Karrie A. Jones, Tapestry High School, Buffalo, NY
Jennifer L. Jones, Niagara University, Niagara University, NY

Enhancing Student Motivation, Self-Efficacy and Ownership in Secondary Mathematics: Using Research to Inform Practice

On the premise that educators have a tremendous influence on the academic success of at risk students, this paper presents a framework for exploring the beliefs and pedagogies of mathematics teachers who are highly successful with challenging populations. A synthesis of the principles of best practice proposed by Vermette (2009) and Jackson (2009), suggests the following three core beliefs of effective teachers:

(1) All students need to have a positive, appropriate and caring relationship with their teacher to achieve elevated levels of academic success and to feel connected to their greater school community.

(2) All students need to have learning experiences that provide multiple opportunities to think deeply about and demonstrate their understanding of important concepts.

(3) All students need appropriate, timely and useful feedback on their academic performance and must be given opportunities to grow and reflect on their understandings.

Through an analysis of how these beliefs translate into a teacher's actions and decision making, this paper provides mathematics educators with specific strategies for reaching and supporting at risk learners.

What does "at risk" mean?

Several decades of research has examined the prevalence, cause and nature of at risk students (Brendtro, Brokenleg & Van Bockern, 2002; Schargel, 2005; Smink & Schargel, 2004). Though "at risk" has become a ubiquitous term in contemporary schooling, according to Slavin, Karweit & Madden (1989), for the purposes of this article, "at-risk" describes those students susceptible to school failure in a traditional education setting. Research has shown that these students are likely to be categorized based on their low scholastic achievement, specific learning disability, emotional or behavioral action, physical limitation, frequent absenteeism and/or previous grade retention (Rozycki, 2004). Though multiple factors have been suggested as common contributors to a student's at risk status, according to Bailey and Stegelin (2003), the nine most common correlates associated with a lack of student achievement are:

- having limited English proficiency
- being from a low socio-economic status
- growing up in single parent households
- being of African American or Hispanic descent
- being from parents who were not high school graduates
- having a below average reading ability
- having a feeling of isolation or disconnect from same aged peers
- having low self-esteem and low self efficacy
- being disinterested and bored with school

This study provides explores the role teacher play in enhancing student motivation, self efficacy and ownership in all of these areas with a specific and intentional focus on the latter three.

Nationwide, students who fall in this at risk category make up over 25% of all school-aged students (Schargel, 2005). This situation is even more profound in large urban centers, where according to a study of the 35 largest US school districts, 47% of the entire school

population is considered at risk of academic failure. This figure rises to 54% in school districts where half of the students were ethnic minorities and 69% when the minority student population was 90% or higher (Balfanz & Legters, 2001).

What can educators do to help students at risk for school failure?

With school failure being such a prevalent and pervasive part of public education, the nine bullets listed above are of tremendous consideration for policy makers and mathematics teachers alike (Bailey & Stegelin, 2003). While some educators may be discouraged by their inability to amend several of these conditions (such as socio-economic status and level of parental education), a 1992 study by Vacha & McLaughlin suggests that a teacher's specific beliefs and instructional methods have a greater impact on overall student achievement than other educational, behavioral or social intervention. As such, Vacha & McLaughlin state that teachers must adopt beliefs and pedagogies consistent with those of highly effective educators if they are to

teach at risk students. Paul J. Vermette and Robyn R. Jackson have each recently published text that holds tremendous promise in identifying such attitudes and teaching methods. Though seemingly diverse in their approaches, the commonalities of these two resources prove to be a valuable starting point for identifying the best practices required for reaching challenging student populations.

ENGAGING teens in their own learning: 8 keys to student success

In his 2009 publication, *ENGAGING teens in their own learning: 8 keys to student success*, Vermette presents an eight-part framework designed to help teachers create and maintain student centered learning environments. Through an extensive discussion of the philosophical decisions associated with supporting a Constructivist classroom, this book is designed to help teachers promote students' personal understanding and ownership of their learning. The eight ENGAGING factors for promoting student success (as well as a brief explanation of each) are presented in the table 1 below:

Table 1

ENGAGING factor	Description
Entice effort and build community	Relationships are built with students *during* instruction; teaching is done in a way that puts individual ideas at the forefront of the lesson.
Negotiate meaning	Students must generate their own meanings and beliefs of the content they are learning, and then defend them with evidence.
Group collaboratively	Student collaboration is an essential component of the learning experience. Interpersonal skills are taught, monitored, assessed and reflected upon by both the teacher and the students.
Active learning	Students are constantly processing new information, making sense of experiences, and communicating their ideas to someone else. Assessment is an active and visible process.
Graphic organizers	A variety of structures are used on a daily basis to help students examine information,

	record thinking and document relationships. Students are comfortable with these structures so they can use these formats without prompting.
Intelligence interventions	Students' think work is differentiated through interventions as both feedback and thinking with the 'eight kinds of smart.' Students are supported through a myriad of interventions by both the teacher and other students.
Note making	Students construct and write their own ideas to keep for further analysis, reflection and modification.
Grade wisely	Grades allow every student to experience success by reaching his/her expectations and goals. The grading policy is designed to get students to try their hardest, take pride in their cognitive and affective growth and leads to a sense of community within the class.

While these eight characteristics of effective teaching are seemingly easy to understand, their implementation in the mathematics classroom is undeniably sophisticated. When used in the planning and delivery of lessons, Vermette maintains that they will increase the motivation, self efficacy and sense of ownership in all learners.

Never work harder than your students & other principles of great teaching

In developing a 'master teacher mindset,' Jackson (2009) asserts that there are seven mastery principles of effective teaching. By applying these principles to one's own teaching practices, she says all teachers can become intentional and skillful in their decision-making processes.   In developing a pathway to expertise, the seven principles of effective teaching according to Jackson are:

Principle of Effective teaching	Description
1. Start where your students are	Classroom instruction is deeply intertwined with students' prior understandings and experiences. Instruction capitalizes on students' existing skills in order to help students acquire skills that they need but do not yet have.
2. Know where your students are going	In looking for the implied content and process behind the standards, more time is spent unpacking the standards than planning individual lessons. All classroom activities are based on the subsequent learning goals, which represent the minimum level of acceptable performance. These steps are clearly communicated to students and parents.
3. Expect to get your students to their goal	Obtaining high levels of student academic achievement is viewed as both a matter of

	student effort and the intentional teaching of *how* to exert effective effort. Students have opportunities to remediate, reflect and reassess when academic success is not initially reached.
4. Support your students along the way	Data gathered from multiple sources, including formative and summative assessments, coaches student achievement and adjusts instruction. Students receive written feedback designed to guide them to a better performance next time.
5. Use feedback to help you and your students get better	Assessments are used as feedback to guide instructional decisions. Students are taught how to use feedback to improve their learning. Formative and summative assessments constantly help guide students towards their learning targets.
6. Focus on quality rather than quantity	Curriculum decisions focus instructional time on a limited number of essential understandings. Assignments help students efficiently and effectively master key learning objectives.
7. Never work harder than your students	Students are expected to be accountable for their own learning. They have work to do which is different from the teachers' work. Routines and jobs give students a greater share of the classroom work.

With an in-depth focus on skillful curricular decision-making, student support and developing high expectations, Jackson provides practical suggestions for implementing these practices into one's own classroom. Her framework for continuous teacher improvement provides a model through which both teachers and students can reap the benefits of systematic and intentional teacher improvement.

With a brief overview of both texts considered, the remainder of this article will present those themes that unify both the Vermette (2009) and Jackson (2009) frameworks of effective teaching. It will also provide evidence of how this structure can be implemented in mathematics classrooms with at risk students. Vermette and Jackson agree that successful teachers think, behave and make decisions in a way that makes them uniquely effective with challenging populations and distinctively different than their colleagues. Both authors are firmly committed to the notion that *every* teacher can be a master teacher by

making decisions based on three main philosophical beliefs:

(1) All students need to have a positive, appropriate and caring relationship with their teacher to achieve elevated levels of academic success and to feel connected to their greater school community.

(2) All students need to have learning experiences that provide multiple opportunities to think deeply about and demonstrate their understanding of important concepts.

(3) All students need appropriate, timely and useful feedback on their academic performance and must be given opportunities to grow and reflect on their understandings.

With these three philosophical beliefs as the core of our inquiry, our focus will now shift to the application of these beliefs into mathematics classroom practices. We will consider the essential questions, "how can a teacher build positive, appropriate and caring relationships with every learner?", "how can a teacher create learning experiences that meet the needs of all learners?" and finally "how can

teachers provide appropriate, timely and useful feedback to all learners?" to guide our discussion. The answers to these questions are the tools Vermette (2009) and Jackson (2009) state educators can use to reach all students.

How can a teacher build positive, appropriate and caring relationships with every learner?

According to Werner & Smith (1989), there is no greater influence of positive change on at-risk youths than the effects of a strong relationship with a trusted and caring adult. Caring adults are not only positive role models for struggling youth but often provide the motivation, support and hope to fuel a student's desire to succeed (Noddings, 1988). In the classroom, at risk students who feel connected, cared for and valued by their teachers are more likely to comply with school rules, complete a higher quality and quantity of tasks and work more persistently on classroom tasks than their non-supported peers (Pigford, 2001; Brendtro, Brokenleg & Van Bockern, 2002). These students have a greater intrinsic motivation both in and out of school and are more likely to pursue future education, career and life goals upon graduation (Haberman, 1995).

Building and sustaining student-teacher relationships is so foundational to both Vermette's (2009) and Jackson's (2009) frameworks that each start their respective texts with strategies for building a community of learners. It is important to note however, that both authors provide strategies for building relationships *during* instruction. Each cite that effective teachers generally know to build community before or after a lesson (by attending school functions, greeting students as they enter the room, etc.), however they often miss valuable opportunities during class time. Thus, the relationship building strategies discussed below are those that teachers are to implement during instruction.

In building relationships, both authors state that trust is essential. Teachers must show students that they have confidence in their ability to be kind, trustworthy and honorable individuals. Hence, they must give their students learning tasks and responsibilities,

which demonstrate this confidence. Jackson speaks explicitly to the power of student "roles", stating that students must be responsible for implementing classroom routines such as attendance taking, facilitating discussion and reviewing homework. Vermette adds to this sentiment by stating that the more opportunities students have to take ownership in classroom policy making, the more likely students will feel connected to their teammates and classroom community. This also modifies the role of the teacher from presenter of knowledge to facilitator and guide, a metaphor Vermette cites will shift classrooms from "teacher centered" to "student centered" learning environments.

In addition, teachers can build relationships with students by making students' ideas a central component of classroom instruction. Both authors agree that effective teachers start where his/her students are and validate students' prior experiences as a legitimate part of the curriculum. To clarify this point, consider the three examples below. Each is the beginning of a 7th grade mathematics lesson.

- In small groups, students discuss the qualities and characteristics they look for in a waiter or waitress when determining how much tip to leave at the end of a meal. (This discussion is used to clarify the concept of appropriate tipping practices and provide a rationale for determining the percentage of a bill - the objective of the lesson.)

- Given several brochures from local bike tours, students are asked to brainstorm expenses they think tour owners likely incur while trying to run the business. (Students use these ideas to explore the relationship between profit, income and expenses.)

- Students are asked to make a list of considerations toy makers must keep in mind when trying to determine the best type of packaging for a new product. (Students use this list as the rationale for learning how to calculate the surface area and volume of a box.)
  Adapted from Lappan, Fey, Fitzgerald, Friel, & Phillips (1998)

The examples above demonstrate that student ideas are not only incorporated into the flow of the lesson, but are the raw material of the lesson. Without student consideration of business expenses for example, the lesson on the relationship between profit, income and expenses is void of meaning and purpose. It should be noted that students cannot be wrong during these brainstorming experiences, but instead are given a forum to consider their background knowledge, integrate their prior experiences and mold their pre-existing schema into new mathematical concepts. Vermette (2009) and Jackson (2009) agree that this is essential to building productive relationships during instruction.

How can a teacher create learning experiences that meet the needs of all learners?

Traditionally, schools have addressed the needs of at risk learners through methods designed to emphasize and remediate learning deficits (Danforth & Smith, 2005). Such students are traditionally placed in tightly controlled alternative settings that utilize direct instruction, repetitive practice and mastery of basic skills (Sagor & Cox, 2004; Schargel, 2005). School wide approaches include homogeneous grouping or 'tracking' of struggling students, grade retention, special education classification and pull out programs (Legters, McDill, & McPartland, 1993; Oakes, 1985).

Current research however, indicates that such approaches actually have a de-motivating and stigmatizing effect on students. Though well intentioned, these isolative programs promote low academic self-concept, unrealistic grade expectations, and low self efficacy (Oakes, 1985; Slavin, 1988). It is for this reason that educators have begun to search for alternative methods to prevent school failure of at risk students.

Knapp (1995) asserts that concentrating on student academic and social assets rather than deficits allow teachers to use their students' experiences as tools for engagement rather than inhibitors of success. In an effort to intentionally build student assets, successful teachers expose their students to as many rich learning experiences as possible. They create learning opportunities that are varied in strategy, and collaborative in nature. Coupled with high expectations, such approaches provide students with the success experiences and meaningful skills that transcend school walls (Sagor & Cox, 2004; Danforth & Smith, 2005).

Glance once again at the three 7th grade math lessons used in the previous discussion of motivating students through building relationships. This time, consider how these lessons engage at risk students to think deeply about the important mathematical content they are learning. How do these lessons force students to make their own meaning of mathematics? How do these lessons foster student collaboration? In the scenarios of leaving a tip at the end of a meal, brainstorming expenses students think a tour owner will likely incur and determining the best type of packaging for a product, how are students actively engaged in the learning process?

The answers to the previous 3 questions provide the basis for promoting student ownership through active and collaborative learning. Both Jackson and Vermette recognize that students need to test and retest their developing knowledge in order to learn new content. Challenging students to do the think work associated with finding and evaluating evidence to support or refute personal experience transforms school from the dissemination of outside facts to the thoughtful examination of one's ideas. It is not simply enough for students to listen to a lecture about tipping or running a business or packaging a new product. Students must make sense of information for themselves through active engagement with the material. As Vermette (2009) asserts, the more deeply students engage with the information, the deeper the understanding. Therefore, in order to provide at risk students with more ownership and motivation in their learning, active learning is key.

Notice that all of the mathematics lessons mentioned above also involve productive student interaction. Jackson and

Vermette (2009) provide three reasons for doing so. First, Jackson (2009) asserts that a community of learners is an extremely motivating place to learn. With each student responsible for guiding others towards understanding, there develops a sense of belonging and ownership that builds classroom community and promotes student self-efficacy. Second, both authors assert that students who learn in a collaborative classroom experience great cognitive benefits. As one exchanges, compares and defends one's ideas with peers, one cannot help but to clarify and deepen one's own understanding. In learning from each other, cooperative learning legitimizes and utilizes students' social capital, another particularly effective strategy for reaching at-risk students. Third, Vermette (2009) asserts that cooperative learning provides students an opportunity to develop the affective skills needed to function in society. In providing students with the ability to learn *from* others, they develop the ability to work *with* others - skills that are directly applicable to adult life (Additional information about cooperative learning can be found in Vermette's 1998 text, *Making Cooperative Learning Work: Student teams in K-12 classrooms).*

How can teachers provide appropriate, timely and useful feedback to all learners?

One of the most well researched teacher behaviors of the past 40 years has been the process and nature of feedback (Bellon, Bellon & Blank, 1992). Recognized as one of the most significant teacher behaviors, when done effectively it has an impact on both cognition and motivation (Brookhart, 2008). Hattie & Timperley (2007) have outlined four distinct levels of feedback. They state that appropriate feedback provides the teacher and learner with information about (1) the quality of the work (2) the process of completing the task (3) the student's self-regulation or feelings about completing the assignment and (4) the student as a person. Especially for students who struggle academically, using feedback as a mechanism to discuss the process of completing a task and the quality of the work produced has the potential to develop feelings of competence

and self efficacy (Brookhart, 2008). According to Dweck (2006), effective feedback is used as a coaching tool to build student-teacher relationships while at the same time providing learners with information they can use to set appropriate learning goals. Through effective communication, she asserts that teachers can help students develop the notion of a 'growth mindset', building motivation as they realize that their abilities can expand over time.

Vermette (2009) and Jackson (2009) both begin their discussions of feedback with a similar, sobering statement about the reality of grading and assessment in post NCLB America. Each is quick to concede that there is a difference between assessment for grading and assessment for growth. They state that a teacher's philosophy on grading is tremendously rooted in an individual's understanding of fairness and justice as well as the nature and purpose of schooling. The commonalities regarding these two authors' ideas center on two main theses: (1) effective feedback builds teacher and student relationships and (2) effective feedback drives instruction.

To begin a discussion about the nature of meaningful feedback according to Vermette (2009) and Jackson (2009), consider the three quotations below. Each is a teacher response that could be given to students creating a list of the qualities they look for in a waiter or waitress. Recall that the purpose of the first exploratory activity was to help students determine how much tip to leave at the end of a meal. While reading, consider what type of information is being shared during each interaction and what impact this might have on student motivation and the quality of the product.

- "That is a detailed list! You must have really shared your ideas effectively. Can you put a star by the one which is the most important?"
- "You've got a good start there. I can tell you really thought extensively about the suggestions being offered. Have you thought about what you expect to happen when you are finished eating?"
- "I like the way you kept discussing until you thought of diverse answers. You recorded many

different qualities of a good waiter or waitress. Which of these apply to other jobs where gratuity is expected?"

As can be pinpointed in each of the previous examples, Vermette (2009) and Jackson (2009) state that effective feedback should speak to both the nature of specific strengths of the product and the process students used to accomplish the task. In the first example, the teacher is acknowledging both the quality of the list and the collaborative interaction, while providing an avenue for extending student thinking. Similarly, the second and third quotations also provide cognitive redirection, while noting the affective process that must have occurred in order to get the job done. Whether it is the effective sharing of ideas, actively listening to others' thoughts or engaging in divergent thinking, each piece of feedback specifically connects student efforts with the strengths of the product.

Vermette and Jackson (2009) posit that such interactions build student-teacher relationships as they reinforce the notion that students' thinking is valuable and worthy of acknowledgment. Especially in at risk learners who often have a history of academic failure, such recognition of competence is extremely motivating. It should be noted that the effort-based competencies that are the focus of teacher feedback are also directly transferable to other situations. Though students may never again choose to consider qualities of an effective waiter, skills such as how to communicate ideas effectively, how to actively listen to others and how to engage in divergent thinking are aptitudes that must be used in adult life.

One final area of convergence between Vermette (2009) and Jackson (2009) is the belief that feedback (data) should guide instruction. In his text, Vermette speaks to the power of "teaching by intervention," essentially using formal and informal student data to differentiate learning experiences. Jackson expands on this idea by stating that students will be better motivated, take more risks and apply their understandings more readily if instruction is presented at an appropriate level of challenge. This level she says is best determined by collecting data from a variety of

sources, including performance tasks, pencil and paper tests, teacher observation and student reflection. Both authors relentlessly emphasize that learners do not assimilate knowledge in the same way or at the same rate. Therefore, effective teaching is always responsive to learners' needs.

Conclusion

Enhancing student motivation, self-efficacy and ownership in learning is the key to successfully reaching at-risk learners. Since teachers are the key to promoting student achievement, the imperative nature of developing these competencies through continuous teacher improvement is apparent. Vermette (2009) and Jackson (2009) provide two very current and rich resources that can serve as valuable guides fostering such growth.

Though different in their approach, an analysis of their fundamental congruencies leads to specific teaching strategies and behaviors that can be used to teach mathematics to challenging populations. It is hoped that the suggestions offered for preventing school failure by way of (1) creating productive relationships with students, (2) developing meaningful learning experiences and (3) providing timely and useful feedback, can be coupled with teachers' own beliefs to increase the likelihood of success for all students.

Works Reviewed

Jackson, R. R. (2009). *Never work harder than your students & other principles of great teaching.* Alexandria, VA: Association for Supervision and Curriculum Development.

Vermette, P. J. (2009). *ENGAGING teens in their own learning: 8 keys to student success*. Larchmont, NY: Eye-On-Education

References

Bailey, B., & Stegelin, D. A. (2003). Creating a sense of place: Anchoring at-risk

students within K-12 classrooms. *Journal of At-Risk Issues. 9*(2), 17-26.

Balfanz, R., & Legters, N. (2001). *How many central city high schools have a severe dropout problem, where are they located, and who attends them?: Initial estimates using the common core of data.* Cambridge, Mass: Harvard University Graduate School of Education.

Bellon, J. J., Bellon, E. C., & Blank, M. A. (1992). *Teaching from a research knowledge base: A development and renewal process.* New York: Merrill.

Brendtro, L. K., Brokenleg, M., & Van Bockern, S. (2002). *Reclaiming Youth at Risk: Our Hope for the Future. Revised Edition.* National Educational Service

Brookhart, S. M. (2008). Feedback that fits - How to make your feedback helpful and heard by students. *Educational Leadership : Journal of the Department of Supervision and Curriculum Development, N.E.A. 65*(4), 54.

Danforth, S., & Smith, T. J. (2005). *Engaging troubling students: A constructivist approach.* Thousand Oaks, Calif: Corwin.

Dweck, C. S. (2006). *Mindset: The new psychology of success.* New York: Random House.

Haberman, M. (1995). *Star teachers of children in poverty.* West Lafayette, Ind.: Kappa Delta Pi, International Honor Society in Education.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research.* 77 (1), 81-112.

Knapp, M. S. (1995). *Teaching for meaning in high-poverty classrooms.* New York: Teachers College Press.

Lappan, G., Fey, J. T., Fitzgerald, W., Friel, S. N., & Phillips, E. D. (1998). *Connected mathematics series.* Palo Alto, CA: Dale Seymour.

Legters, N., McDill, E., & McPartland, J. (1993, October). Section II: Rising to the challenge: Emerging strategies for educating students at risk. In *Educational reforms and students at risk: A review of the current state of the art* (pp. 47-92). Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

Noddings, N. (1988, December 7). Schools face crisis in caring. *Education Week*, 32.

Oakes, J. (1985). *Keeping track: How schools structure inequality.* New Haven: Yale University.

Pigford, T. (2001). Improving teacher-student relationships: What's up with that?. *Clearing House.* 74(1), 337-339.

Rozycki, E. G. (2004). At-risk students: What exactly is the threat? How Imminent Is It?. *Educational Horizons.* 82 (3), 174-179.

Sagor, R., & Cox, J. (2004). *At-risk students: Reaching and teaching them.* Larchmont, NY: Eye On Education.

Schargel, F. P. (2005). *Best practices to help at-risk learners.* Larchmont, NY: Eye On Education.

Slavin, R. (1988). Synthesis of research on grouping in elementary and secondary schools. *Educational Leadership. 46* (1), 67-77.

Slavin, R. E., Karweit, N. L., & Madden, N. A. (1989). *Effective programs for students at risk.* Boston: Allyn and Bacon.

Smink, J., & Schargel, F. P. (2004). *Helping students graduate: A strategic approach to dropout prevention.* Larchmont, N.Y.: Eye On Education.

Vacha, E. F., & McLaughlin, T. F. (1992). The social structural, family, school, and personal characteristics of at-risk students: Policy recommendations for school personnel. *Journal of Education - Boston University School of Education. 174* (3), 9.

Vermette, P. J. (1998). *Making cooperative learning work: Student teams in K-12 classrooms*. Upper Saddle River, N.J.: Merrill.

Werner, E., & Smith, R. (1989). *Vulnerable but Invincible: A longitudinal study of resilient children and youth.* New York: Adams, Bannister, and Cox.

About the Authors:

Karrie A. Jones is a high school mathematics teacher at Tapestry High School in Buffalo, NY. She holds a B.A. in Secondary Mathematics Education from Niagara University and an M.S. in Special Education from Niagara University. She has been working with inner-city teens for five years as a high school teacher. Ms. Jones is pursuing her PhD in Mathematics Education at University at Buffalo, Buffalo, NY.

Jennifer L. Jones is currently an instructor of mathematics at Niagara University. Like her twin sister Karrie, Jennifer holds a B.A. in Secondary Mathematics Education from Niagara University and an M.S. in Special Education from Niagara University. Prior to her position at Niagara University, Ms. Jones was a 7th grade mathematics teacher for four years in Lockport, NY. She is also pursuing her PhD in Mathematics Education at University at Buffalo, Buffalo, NY.