# Motivational Strategies that Foster Students' Self-efficacy and Perseverance in Secondary Mathematics.

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Abstract

By focusing on fostering self-efficacy and perseverance in secondary mathematics, teachers lay a foundation for successful problem solving in high school mathematics. Self-efficacy can be built using student choice in the process or product of mathematical tasks. Celebrating student successes, especially the small ones, and providing appropriate challenges also promote self-efficacy. Teachers who create curiosity within a lesson cultivate perseverance. Using purposeful instructional strategies that builds on understanding allows students to work through an entire problem without feeling the need to give up. In this paper, I describe how teachers can create classroom environments and tasks that use the above strategies to foster self-efficacy and perseverance in a secondary mathematics classroom.

By middle school, many students experience a significant drop in mathematical achievement (Alspaugh, 1998). To combat this drop, teachers can implement a variety of strategies to promote success and self-efficacy in the classroom to motivate struggling students to be successful in mathematics. Low motivation can lead to other feelings towards mathematics, such as mathematical anxiety (Kesici & Erdogan, 2010). Teachers helping students make this change starting in middle school and continuing through high school is extremely important. Often middle school is seen as a transitional period and the learning that takes place in grades 6-8 is regarded as unimportant when compared to high school material. Mathematics is a content that builds on prior understanding so students must have a solid grasp on both elementary and middle school mathematics before entering high school. Woolley, Strutchens, Gilbert, and Martin note that "the acquisition of mathematics knowledge and problem solving skills in middle school is the foundation for a trajectory leading to mathematics success in high school, college, and beyond (Woolley, Strutchens, Gilbert, & Martin, 2010)." The motivating strategies outlined should be started in middle school and continued through high school so that students have a solid, continuous understanding of mathematics.

Creating a classroom environment that promotes self-efficacy is the first thing teachers can do to encourage struggling learners to be successful in mathematics. This focus on effort is especially important in low achievers as they "tend to focus on lack of ability as the cause of their failures (Middleton, 2013)." This contradicts high mathematics achievers who naturally associate non-effort when they do not do well on an assignment. To do this, teachers should ask students to compare their current performance with prior performance. Often students "compare themselves with their peers instead of determining their own deficiencies and mistakes (Kesici & Erdogan, 2010)." Interest and choice both play a part in student self-efficacy (Usher, 2009).

Choosing the right tasks is important for teachers focusing on promoting self-efficacy and perseverance in mathematics. To engage students who are unmotivated, choosing tasks that relate to students' personal interests has proven to be effective. According to Middleton, "the more classroom tasks tap in to these personal interests, the more effort and persistence the student is willing to expend to achieve the goals of the task (2013)." These tasks need to have multiple entry points, often known as low-entry, high-ceiling tasks. Allowing students the freedom to use multiple strategies elicits different reasoning from students and students can use their mathematical strengths (Mueller, Yankelewitz, & Maher, 2011).

When teachers choose tasks that allow students to approach the mathematics in a variety of ways, it is a natural step to creating a collaborative environment that encourages mathematical discussions. An environment that includes all students and makes all students feel like part of the group increases self-efficacy. Teachers should work to create a class culture that facilitates active and engaged learners. To do this, students should be "encouraged to share ideas and representations and to listen to, question, and convince one another of their solutions (Mueller et al., 2011)." Struggling students often look to their peers, instead of teachers, for guidance on behaviors. When these students see others communicating and contributing, it only serves to motivate them to do the same as they are driven to emulate others' classroom strategies (Middleton, 2013). Not only is this good practice, but it also supports the Standards for Mathematical Practice in which students are asked to critique the reasoning of others (Standards for Mathematical Practice). When students share and critique research has shown that, "students gained ownership of new mathematical ideas after being confronted with other students' differing understanding of challenging tasks (Mueller et al., 2011)."

To promote this type of discussion, teachers can follow Margaret Smith's 5-step process for orchestrating discussions in mathematics' classrooms (2011). The five steps are: anticipate, monitor, select, sequence, connect (see Figure 1).

Teachers who do this are often themselves motivated to support student-centered classrooms. Teacher motivation styles effect student learning. In a study done by Manouchehri, it was demonstrated that "teachers who are motivated to support student autonomy provided more opportunities for students to examine mathematical thinking, to pose questions, and to try to make meaning of their own thoughts when compared with teachers motivated to gain control of the classroom environment (Megowan-Romanowicz, Middleton, Ganesh, & Joanou, 2013)." This, coupled with high expectations of students' success, increases student motivation (Woolley et al., 2010).

Creating a classroom that fosters self-efficacy and perseverance starts with encouraging effort. Teachers can do this by using peak and valley charts for students to identify their own weaknesses and areas for growth (See figure 2). Using pre and post and assessments to show students their growth is another strategy. Most important is creating an environment where students can discuss their ideas with one another and with the teacher. In these environments, students should feel that their ideas and contributions are critical to the learning of the class. One important thing that should also be added for teachers looking to put this into practice is rewarding students for reasoning, not just for outcome (Rasmussen and Marrongelle, 2006).

In "Norms for Participation in a Middle School Mathematics Classroom and Its Effect on Student Motivation," Megowan-Romanowicz and Middleton provide a case study that compares discussions in a variety of classrooms. This three-year study compared how mathematical practices were implemented in four classrooms. The teachers not only say they have high

expectations, but they show it by valuing all students' contributions to the classroom. In this example, the teacher provides little guidance for the conversation outside of clarifying understanding. Instead, the focus is on student participation and contribution.

The following is an example of an interaction from Ms. Cunnane's resource mathematics class. In this class, students complete work in small groups with white boards and then present their results to the class. Ms. Cunnane is identified by Megowan-Romanowiz and Middleton as a guest teacher who worked with these students for approximately a month before the following was recorded. The vignette is from "Norms for Participation in a Middle School Mathematics Classroom and Its Effect on Student Motivation (2013)."

> Teacher: Who has an idea of something they might record on their trip to Morenci? Sal: Like maybe I would collect some rocks and maybe I would measure them … and I guess by measuring maybe I could find the weight of rocks …
>
> Teacher: Okay, so you might collect some weight information …yes (calls on Gabriella)?
>
> Gabriella: I would [she is speaking too softly to hear but she mentions time and how far]
>
> Teacher: How much time or how much …
>
> Boy's voice from off camera: Distance?
>
> Teacher: How much distance? Okay … yes (calls on Pedro)?
>
> Pedro: I would find the probability of seeing red cars.
>
> Teacher: Probability of seeing red cars … great answer … yes?

Jorge: How many miles it takes and how much gas you would need to get there?

Jesus: Ahhh …! (Evidently he was disappointed that Jorge had said what he was going to say.)

Teacher: Yes, very good … how many miles, how much gas … very good …

Dan: How much money you spend?

Teacher: How much money you spend? What will you spend money on, driving to Morenci?

Dan: Gas … Food …? Teacher: Gas … okay … maybe even a soda … maybe you stop for a soda—something like that. What else? You had your hand up.

Tom: (he hesitates before responding and then smirks) How boring it was …

Teacher: How would you measure that? … Would you put that on a 1 to 10 scale of boringness?

Tom: Yeah.

Simon: Eleven (his back is to the teacher and he mutters, apparently for the benefit of students sitting at his table).

Anthony: A hundred.

Teacher: A 1 to 100 scale of boringness? … and then would you get a boringness reading from every person in your car?

Tom: Yeah.

Teacher: Would you do that … what? … every 5 minutes, every 10 minutes …? Something like that?

Simon: Every 10 hours.

Teacher: Every 10 minutes?

Simon: Hours.

Teacher: Every 10 … hours?

Anthony: (laughing) Oh my goodness!

Teacher: How long does it take to go to Morenci?

Simon: An hour.

Anthony: An hour and a half.

Unidentified student: Three hours.

Teacher: Oh. Okay … unless you walk. Then it might take a couple days at least … yes? (calls on a student at another table to see what he would suggest measuring …)

Felix: Traffic …

**Conclusions**

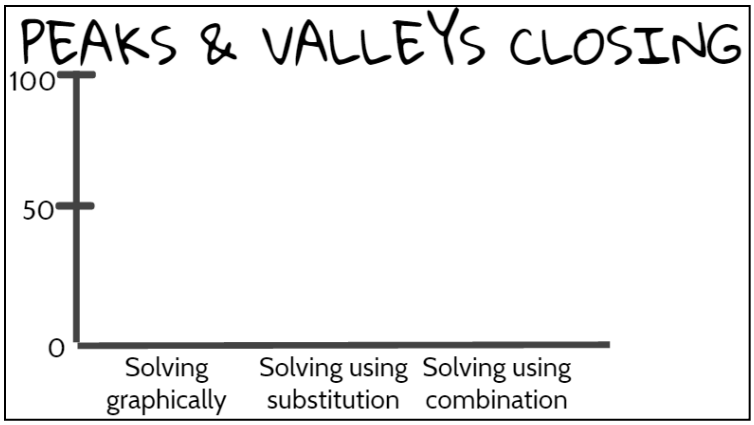
A classroom that promotes self-efficacy and perseverance starts with focusing on the effort students put into their work. Students should be asked to reflect on their efforts and their outcomes as related to their earlier understandings. To engage students in day-to-day mathematics, teachers need to ensure that the tasks they select for class allow all students to have an entry point and have the option for the use of multiple strategies to reach a solution. Summarizing tasks should be done with student-centered conversations. These conversations can be facilitated using Margaret Smith's 5 steps for promoting discussion (2011). All students should be encouraged to participate and their opinions valued by both the teacher and classmates.

**Tables and Figures**

***Figure 1.*** *A description of the 5 steps of orchestrating mathematical instruction by (Smith, 2011). Descriptions by Fawn Nguyen (2012).*

1. Anticipate — the teacher must do the problem ahead of time and anticipate the different strategies and solutions that students may come up with.
2. Monitor — the teacher needs to pay close attention when students are working in groups, listen to their mathematical thinking and observe their strategies.
3. Select — the teacher needs to select which groups or which member(s) of a group will share with the whole class.
4. Sequence — the teacher must arrange the order in which the selected people will share. (No fun if the group with the "best" strategy shared first!)
5. Connecting — the teacher is responsible for asking students to connect the solutions presented by the different groups and what the key mathematical ideas are in the problem.

***Figure 2.*** *A peaks and valleys chart used by students to self-assess understanding of solving systems of linear equations as a closing for a lesson. Students are asked to rate their understanding from 0-100. After continued work in class, students revisit the chart to discuss their growth in understanding.*



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