her outfit for tomorrow:

<table>
<thead>
<tr>
<th>Shirt</th>
<th>Pants</th>
<th>Shoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Jeans</td>
<td>Flip - Flops</td>
</tr>
<tr>
<td>White</td>
<td>Sweats</td>
<td>Sneakers</td>
</tr>
<tr>
<td>Red</td>
<td></td>
<td>Dress Shoes</td>
</tr>
</tbody>
</table>

A.) Make a tree that represents all of Heather’s possible outfits.

B.) List the sample space that includes all of her possible options.
1.) Adam is looking at the lunch menu below:

<table>
<thead>
<tr>
<th>Meal</th>
<th>Drink</th>
<th>Dessert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Dog</td>
<td>Water</td>
<td>Cookies</td>
</tr>
<tr>
<td>Hamburger</td>
<td>Juice</td>
<td>Ice Cream</td>
</tr>
</tbody>
</table>

A.) Use the Counting Principle to determine how many possible lunch combinations Adam has to choose from.

B.) What is the probability that Adam will choose a hot dog, water and ice cream?

2.) Heather is trying to choose her outfit for tomorrow:

<table>
<thead>
<tr>
<th>Shirt</th>
<th>Pants</th>
<th>Shoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Jeans</td>
<td>Flip - Flops</td>
</tr>
<tr>
<td>White</td>
<td>Sweats</td>
<td>Sneakers</td>
</tr>
<tr>
<td>Red</td>
<td></td>
<td>Dress Shoes</td>
</tr>
</tbody>
</table>

A.) How many possible outfits does Heather have to choose from?

B.) What is the probability that Heather will choose a black shirt and jeans as part of her outfit?
Appendix B: Big Picture Project

Name: ___________________________ Color: _________
Stretching and Shrinking

The BIG Picture!

This take-home project has two parts. First, you will draw a similar image of a picture by enlarging or shrinking it. Second, you will write a report on creating similar figures.

Part 1: Draw a Similar Image

Choose a picture or cartoon to enlarge or shrink (or you can create your own). The picture should not be too complex. Using a coordinate system, write a rule that would produce a similar image. If you enlarge your picture, the new image must have a scale factor of at least 3 times the original. If you shrink your picture, it must have a scale factor of no more than 1/4 the original.

Your final project must be presented in a format that can be displayed for others to see. In your project, include the following:

1.) The original picture and the new image.
2.) Your rule and scale factor.
3.) Your list of original points and the new coordinates after you have applied your rule.
4.) Your write up / report.

Part 2: Write a Report

Write a report describing how you created your similar figure. In your report, do the following things:

1.) Describe your cartoon character and the technique or method you used to create the image.
2.) Is your new image similar to the original? How do you know?
3.) How do the side lengths compare to the original? The angles? How were these affected by the rule you chose?
4.) Any other interesting information or problems you encountered and the decisions you made as a result.

Your project will be graded according to the rubric on the next page.
### Performance Task Rubric:

<table>
<thead>
<tr>
<th>Plot/List Points</th>
<th>Transform and plot new points</th>
<th>Content Knowledge</th>
<th>Spelling and Grammar</th>
<th>Quality and Creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Original picture is present, Points written in correct form</td>
<td>All/most points have been transformed correctly (listed and plotted)</td>
<td>Questions answered completely and correctly</td>
<td>Complete sentences</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Demonstrates a solid understanding of similarity and proportionality</td>
<td>Spelling and grammar is mostly correct</td>
</tr>
<tr>
<td>2</td>
<td>Some points listed incorrectly</td>
<td>Some points have been done incorrectly</td>
<td>For the most part, questions are correct</td>
<td>Write up is in complete sentences but spelling and grammar need work.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May contain mathematical errors</td>
<td>Could include more detail and further explanation</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Picture submitted but no points have been listed, Several points are incorrect</td>
<td>Picture submitted but no points have been listed</td>
<td>Write up is incomplete</td>
<td>Incomplete sentences</td>
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<tr>
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<td></td>
<td>Several points are incorrect</td>
<td>Missing the big ideas of similarity</td>
<td>Poor spelling and grammar</td>
</tr>
<tr>
<td>0</td>
<td>Incomplete or not submitted</td>
<td>Incomplete or not submitted</td>
<td>Write-up was not submitted</td>
<td>Write-up was not submitted</td>
</tr>
</tbody>
</table>

### Grading Table:

- A+: 15
- A: 13 - 14
- B+: 12
- B: 11
- C+: 10
- C: 9
- D: 8
- F: 7 or below
In the first column, list the original coordinates of your character. You do not need to list every single point, only the major ones. You should have at least 15 points listed.

In the second column, use your rule to find the coordinates of your new image.

If you run out of room on the first table, you can continue on to the second one or add a separate sheet of paper.

<table>
<thead>
<tr>
<th>Original points (x,y)</th>
<th>Apply your rule ( , )</th>
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</thead>
<tbody>
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</table>

<table>
<thead>
<tr>
<th>Original points (x,y)</th>
<th>Apply your rule ( , )</th>
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</table>
Appendix C: Building Project

Group Names: __________, __________, __________, & __________

Math Enrichment

The Building Challenge

Imagine that you are part of a team of architects preparing a proposal for designing an office building. In order for your team’s proposal to be accepted, it has to meet the building and cost specifications listed below, and cost less than the other proposals submitted. The first step in preparing the proposal is coming up with a design and drawing it on paper. Then, it will be necessary to build a model. Remember, the winning proposal will be a building that is kept within the height range and is as close to the minimum cost as possible.

Building Specifications:
- Height must be between 250 - 275 centimeters
- Building cannot be supported by other structures (walls, ceilings, etc.). It must stand on its own.

Building Material Costs:
- Straws cost $1.13 each
- Masking tape costs $0.31 per cm
- Paper clips cost $0.25 each

Minimum Building Cost:
- Building must cost at least $35.00 to build.

Step 1: Decide on a design with your group. Make a sketch of the building. This should be drawn neatly in pencil on a separate sheet of paper and stapled to this form.

Step 2: Estimate how much of each material you will need and what your group’s building will cost. Make sure that you are at or above the minimum building cost. Complete the following table with your group:

<table>
<thead>
<tr>
<th>Item</th>
<th>How many needed?</th>
<th>Unit Price</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straws</td>
<td></td>
<td>$1.13 each</td>
<td></td>
</tr>
<tr>
<td>Tape (cm)</td>
<td></td>
<td>$0.31 per cm</td>
<td></td>
</tr>
<tr>
<td>Paper Clips</td>
<td></td>
<td>$0.25 each</td>
<td></td>
</tr>
</tbody>
</table>

Grand Total: __________