The Research Base Supporting the Rigor Appraisal Observation Instrument

Authors
Lindsey Devers Basileo
Merewyn Elizabeth Lyons

November 2019

The Rigor Appraisal Observation Instrument was developed to provide a non-evaluative, objective third-party view of the inner workings of schools. The instrument is based on research supported metrics and has been used to observe schools nationwide to determine a measurable pathway for whole-school improvement.

Introduction

The Rigor Appraisal Observation Instrument was developed to provide a non-evaluative, objective third-party view of the inner workings of schools. The instrument is based on research supported metrics and has been used to observe schools nationwide to determine measurable pathways for whole-school improvement. The Rigor Appraisal is derived from both applied and empirical research which aims to increase student achievement and improve conditions at schools over time. While the instrument can be used to improve the performance of schools with low scores on statewide annual assessments, it can also be used to elevate the performance of schools that are already achieving at higher levels. The instrument includes five critical components of rigor: Conditions for Learning Rigorous Standards, Standards-Based Student Evidence, Activating Student Teams to Achieve the Standards, Verify Learning to Take Action within a Lesson, and Tracking Student Progress toward Standards. The five pillars are described below.

- **Conditions for Learning Rigorous Standards:** this pillar measures the observable systems in place including school and classroom climate, structures for self-regulation, and cooperation and collaboration in teacher teams focused on creating a rigorous learning environment.
- **Standards-Based Student Evidence:** this pillar measures structures in place to accurately assess the alignment between the target, task, and the taxonomy level of the standard; whether the task is designed for team collaboration; and that student work produces consistent evidence of mastery.
- **Activating Student Teams to Achieve the Standards:** this pillar measures the degree to which students work in academic teams, that teams develop resilience through productive struggle, and that teams function autonomously.
- **Verify Learning to Take Action within a Lesson:** this pillar measures teacher monitoring and use of instructional adjustments,

actionable teacher and peer feedback to improve learning processes, and student self-verification of learning.
- **Tracking Student Progress toward Standards:** this pillar measures the effectiveness of school leaders and teachers to incorporate short-, mid-, and long-cycle data systematically to improve the quality of teaching and learning in the school and the degree to which the school leader uses data to ensure teacher accountability for student learning.

The Rigor Appraisal measures discrete systems of school success that are observable and change over time. While prior research identifies many characteristics of successful school reform, this instrument focuses on those that are observable and measurable. Consequently, this instrument focuses on only those aspects of systems that are visible during school walkthroughs. It will show the degree to which interrelated systems are operating efficiently and will indicate systems that are contributing the most to improving student achievement and learning.

Prior to outlining the research base for each pillar of the Rigor Appraisal, we will describe how the instrument is used and scored and provide the theoretical framework for the instrument.

Background

District and school leaders use the Rigor Appraisal to address root causes, guide specific coaching requirements, and develop a plan of action tailored to each school's individual needs. An expert coach scores it onsite, typically completing three or four Rigor Appraisals per building each year. The coach uses the results of the Rigor Appraisal to guide the school leadership team to more effectively monitor teacher implementation of strategies in daily classroom practice.

The Rigor Appraisals are also coupled with a series of professional development sessions for teachers and leaders. Rigor Appraisals are non-evaluative and gather no identifying information on teachers. The instrument provides actionable data needed to determine the current schoolwide conditions of teaching and learning.

During a Rigor Appraisal, the coach meets onsite with the principal and school leadership team to collect information about current teams, processes, policies, and systems that impact teacher practice and student learning. The coach and school leadership team walk the school to collect anonymous information from a randomly chosen sample of classrooms, then code the schoolwide Rigor Appraisal instrument in its entirety. Throughout the walk, the coach and school leadership team discuss their observations. The coach then uses aggregated results to guide the leadership team on root causes, establish baseline conditions, and determine the next steps for implementing support structures to improve teaching and learning.

Theoretical Framework

Successful school improvement efforts are based on the understanding that schools are systems of interrelated parts. Any change to one part affects the performance of the system. If any of the systems are dysfunctional, the performance of the entire school is degraded (Shindler, Jones, Williams, Taylor, & Cardenas, 2016). Sustainable change comes from inside the school, and those making the changes must take ownership (Alliance for the Study of School Climate, 2014). Principals and leadership teams must be motivated and engaged in the reform effort. Successful change to school culture is marked by increasing human and social capital in teachers and increasing expectations for students (Herman et al., 2008; Klute, Cherasaro, & Apthorp, 2016; Le Floch et al., 2016). In order to have successful school reforms, leadership teams must change the culture of the school and the mindset of both students and teachers.

Self-determination theory states that all human goal-related behavior is oriented to the fulfillment of three psychological needs: competence, relatedness, and autonomy (Deci & Ryan, 2000). Competence refers to the desire for a sense of self-efficacy. Relatedness is the desire to feel connected to others, to love and be loved. Autonomy is the desire to self-organize behavior and experience both freedom and integration. Autonomous regulation leads to better academic performance in the pursuit of goals (Deci & Ryan, 2000).

While self-determination theory focuses on general psychological needs, Zullig, Koopman, Patton, and Ubbes (2010) identified three psychological needs within schools that influence

Self-Determination Theory (Deci & Ryan, 2000)	School Climate (Zullig et al., 2010)	Rigor Appraisal
Competence	• Academic support • Academic satisfaction	• Standards-Based Student Evidence • Verify Learning to Take Action within a Lesson • Tracking Student Progress toward Standards
Relatedness	• Positive student-teacher relationships • School connectedness • School social environment • Perceived exclusion/privilege	• Conditions for Learning Rigorous Standards
Autonomy	• Order and discipline • Physical environment	• Activating Student Teams to Achieve the Standard

Figure 1: Alignment of the Rigor Appraisal to Self-Determination Theory and School Climate

effective performance, including academic support and satisfaction; positive student-teacher relationships, school connectedness, perceived exclusion or privilege, order, discipline; and physical environment. These interactions affect student perceptions of academic self-efficacy, happiness, and overall satisfaction with life, and impact the climate of the school.

The Rigor Diagnostic measures the degree to which the school as an organization meets the needs of students, enhances a sense of well-being and fosters learning in a culture of caring and mutual support. Figure 1 shows the alignment of these theories to the Rigor Appraisal Pillars.

The Rigor Appraisal identifies specific behavioral outcomes that support both social competence and academic achievement, as well as behavioral benchmarks. At the heart of all the pillars is observable student and staff behaviors and structures that will result in an overall school climate that is supportive of high performance, including student autonomy, teacher support of student autonomy, and strong distributive leadership teams. These three perspectives are discussed next.

STUDENT AUTONOMY

Wehmeyer, Shogren, Toste, and Mahal (2017) have built upon the importance of self-determination theory and school climate to student learning, emphasizing student self-regulation and autonomy in the classrooms. Classrooms that support student autonomy build smaller communities in which students have meaningful roles in creating classroom rules, feel safe to explore and take risks to solve problems, set goals and are responsible for monitoring and evaluating their progress. Student-directed learning strategies promote student engagement and ownership of learning rather than inhibiting them. Building inner motivation is key to effective learning (Connor & Davidson, 2003). Personal qualities which include self-efficacy, adaptability, recognition of having control over choices, willingness to accept and ask for help, and the ability to form secure bonds with others are resources to satisfy psychological needs for competence, relatedness, and autonomy (Deci & Ryan, 2000).

Students with positive views of themselves as learners demonstrate higher levels of motivation, self-regulation, engagement, and higher academic achievement (Mason & Scrivani, 2004). Self-regulation – the strategic, metacognitive behavior aimed at a goal – is related to student academic achievement and predictive of self-efficacy (Hinnant-Crawford, Faison, & Chang, 2018; Zimmerman & Schunk, 2011). Co-regulation, by contrast, involves carrying out shared tasks with peers through discussion, questioning, and problem solving. Co-regulation positively influences the growth of self-regulatory skills. Both self-regulation and co-regulation are critical to student learning. The degree to which teaching and the classroom environment support these inner resources directly influences students' engagement and intrinsic motivation (Reeve, 2006).

TEACHER SUPPORT OF STUDENT AUTONOMY

Students cannot build autonomy in isolation. Teachers must set up appropriate structures for students to thrive. Reeve (2006) identifies five behaviors that are characteristics of autonomy-supportive teachers:

1. They nurture student inner motivational

resources and coordinate instructional activities with students interests in mind allowing for greater student choice.
2. They use informational language rather than controlling language to communicate classroom requirements in ways that affirm student competence.
3. They communicate value and rationales for activities and clearly justify the effort required to complete them.
4. They acknowledge and accept students' expression of negative feelings about learning tasks by understanding their perspective, while affirming the importance of the activity for student learning.
5. They provide clear structures to support students in achieving academic goals.

A key aspect to supporting student autonomy is the quality of the relationship between students and teacher. Teachers who develop high quality relationships with students often are more attuned to student feelings and needs, support students' ability to self-regulate, and can provide gentle discipline to socialize student understanding of behaviors as right or wrong (Barger & Linnenbrink-Garcia, 2017; Feucht, 2010; Tolhurst, 2007). Teachers' own personal beliefs influence those of their students. Teacher support of student autonomy impacts the degree of self-regulation, boosts intrinsic motivation, and improves academic outcomes (Martinek, Hofmann, & Kipman, 2016).

STRONG DISTRIBUTIVE LEADERSHIP TEAMS

In order to create an autonomous learning environment, a strong principal leader and school leadership team are essential to provide structures and support. The principal and leadership team must signal the need for transformation and be able to make the changes necessary to provide an autonomous environment. Staff who perceive the greatest improvement of their schools characterize principals as demonstrating strategic leadership, a strong grasp of the theory of action to make the needed changes, and the ability to motivate and engage staff in the effort (Le Floch, et al., 2016).

Schools that sustain successful reform demonstrate a collaborative culture, encourage distributed leadership, provide continuous professional learning, and maintain quality improvement initiatives (Jacobson, 2011). Leaders must support teachers and students in building a collaborative atmosphere by also involving parents and the community in school transformation. Distributed leadership provides teachers autonomy to take on leadership roles and be responsible for ensuring consistent high-quality instruction in an autonomous learning environment. Continuous professional learning and growth is a prime hallmark of a culture of high performance. Finally, the organizational governance of the school must support ongoing initiatives that provide autonomy to teachers and students to improve the quality of teaching and learning.

These theoretical concepts are fundamental to the Rigor Appraisal and to understanding the catalysts of change within schools. Observable, measurable aspects of efficient, high performing systems help leaders assess where the school is in the process and where they need to go. The next sections will outline the research base for each pillar within the Rigor Appraisal.

Research Support for the Rigor Appraisal Pillars

In this section, each pillar is discussed including the theoretical and empirical underpinnings. Recall the five pillars of the Rigor Appraisal include: Conditions for Learning Rigorous Standards, Standards-based Student Evidence, Activating Student Teams to Achieve the Standard, Verify Learning to Take Action within a Lesson, and Tracking Student Progress toward Standards.

CONDITIONS FOR LEARNING RIGOROUS STANDARDS

The Conditions for Learning Rigorous Standards pillar measures the observable systems in place including the school and classroom climate, self-regulation, and high functioning teacher teams. The interaction of the many parts of the system create these conditions at the school level and each is needed for a rigorous learning environment. Each of the concepts will be reviewed next.

School and Classroom Climate

School and classroom climate influences student wellbeing, life satisfaction, ethnic and moral identity, and resilience (VanLone et al., 2019; Aldridge, Fraser, Fozdar, Ala'i, Earnest, & Afari, 2018). It is both a whole-school and within class phenomenon and contributes to students' sense of belonging and safety. School climate can be defined as the influence of the quality and consistency of interactions between school staff and students (Suldo, Riley, & Shaffer, 2006). These interactions include teacher-student relationships, a sense of safety, connectedness to the school, and student engagement – all of which can impact student perceptions of academic self-efficacy. Components of school climate include safety, teaching, learning, interpersonal relationships, institutional environment, leadership, and professional relationships.

Several studies have investigated the relationship between school climate and student achievement and have found a positive association (Benbenishty, Astor, Roziner, & Wrabel, 2016; Berkowitz, Moore, Astor & Benbenishty, 2016; Davis & Warner, 2018; Konold, Cornell, Jia, & Malone, 2018). One study even found that school climate had a greater influence on academic progress than student background characteristics (Davis & Warner, 2018).

Suldo and colleagues (2006) conducted a review of literature that studied school and classroom climate, and student achievement. They found evidence that positive school climate is associated to higher academic achievement, that the classroom and the school are both important factors in predicting student achievement, and that teacher demonstration of caring and support for students is an essential component of classroom climate. Moreover, they found that having a positive school climate can narrow the achievement gap among student subgroups.

Self-Regulation

Self-regulation and co-regulation are essential skills for students to efficiently learn. Self-

regulation consists of the processes that students use to engage and sustain the necessary cognition, emotion, and behavior to accomplish learning goals (Zimmerman & Kitsantas, 2014). Hinnant-Crawford and colleagues (2018) characterize co-regulation as a communal, collective form of teaching and learning that is supportive of a culturally responsive teaching and learning environment. As self-regulation and co-regulation increase, students begin to take responsibility for maintaining rules and procedures in a positive classroom environment.

Proper structures support self-regulation and co-regulation and create a positive school climate. These structures include consistency of practice and predicable routines, disciplinary practices that encourage self-regulation and mutual responsibility, student choice to develop intrinsic motivation to learn, and clearly stated expectations and standards of performance (Darling-Hammond & Cook-Harvey, 2018).

Several studies have investigated the relationship between self-regulation and student achievement and have found a positive association (Blitz, Yull, & Clauhs, 2016; Zimmerman & Kitsantas, 2014). Measures of self-regulation can significantly predict student grade point average and performance on standardized tests (Zimmerman & Kitsantas, 2014). It is also significantly related to the development of visuomotor, mathematics, to emergent literacy, vocabulary skills in young children (Becker, Miao, Duncan, & McClelland, 2014; DeFlorio et al., 2019; Williams, White, & MacDonald, 2016), to reading comprehension and vocabulary in elementary school students (Day & Connor, 2017; Day, Connor, & McClelland, 2015; Skibbe, Montroy, Bowles, & Morrison, 2019), and to secondary and postsecondary mathematics performance (Cleary, Velardi, & Schnaidman, 2017; Musso, Boekaerts, Segers, & Cascallar, 2019). There is also evidence that students in schools with high achievement scores use more self-regulated learning strategies than those in schools with lower achievement scores (Wenjuan, Ling, & Jun, 2019).

Collaboration in Teacher Teams

Effective team collaboration can positively impact the school culture and increase student achievement particularly when teams are data driven (Green & Allen, 2015; LeClerc & Moreau, 2011; Muñoz & Branham, 2016; Ratts et al., 2015; Ronfeldt, Farmer, McQueen, & Grissom, 2015; Tichnor-Wagner, Harrison, & Cohen-Vogel, 2016). There is evidence that heterogeneous mixing of teachers with different levels of expertise in teams may also improve the performance of the least effective members, and the achievement of their students (Sun, Loeb, & Grissom, 2017). The higher the quality of collaboration in teacher teams, the more effective teachers are at raising student achievement (Ronfeldt, Farmer, McQueen, & Grissom, 2015). For example, one study found that professional learning communities have an indirect but positive effect on student math achievement as mediated by group-level teacher expectations (Park, Lee, & Cooc, 2018).

To establish effective teacher teams, schools must change rules to allow the division of labor and introduce supports for distributed leadership (Hirsh & Segolsson, 2019). Leaders must support distributed leadership by providing frequent and formal opportunities for teachers to meet in learning communities, encouraging professional autonomy for teachers in the shared decision-making processes, and setting high expectations for academic performance. Learning communities contribute to professional growth as they provide mutual support for teachers (Seglem, 2017). While

there are numerous studies devoted on how to create successful teacher teams (Katzenbach & Smith, 2003; Pierce, Kostova, & Dirks, 2003; Argon & Ekinci, 2016; Cherkowski & Schnellert, 2017; Conner, 2015; Schaap and de Bruijn, 2018; Szatkowski & Brannan, 2019), the visible structures that support success of these teams are the focus of this review.

Schoolwide team ownership of results is an observable socialized norm. Through teaming, teachers exercise autonomy and develop ownership of student learning, deepen their collective understanding of the learning process, and expend time and effort to ensure that lessons advance student learning. Clear rules and procedures for team tasks with roles and responsibilities for students are also observable aspects of highly effective teacher teams. Effective collaboration is evident when team tasks and roles are consistently implemented across grade level and subject area classrooms. Further, student autonomy is highly visible when teams collaborate effectively.

STANDARDS-BASED STUDENT EVIDENCE

Standards-based student evidence indicates the presence of structures that support consistent and systematic teaching and learning at the taxonomy level of the standard, student progress toward mastery of the standards, and the quality of tasks for collaboration among students.

Target, Task, and Taxonomy Alignment

Despite state laws and regulations to enforce standards-based instruction, the extent to which teachers teach content according to state standards varies by subject area, target populations, and geographic location (Edgerton & Desimone, 2018). Teacher belief in the authority of the standards – their usefulness and appropriateness for their students – is related to use of standards-based content in instruction. In other words, teachers are more likely to teach standards-based lessons when they believe that their students will benefit from them. Additionally, while state laws and regulations are requiring teachers to be standards-based, school or district implementation can vary drastically.

The alignment of learning tasks to the rigor of the standards requires strategic planning. Teachers must plan questioning that elicits student responses at the taxonomic level of the standards. Teachers should build this automaticity into instruction, so that students can perform learning tasks without teacher guidance (Maye, 2013).

Curriculum alignment to standards impacts student learning through instruction. Curriculum, instruction, and assessment must be aligned to ensure that students demonstrate learning at the level of performance, or taxonomy, of the standards (Ziebell & Clarke, 2018). However, tasks often do not match the taxonomic levels of the standards and are frequently designed at levels of lesser cognitive complexity (Anees, 2017).

Curriculum misalignment may be due to errors of calibration by teachers as they examine the standards and attempt to identify the correct taxonomic level. Calibration refers to the metacognitive skill that learners use to judge the level and adequacy of cognitive processes to accomplish a task (Pieschl, 2009). Task complexity consists of the knowledge and cognitive demands of the task. Teachers must be able to accurately judge task complexity and design learning to enact the appropriate metacognitive strategies. For students, errors in calibration arise from learners'

misperceptions about task complexity. Most errors result when students incorrectly use cognitive strategies suited for simple tasks when presented with more complex tasks. Teachers must guide students to be aware of both their internal cognitive process and of the external demands of the task to be successful, self-regulated learners.

Tasks Designed for Teams

While the academic teaming section will cover observable traits of effective academic student teams, we emphasize here the importance of creating tasks that allow teams to work autonomously and to demonstrate mastery of the standard. Alignment between the target, task, and taxonomy are essential, but the task must also be team-worthy and produce evidence of learning. Tasks that do not engage all team members or do not require a team for completion are not team worthy. Appropriately structured teams and tasks are observable features of student learning communities in autonomy-supportive classrooms (Wehmeyer, Sands, Knowlton, & Kozleski, 2002; Wehmeyer, Shogren, Toste, & Mahal, 2017).

Student Work Produces Evidence of Mastery

Student mastery of the standards depends upon the quality and alignment of learning tasks with the standards. Teachers must decide on the evidence they expect students to produce that reflects mastery of the standards. The demonstration of learning should be consistent across grade levels and subject areas. Thus, both mastery and appropriate alignment are interdependent as the level of the learning task predicts the level of student performance (Elmore, 2008).

The concept of student mastery of the standards is rooted in Benjamin Bloom's (1971) mastery learning. Mastery learning decreases variation in student achievement through differentiation of instruction. To achieve mastery learning, instruction must provide feedback, correction for students who have not mastered the learning, and enrichment for those that have reached mastery (Guskey, 1997; 2007). Bloom (1971) specified that there must be instructional alignment among the lesson, feedback, correctives, and enrichment activities and the specific learning standards that students are expected to meet. Further, students should know what mastery looks like, own the learning, and develop automatic processes for appropriately handling different learning tasks.

ACTIVATING STUDENT TEAMS

Activating student teams measures the degree to which students are in academic teams, that teams develop resilience through productive struggle, and that teams function autonomously. The concept of academic teams goes beyond typical grouping students. Students should be challenged by learning tasks that requires team effort. As teams, they must verify the effectiveness of their own learning processes and the quality of their collective work. Students develop high levels of autonomy and critical thinking skills through collaboration in academic teams (Francisco, 2013).

Academic Teams

Academic teams are defined as student-led, small, diverse teams with clear protocols for engaging in standards-based academic work (Toth & Sousa, 2019). As with team-based learning (Michaelsen & Sweet, 2008), academic teaming is student-centered. The goal is to have students meaningfully engage in discussions and deeply process academic content. Organizing students in small collaborative groups creates opportunities for interaction that lead to improved

cognitive learning that is particularly beneficial for subgroups such as English Learners or students identified as having disabilities or learning differences (Valls & Kyriakides, 2013).

Academic teaming is appropriate for elementary through high school grade levels, while team-based learning is geared towards postsecondary education. Academic teaming is more specific in its use of state standards to develop targets for rigorous learning tasks. Additionally, each member of an academic team has a specific responsibility such as being a facilitator or tracking group progress towards the attainment of standards.

Academic teaming has little empirical literature that directly tests the claims of increased student achievement. We have only one study that directly assessed that relationship (Basileo, 2018). The study used propensity score matching to create a comparable control group by matching teaming students to similar students in the district whose teachers did not receive the professional development on teaming. The results of the study revealed statistically significant and positive effects in both reading and math. Furthermore, there were notable decreases in student achievement gaps for African American students, English Learners and students identified as having disabilities or learning differences.

Team-based learning has also demonstrated evidence of student achievement gains in post-secondary literature. The practice can increase learning and improve engagement. Swanson, McCulley, Osman, Lewis, and Solis (2019) conducted a meta-analysis of the effect of team-based learning on content knowledge. A mean effect size of .55, ($p<.001$) was found synthesizing the 17 studies that met the criteria for inclusion. Group size (5 or less) was found to moderate the relationship increasing the mean effect size to .91 ($p<.001$). Other outcomes have also been associated with team-based learning including having higher student satisfaction (Ozgonul & Alimoglu, 2019). Team success becomes as important as personal success which impacts student engagement (Newmann, Wehlage, & Lamborn, 1992; Ozgonul & Alimoglu, 2019; Stipek, 1996). Effective teams can also have positive effects on team diversity (Basileo, 2018; Kearney, Gebert, & Voelpel, 2009; Roberge & Van Dick, 2010; Stahl, Maznevski, Voigt, & Jonsen, 2010).

Developing Resilience through Productive Struggle

Productive struggle is an opportunity for deep learning. Instruction that encourages and supports productive struggle provides opportunities for students to develop resilience and efficacy in the face of challenging tasks (Warshauer, 2015). The more opportunities for productive struggle, the more a student can critically think and solve problems in real world situations. The term "productive struggle" comes from research into the cognitive processes of learning mathematics. It refers to the effort students must expend to make sense of what they are learning when answers are not readily apparent (Edwards & Beattie, 2016; Hiebert & Grouws, 2007).

Through productive struggle, teachers must demonstrate the belief that all students can learn and takes responsibility for their own learning. Students recognize that the authority lies not in the teacher's statements but in the struggle to find a solution. Students learn that what they are learning is connected to many other disciplines, rather than an isolated set of procedures and use their reasoning to solve various kinds of problems (Valentine & Bolyard, 2018).

Ewing, Gresham, and Dickey (2019) identified specific skills and dispositions teachers must have to successfully engage students in productive struggle. Teachers must:

- make explicit connections for their students between the content and the students' personal experience and cultural background;
- provide students with multiple strategies of understanding and learning, such as manipulatives or pictures;
- develop a productive disposition toward the content themselves to be able to share its usefulness and importance; and
- presume that all their students are capable and set high expectations for all.

Teachers engage students in productive struggle by assigning challenging tasks that are accessible by all students. Everyone is expected to persist in successfully completing these tasks (Livy, Muir, & Sullivan, 2018). Throughout productive struggle, teachers must facilitate but resist the temptation to solve problems for students. Teachers must also recognize the nature of the productive struggle students are experiencing in order to guide them through it (Zeybek, 2016).

Building Student Autonomy through Teaming

Students need support from their teachers to develop skills in using autonomy appropriately for learning. Teachers must also create proper structures for students to work autonomously in teams. Stefanou, Perencevich, DiCintio, and Turner (2004) defined three kinds of autonomy support:

- organizational support to encourage student ownership of the learning environment;
- procedural support to encourage student ownership of the form of work production; and
- cognitive support to encourage student ownership of learning.

All students need explicit instruction and feedback to use these autonomies appropriately. The degree to which they exercise autonomy depends upon their age and developmental readiness. In general, cognitive autonomy support is the priority because it is this that leads to the deepest level of student engagement in learning (O'Brien, 2018; Wehmeyer, 1997). Autonomy and self-determination are developed when students focus on choice-making, decision-making, problem-solving, goal setting and attainment, self-regulation, self-advocacy, self-efficacy, self-awareness, and self-knowledge. These skillsets are best built in academic teams through organizational autonomy and are related to student achievement (Kosko, 2015; Marshik, Ashton, & Algina, 2017).

VERIFY LEARNING TO TAKE ACTION WITHIN A LESSON

Recall that this pillar measures teacher monitoring and use of instructional adjustments, actionable teacher and peer feedback to improve learning processes, and student self-verification of learning. Each of these will be discussed next.

Teacher Monitoring and Instructional Adjustments

During lessons, teachers recognize trouble spots when students do not comprehend information or do not make correct inferences from what they are learning. Teachers respond to these trouble spots with micro-interventions – adjustments made during the lesson to clarify understanding and regain the flow of reasoning (Alibali, Nathan, Church, Wolfgram, Kim, & Knuth, 2013). Bonne (2016) further defines micro-interventions as actions conducted by teachers within their own classrooms that leverage their pedagogical

experience to strengthen both student self-efficacy and achievement.

Student learning is accelerated when teachers adjust instruction immediately based on student response and provide feedback for improvement. This is particularly important for students with lower performance scores and for students identified as having disabilities or learning differences. Students whose teachers make these adjustments earlier perform at higher levels than students whose teachers delay instructional adjustments (Coyne et al., 2013).

Teachers monitor student progress by examining evidence of learning. When teachers use evidence to adjust instruction and provide feedback to move learning forward – and when students use it to adjust their learning strategies – it is formative assessment (Black & Wiliam, 2009; Panadero, Andrade, & Brookhart, 2018;). There is a large body of evidence to support the claim that formative assessment practices can increase student outcomes (Black & Wiliam, 1998; Crooks, 1988; Kingston and Nash, 2011). For example, Black and Wiliam (1998) found that students whose teachers used daily classroom assessments to provide feedback to students achieved within seven months what would otherwise have taken a year. Moreover, they found that gains seem to be consistent across countries (including Canada, England, Israel, Portugal, and the United States), as well as across age and subject areas. Even inexperienced teachers can positively impact student learning through the development of formative assessment practices in their classes, and with schoolwide use, these modest gains in achievement could elevate the performance of a school from the lower quartile to the upper half (Wiliam, Lee, Harrison, & Black, 2004).

The largest most recent study of formative assessment also provides evidence for teacher monitoring. In their meta-analysis of 19 empirical studies, Klute, Apthorp, Harlacher, and Reale (2017) found that formative assessment has an average effect size on student achievement of .26 standard deviations, with the largest average effect size for mathematics achievement (.36), followed by reading (.22) and writing (.21). These are substantially important effects for math achievement (U.S. Department of Education, 2017).

Actionable Feedback

Feedback has the greatest effect when it is timely, based on clear criteria, and includes specific scaffolding to improve performance based on student evidence (Looney, 2011). Teachers should provide frequent on the spot specific feedback to students by means of formative classroom assessments that are both diagnostic and prescriptive (Guskey, 2007). Corrective instruction for students who do not attain mastery is based on the formative assessment data and is qualitatively different from the original instruction.

Formative feedback is an essential part of formative assessment, and must be simple, descriptive, and focused a specific task (Fluckiger, Tixier y Vigil, Pasco, & Danielson, 2010). Effective feedback provides information about products, process, and progress of learning (Guskey, 1996, 2001; Shute, 2007; Stiggins, 2008). Formative feedback can come from the teacher or from other students. Students can provide evidence of their own learning through work samples or demonstrations. By communicating their learning to teachers, parents, and peers, they receive feedback that they can use to self-assess and improve their learning processes (Davies, 2001). Often, feedback comes in the form of ongoing classroom dialog among students as they learn.

This dialog builds student metacognitive skills and self-regulation (Braund & DeLuca, 2018).

Teachers need professional development to advance the mindset, skills, and knowledge they need to provide effective feedback. Feedback is effective only if learners receive it and understand it (Hattie, Gan, & Brooks, 2017). To be effective, feedback must clarify expectations and standards, occur during the learning period, foster student self-regulation, and provide information about the next steps after the present learning is achieved (Brooks, Carroll, Gillies, & Hattie, 2019). Students must know how they are doing and where they are going (Hattie & Timperley, 2007).

Despite this, studies have shown that most feedback is directed at the task level, rather than at the process of self-regulatory levels that require deeper understanding (Brooks, Carroll, Gillies, & Hattie, 2019). Although teachers believe that process-oriented, or facilitated, feedback is important, they find it very difficult to do in the classroom setting (Van den Bergh, Ros, & Beijaard, 2014). In their study of teacher perceptions and practice of feedback to students, Dessie and Sewagegn (2019) found that most teachers believe that feedback can help students to improve their learning and build their self-confidence. However, teachers inaccurately believe that feedback consists of praise, grades, and marks for correct or incorrect responses.

Studies have found a positive relationship between effective feedback and student achievement (Hattie, Gan, & Brooks, 2017; Hattie & Timperley 2007; Vollmeyer & Rheinberg, 2005). Therefore, it is important to ensure that teachers know how to use feedback appropriately to support student learning. Recent brain research has also demonstrated through functional magnetic resonance imaging that students process performance-related feedback differently depending upon their individual levels of intrinsic motivation. For this reason, teachers need to consider how to build intrinsic motivation to maximize the effect of feedback on learning (DePasque & Tricomi, 2015).

Students Verify Their Learning

Student verification of their own learning is a form of self-assessment. Brown and Harris (2014) define student self-assessment as "an evaluation of a student's own work products and processes in classroom settings" (p. 22). The greatest value of student self-assessment is its positive impact on student self-regulation and metacognition when students are taught explicitly how to self-assess and discover and confirm their learning. Student self-assessment is a learnable competence and is beneficial for all learners. It is also linked to improved motivation, self-efficacy, behavior, and the quality of relationships between students and teachers (Glaser, Kessler, Palm, & Brunstein, 2010; Griffiths & Davies, 1993; Munns & Woodward, 2006; Olina & Sullivan, 2002; Panadero, Brown, & Strijbos, 2015; Schunk, 1996).

Accurate self-assessment happens when students participate in establishing criteria for work quality and teachers instruct students how to use other assessment data, such as tests or other graded work, to calibrate their self-assessments (Ross, 2006; Brown & Harris, 2014). Student self-assessment can contribute to developing stronger self-regulation (De Smedt & Van Keer, 2018). Furthermore, research indicates that the use of specific criteria or comparison to exemplars can improve the quality of self-assessments (Harrison, O'Hara, & McNamara, 2015). After corroborating self-assessments with peers, students have information to identify performance gaps and to

take appropriate actions to remedy them. Self-assessment works most effectively when students receive feedback from peers to improve accuracy particularly when the classroom climate provides psychological safety for self-evaluation (Ross, 2006; Brown & Harris, 2014). Students must justify their self-evaluations to peers citing specific evidence. Peer assessment is a student-centric practice that develops critical thinking, creativity, effective communication, and collaboration. As a culturally responsive practice it holds the promise of addressing an array of persistent social and emotional issues (Harrison, O'Hara, & McNamara, 2015). Further, when peers hold each other accountable, they are motivated to perform at higher levels (Stein, Colyer, & Manning, 2016). Self- and peer-assessment fosters skills and attitudes that help students become self-reliant learners (Panadero, Brown, & Strijbos, 2015).

TRACKING STUDENT PROGRESS TOWARD STANDARDS

Recall that this pillar measures the effectiveness of school leaders and teachers to incorporate short-, mid-, and long-cycle data systematically to improve the quality of teaching and learning in the school and the degree to which the school leader uses data to ensure teacher accountability for student learning.

Short-, Mid- and Long-Cycle Data to Improve Student Learning

Effective school leaders and teachers use short-, mid-, and long-cycle data to continuously improve the quality of teaching and learning in the school. There are various definitions of formative and summative assessments. Typically, assessments for learning are considered formative, while assessments of learning are considered summative. Wiliam (2006) classifies formative assessment as three types:

- Long-cycle – occurring across marking periods, semester, or years
- Medium-cycle – occurring within and between teaching units
- Short-cycle – occurring within and between lessons

To be formative, an assessment must bring forth evidence that allows teachers to interpret the learning needs of students and use that evidence to adjust instruction to meet those needs. There has been much interest in using both formative and summative assessment data for both instructional and system monitoring purposes. Integration of formative and external summative assessments provide many essential elements for decision making for schools and district. However, it poses many technical barriers when aligning the two types as they are not directly related (Looney, 2011).

Teacher Accountability

Teacher accountability for student academic outcomes is widespread. Accountability has internal and external dimensions. Rosenblatt (2015) defines internal accountability as the adherence to one's own personal code of conduct. External accountability is adherence to standards and expectations imposed by others. Both dimensions have an impact on the effectiveness of schools in ensuring positive educational outcomes for students. Measures of both dimensions of accountability may be valuable tools for school administrators to use to encourage teacher self-reflection about their responsibilities and build greater accountability.

Accountability and responsibility are not necessarily the same constructs. Teacher accountability requirements do not necessarily engender a greater sense of responsibility. However, school climate positively impacts teachers' sense of responsibility for educational outcomes (Matteucci, Guglielmi, & Lauermann, 2017). Teachers with a greater sense of responsibility are more likely to use focused instruction to motivate students to higher levels of performance.

Teacher assessments of student performance are influenced by the degree of accountability they have for the quality of the assessment. Social cognition research has established that the processes by which we make judgements are either category-based or attribute-based. Category-based processing involves social categories or stereotypes, and requires simple cognition (Fiske, 1993; Fiske & Neuberg, 1990). Attribute-based processing considers numerous different personal attributes and requires complex cognition (Fiske & Neuberg, 1990). Teachers with low accountability use category-based processing to determine the level of student performance; their recall of detail in these assessments is inaccurate. Teachers with high accountability used attribute-based processing; the accuracy of their recall of detail is greater (Krolak-Schwerdt, Böhmer, & Gräsel, 2013). Given the importance of teacher judgement in assessing student performance, accountability is an important driver of accuracy and the elimination of assessment bias.

In order to be accountable, it is also necessary to have control over the conditions which contribute to successful student learning. The quality of teaching and student learning is influenced by the degree of professional autonomy that teachers exercise in the performance of their duties (Ingersoll & Collins, 2017). In the United States, the top-down accountability requirements for school improvement have decreased the control that teachers exercise over major decisions affecting the quality of instruction as well as school climate. Ingersoll and Collins (2017) found that schools with the most centralized decision making and least teacher control are often the lowest performing.

Successful school and teacher accountability depend upon leadership. Leaders must establish a clear path to the goal, support execution through team interdependence, and measure performance (Jamal, Tilchin, & Essawi, 2015). This requires an open climate that allows shared leadership. Transformational leadership is closely connected to the development of an open school environment that encourages and inspires teachers to high levels of performance (McCarley, Peters, & Decman, 2016). Leaders must be able to identify students who need interventions and tactfully but firmly hold teachers accountable for the appropriate actions to ensure learning. The goal of teacher accountability is for teachers to hold themselves accountable and work within their teams to successfully ensure students are progressing toward mastery of the standard.

Conclusion

The Rigor Appraisal Observation Instrument was created to provide a non-evaluative, objective third-party view of the inner workings of schools. The Rigor Appraisal is used to provide actionable data to determine the current conditions of teaching and learning within schools. The metrics from the Rigor Appraisal should be used to address root causes, guide specific coaching requirements, and develop a plan of action tailored to each school's individual needs. This report outlined the theoretical framework for the instrument, including student autonomy, teacher support of student autonomy, and strong distributive leadership teams. Furthermore, each pillar within the instrument was discussed including the theoretical and empirical underpinnings.

While it is essential to outline the theory base for the instrument it is also critical to assess the predictability, reliability, and validity of the tool. Large sample sizes and valid outcome measures are essential to test these premises. To do this there first must be a large enough sample of schools that have received Rigor Appraisals across and within states to have confidence in the findings. Once the sample is large enough, reliability statistics can be computed. Additionally, student achievement measures and other valid school outcomes are needed to assess the predictability and validity of the instrument. The release of student achievement measures is often delayed and varies by state. While applied research has been ongoing since the inception of the instrument, future areas of research will include conducting a more robust analysis of the instrument nationwide and assessing the validity of concepts within the Rigor Appraisal, particularly when there is enough statistical power to do so.

References

Aldridge, J., Fraser, B. J., Fozdar, F., Ala'i, K., Earnest, J., & Afari, E. (2018). Students' perceptions of school climate as determinants of wellbeing, resilience and identity. *Improving Schools*, *19*(1), 5-26.

Alibali, M. W., Nathan, M. J., Church, R. B., Wolfgram, M. S., Kim, S., & Knuth, E. J. (2013). Teachers' gestures and speech in mathematics lessons: Forging common ground by resolving trouble spots. *ZDM Mathematics Education*, *45*, 425-440.

Alliance for the Study of School Climate. (2014). Change from the inside: Examining K-12 school reform using the *ASSC School Climate Assessment Indicator*. Retrieved from http://www.schoolclimate.us/resources/change_from_inside.html

Anees, S. (2017). Analysis of assessment levels of students' learning according to cognitive domain of Bloom's taxonomy. Online submission ED586762. Retrieved from https://eric.ed.gov/?q =Analysis+of+ Assessment+ Levels+of+Students%e2%80%99s+ Taxonomy&id=ED586762

Argon, T., & Ekinci, S. (2016). Teachers' view on organizational deviance, psychological ownership and social innovation. *Universal Journal of Educational Research*, *4*(12A), 133-139. 10.13189/ujer.2016.041317

Barger, M. M., & Linnenbrink-Garcia, L. (2017). Developmental systems of students' personal theories about education. *Educational Psychologist*, *52*(2), 63-83.

Basileo, L.D., (2018). *How a great city school district is improving performance and closing achievement gaps for all students: A 10,000-student study of Des Moines Public Schools.* Retrieved from https://instructionalempowerment.com/wp-content/uploads/2023/06/IE01-121-Research-Report-Des-Moines-Updated-05-2023.pdf.

Becker, D. R., Miao, A., Duncan, R., & McClelland, M. M. (2014). Behavioral self-regulation and executive function both predict visuomotor skills and early academic achievement. *Early Childhood Research Quarterly. 29*, 411-424. http://dx.doi.org/10.1016/j.ecresq.2014.04.014

Benbenishty, R., Astor, R. A., Roziner, I., & Wrabel, S. (2016). Testing the causal links between school climate, school violence, and school academic performance; A cross-lagged panel autoregressive model. *Educational Researcher*, *45*(3), 197-206.

Berkowitz, R., Moore, H., Astor, R. A, & Benbenishty, R. (2016). A research synthesis of the associations between socioeconomic background, inequality, school climate, and academic achievement. *Review of Educational Research*, *87*(2), 425-469.

Black, P. & Wiliam, D. (1998) *Inside the Black Box: raising standards through classroom assessment*. London: School of Education, King's College.

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability*, *21*(1), 5–31.

Blitz, L. V., Yull, D., & Clauhs, M. (2016). Bringing sanctuary to school: Assessing school climate as a foundation for culturally responsive trauma-informed approaches for urban schools. *Urban Education*. https://doi.org/10.1177/0042085916651323

Bloom, B. S. (1971). Mastery learning. In J. H. Block (Ed.), Mastery learning: *Theory and practice* (pp. 47-63). New York: Holt, Rinehart & Winston.

Bonne, L. (2016). New Zealand students' mathematics-related beliefs and attitudes: Recent evidence. *New Zealand Journal of Educational Studies*, *51*(1), 69-82.

Braund, H., & DeLuca, C. (2018). Elementary students as active agents in their learning: An empirical study of the connections between assessment practices and student metacognition. *Australian Educational Researcher*, *45*(1), 65-85.

Brooks, C., Carroll, A., Gillies, R. M., & Hattie, J. (2019). A matrix of feedback for learning. Australian *Journal of Teacher Education*, *44*(4), 14-32.

Brown, G. T. L., Harris, L. R. (2014). The future of self-assessment in classroom practice: Reframing self-assessment as a core competency. *Frontline Learning Research*, *3*, 22-30.

Cherkowski, S., & Schnellert, L. (2017). Exploring teacher leadership in a rural, secondary school: Reciprocal learning teams as a catalyst for emergent leadership. *International Journal of Teacher Leadership*, *8*(1), 6-25.

Cleary, T. J., Velardi, B., & Schnaidman, B. (2017). Effects of the Self-Regulation Empowerment Program, (SREP) on middle school students' strategic skills, self-efficacy, and mathematics achievement. *Journal of School Psychology*, *64*, 28-42.

Conner, T. (2015). Relationships and authentic collaboration: Perceptions of a building leadership team. Leadership and Research in Education: *The Journal of the Ohio Council of Professors of Educational Administration (OCPEA)*, *2*(1), 12-24.

Connor, K. M., & Davidson, J. R. T. (2003). Development of a new resilience scale: The Connor-Davidson Resilience Scale (CD-RISC). *Depression and Anxiety*, 18, 76-82.

Coyne, M. D., Simmons, D. C., Hagan-Burke, S., Simmons, L. E., Kwok, O., Kim, M., … Rawlinson, D. M. (2013). Adjusting beginning reading intervention based on student performance: An experimental evaluation. *Exceptional Children*, *80*(1), 25-44.

Crooks, T. J. (1988). The impact of classroom evaluation practices on students. *Review of Educational Research*, *58*(4), 438-481.

Darling-Hammond, L., & Cook-Harvey, C. M. (2018). *Educating the whole child: Improving school climate to support student success.* Palo Alto, CA: Learning Policy Institute.

Davies, A. (2001). Involving students in communicating about their learning. National *Association of Secondary School Principals. NASSP Bulletin*, *85*(621), 47-52.

Davis, J. R., Warner, N. (2018). Schools matter: The positive relationship between New York City high schools' student academic progress and school climate. *Urban Education*, *53*(8), 959-980.

Day, S. L., & Connor, C. M. (2017). Examining the relations between self-regulation and achievement in third-grade students. *Assessment for Effective Intervention*, *42*(2), 97-109.

Day, S. L., Connor, C. M., McClelland, M. M. (2015). Children's behavioral regulation and literacy: The impact of the first grade environment. *Journal of School Psychology*, *53*, 409-428.

Deci, E. L., & Ryan, R. M. (2000). The "What" and "Why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227-268.

DeFlorio, L., Klein, A., Starkey, P., Swank, P. R., Taylor, H. B., Halliday, S. E., Beliakoff, A., & Mulcahy, C. (2019). A study of the developing relations between self-regulation and mathematical knowledge in the context of an early math intervention. *Early Childhood Research Quarterly*, *46*, 33-48.

DePasque, S., Tricomi, E. (2015). Effects of intrinsic motivation on feedback processing during learning. *NeuroImage*, *119*, 175-186.

Dessie, A. A., & Sewagegn, A. A. (2019). Moving beyond a sign of judgment: Primary school teachers' perception and practice of feedback. *International Journal of Instruction*, 12(2), 51-66. https://doi.org/10.29333/iji.2019.1224a

De Smedt, F., Van Keer, H., (2018). Fostering writing in upper primary grades: A study into the distinct and combined impact of explicit instruction and peer assistance. *Reading and Writing*, *31*(2), 325-354.

Edgerton, A. K., & Desimone, L. M. (2018). Teacher implementation of college- and career-readiness standards: Links among policy, instruction, challenges, and resources. *AERA Open*, *4*(4), 1-22.

Edwards, A. R., & Beattie, R. L., (2016). Promoting student learning and productive persistence in developmental mathematics: Research frameworks informing the Carnegie Pathways. *NADE Digest*, *9*(1), 30-39.

Elmore, R. F. (2008). *Improving the instructional core.* Retrieved from https://achievethecore.org/content/upload/Improving%20The%20Instructional%20Core_Elmore%20Article.pdf

Ewing, J., Gresham, G. J., Dickey, B. (2019). Pre-service teachers learning to engage all students, including English language learners, in productive struggle. *Issues in the Undergraduate Mathematics Preparation of School Teachers: The Journal*, *2*, 1-11.

Fiske, S. T. (1993). Social cognition and social perception. *Annual Review of Psychology*, *44*, 155–194.

Fiske, S. T., & Neuberg, S. L. (1990). A continuum of impression formation, from category-based to individuating processes: Influences of information and motivation on attention and interpretation. *Advances in Experimental Social Psychology*, *23*, 1–74.

Fluckiger, J., Tixier y Vigil, Y., Pasco, R., & Danielson, K. (2010). Formative feedback: Involving students as partners in assessment to enhance learning. *College Teaching*, *58*, 136-140.

Francisco, J. M. (2013). Learning in collaborative settings: Students building on each other's ideas to promote their mathematical understanding. *Educational Studies in Mathematics*, *82*(3), 417-438.

Feucht, F. C. (2010). Epistemic climate in elementary classrooms. In L. D. Bendixen & F. C. Feucht (Eds.), *Personal epistemology in the classroom: Theory, research, and educational implications* (pp. 55–93). Cambridge, MA: Cambridge University Press.

Glaser, C., Kessler, C., Palm, D., & Brunstein, J. C. (2010). Improving fourth graders' self-regulated writing skills: Specialized and shared effects of process-oriented and outcome-related self-regulation procedures on students' task performance, strategy use, and self-evaluation. *Zeitschrift Für Padagogische Psychologie*, *24*(3-4), 177–190.

Green, T., & Allen, M. (2015). Professional development in urban schools: What do teachers say? *Journal of Inquiry & Action in Education*, *6*(2), 53-79.

Griffiths, M., & Davies, C. (1993). Learning to learn: Action research from an equal opportunities perspective in a junior school. *British Educational Research Journal*, *19*(1), 43–58.

Guskey, T. R. (1996). Reporting on student learning: Lessons from the past—Prescriptions for the future. In *Communicating student learning: 1996 Yearbook of the Association for Supervision and Curriculum Development*, T. R. Guskey (Ed.), (pp. 13–24). Alexandria, VA: Association of Curriculum and Development.

Guskey, T. R. (1997). *Implementing mastery learning* (2nd ed.). Belmont CA: Wadsworth.

Guskey, T.R. 2001. Helping standards make the grade. *Educational Leadership*, *59*(1): 20–27.

Guskey, T. R. (2007). Closing achievement gaps: Revisiting Benjamin S. Bloom's "Learning for Mastery". *Journal of Advanced Academics*, *19*(1), 8-31.

Harrison, K., O'Hara, J., & McNamara, G. (2015). Re-thinking assessment: Self- and peer-assessment as drivers of self-direction in learning. *Eurasian Journal of Educational Research*, *60*, 75-88.

Hattie, J., Gan, M., & Brooks, C. (2017). Instruction based on feedback. In R. E. Mayer & P. A. Alexander (Eds.), *Handbook of research on learning and instruction* (2nd ed., pp. 290-324). London, England: Routledge.

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

Herman, R., Dawson, P., Dee, T., Greene, J., Maynard, R., Redding, S., & Darwin, M. (2008). *Turning Around Chronically Low-Performing Schools: A practice guide* (NCEE #2008- 4020). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from https://ies.ed.gov/ncee/wwc/Docs/PracticeGuide/Turnaround_pg_04181.pdf

Hiebert, J., & Grouws, D. A. (2007). The effects of classroom mathematics teaching on students' learning. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 371–404). Greenwich, CT: Information Age.

Hinnant-Crawford, B., Faison, M. and Chang, M. (2018). Culture as mediator. Co-regulation, self-regulation, and middle school mathematics achievement. *Journal for Multicultural Education*, *10*(3), 274-293. https://doi.org/10.1108/JME-05-2016-0032

Hirsh, A., & Segolsson, M. (2019). Enabling teacher-driven school-development and collaborative learning: An activity theory-based study of leadership as an overarching practice. *Educational Management Administration & Leadership*, *47*(3), 400-420.

Ingersoll, R. M., Collins, G. J. (2017). Accountability and control in American schools. *Journal of Curriculum Studies*, *1*, 75-95.

Jacobson, S. (2011). Leadership effects on student achievement and sustained school success. International *Journal of Educational Management*, *25*(1), 33-44, doi: 10.1108/09513541111100107

Jamal, A., Tilchin, O., & Essawi, M. (2015). A teacher accountability model for overcoming self-exclusion of pupils. *International Education Studies*, *8*(9), 58-64.

Katzenbach, J. R., & Smith, D. K. (2003). The discipline of teams. *Harvard Business Review*, *71*(2), 111-120.

Kearney, E., Gebert, D., & Voelpel, S. C. (2009). When and how diversity benefits teams: The importance of team members' need for cognition. *The Academy of Management Journal*, *52*(3), 581–596.

Kingston, N., and Bash, B., (2011). Formative Assessment: A meta-analysis and a call for research. *Educational Measurement: Issues and Practice*, *30*(4), 28-37.

Klute, M., Apthorp, H., Harlacher, J., & Reale, M. (2017). *Formative assessment and elementary school student academic achievement: A review of the evidence* (REL 2017–259). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Central. Retrieved from https://ies.ed.gov/ncee/edlabs/regions/central/pdf/REL_2017259.pdf

Klute, M., Cherasaro, T., & Apthorp, H. (2016). *Summary of research on the association between state interventions in chronically low-performing schools and student achievement*. Retrieved from http://files.eric.ed.gov/fulltext/ED565613.pdf

Konold, T., Cornell, D., Jia, Y., & Malone, M. (2018). School climate, student engagement, and academic achievement: A latent variable, multilevel multi-informant examination. *AERA Open*, *4*(4), 1-17.

Kosko, K. W. (2015). Geometry students' self-determination and their engagement in mathematical whole class discussion. *Investigations in Mathematics Learning*, *8*(2), 17-36.

Krolak-Schwerdt, S., Böhmer, M., & Gräsel, C. (2013). The impact of accountability on teachers' assessments of student performance: A social cognitive analysis. *Social Psychology of Education: An International Journal*, *16*, 215-239.

LeClerc, M., & Moreau, A. C. (2011). Communautés d'apprentissage professionnelles dans huit écoles inclusives de l'Ontario. *Education et Francophonie*, *39*(2), 189-206.

Le Floch, K. C., O'Day, J., Birman, B., Hurlburt, S., Nayfack, M., Halloran, C., … Hulsey, L. (2016). *Case Studies of Schools Receiving School Improvement Grants: Final Report*. Retrieved from http://files.eric.ed.gov/fulltext/ED565615.pdf

Livy, S., Muir, T., & Sullivan, P. (2018). Challenging tasks lead to productive struggle. *Australian Primary Mathematics Classroom*, *23*(1), 19-24.

Looney, J. W. (2011). Integrating formative and summative assessment: Progress toward a seamless system? *OECD Education Working Papers*, No. 58, OECD Publishing. doi: 10.1787/5kghx3kbl734-en

Marshik, T., Ashton, P. T., & Algina, J. (2017). Teachers' and students' needs for autonomy, competence, and relatedness as predictors of students' achievement. *Social Psychology of Education: An International Journal*, *20*(1), 39-67. DOI 10.1007/s11218-016-9360-z

Martinek, D., Hofmann, F., & Kipman, U. (2016). Academic self-regulation as a function of age; The mediating role of autonomy support and differentiation in school. *Social Psychology of Education: An International Journal*, *19*(4), 729-748.

Mason, L., & Scrivani, L. (2004). Enhancing students' mathematical beliefs: An intervention study. *Learning and Instruction*, *14*, 153–176. http://dx.doi.org/10.1016/j.learninstruc.2004.01.002

Matteucci, M. C., Guglielmi, D., Lauermann, F. (2017). Teachers' sense of responsibility for educational outcomes and its associations with teachers' instructional approaches and professional wellbeing. *Social Psychology of Education: An International Journal*, *20*, 275-298.

Maye, D. (2013). Hitting the mark: Strategic planning for academic rigor. *Delta Kappa Gamma Bulletin*, *79*(4), 29-36.

McCarley, T. A., Peters, M. L., & Decman, J. M. (2016). Transformational leadership related to school climate: A multi-level analysis. *Educational Management Administration & Leadership*, *44*(2), 322-342.

Michaelsen, L. K. and Sweet, M. (2008). The essential elements of team-based learning. *New Directions for Teaching and Learning*, *116*, 7-27. doi:10.1002/tl.330

Munns, G., & Woodward, H. (2006). Student engagement and student self-assessment: The REAL Framework. *Assessment in Education: Principles, Policy and Practice*, *13*(2), 193–213.

Muñoz, M. A., & Branham, K. E. (2016). Professional learning communities focusing on results and data-use to improve learning: The right implementation matters. *Planning and Changing*, *47*(1/2), 37-46.

Musso, M. F., Boekaerts, M., Segers, M., & Cascallar, E. C. (2019). Individual differences in basic cognitive processes and self-regulated learning: Their interaction effects on math performance. *Learning and Individual Differences*, *71*, 58-70.

Newmann, F. M., Wehlage, G. G., & Lamborn, S. D. (1992). The significance and sources of student achievement. In F. M Newmann (Ed.), *Student engagement and achievement in American secondary schools.* New York, NY: Teachers College Press.

O'Brien, P. (2018). Self-determination for primary school children: Theory and practice. *REACH Journal of Special Needs Education in Ireland*, *31*(2), 155-168.

Olina, Z., & Sullivan, H. J. (2002). Effects of classroom evaluation strategies on student achievement and attitudes. *Educational Technology Research and Development*, *50*(3), 61–75.

Ozgonul, L., & Alimoglu, M. K. (2019). Comparison of lecture and team-based learning in medical ethics education. *Nursing Ethics*, *26*(3), 903–913. https://doi.org/10.1177/0969733017731916

Panadero, E., Andrade, H., & Brookhart, S. (2018). Fusing self-regulated learning and formative assessment: A roadmap of where we are, how we got here, and where we are going. *The Australian Educational Researcher*, *45*(1), 13-31.

Panadero, E., Brown, G. T. L., Strijbos, J. (2015). The future of student self-assessment: A review of known unknowns and potential directions. *Educational Psychology Review*, *28*(4), 803-830.

Park, J., Lee, I. H., & Cooc, N. (2018). The role of school-level mechanisms: How principal support, professional learning communities, collective responsibility, and group-level teacher expectations affect student achievement. *Educational Administration Quarterly*, *0*(0), 1-39. https://doi.org/10.1177/0013161X18821355

Pierce, J. L., Kostova, T., & Dirks, K. T. (2003). The state of psychological ownership: Integrating and extending a century of research. *Review of General Psychology*, *7*(1), 84-107.

Pieschl, S. (2009). Metacognitive calibration – an extended conceptualization and potential applications. *Metacognition Learning*, *4*, 3-31.

Ratts, R. F., Pate, J. L., Archibald, J. G., Andrews, S. P., Ballard, C. C., Lowney, K. S. (2015). The influence of professional learning communities on student achievement in elementary schools. *Journal of Education & Social Policy*, *2*(4), 57-61

Reeve, J. (2006). Teachers as facilitators: What autonomy-supportive teachers do and why their students benefit. *The Elementary School Journal*, *106*(3), 225-236.

Roberge, M. E., & van Dick, R. (2010, December). Recognizing the benefits of diversity: When and how does diversity increase group performance? *Human Resource Management Review*, *20*(4), 295–308.

Ronfeldt, M., Farmer, S. O., McQueen, K., & Grissom, J. A. (2015). Teacher collaboration in instructional teams and student achievement. *American Educational Research Journal*, *52*(3), 475-514.

Rosenblatt, Z. (2015). Personal accountability in education: Measure development and validation. *Journal of Educational Administration*, *55*(1), 18-32.

Ross, J. A. (2006). The reliability, validity, and utility of self-assessment. *Practical Assessment Research & Evaluation*, *11*(10), 1-13. Retrieved from https://scholarworks.umass.edu/pare/vol11/iss1/10/

Schaap, H., & de Bruijn, E. (2018). Elements affecting the development of professional learning communities in schools. *Learning Environments Research*, *21*(1), 109-134. https://doi.org/10.1007/s10984-017-9244-y

Seglem, R. (2017). Creating a circle of learning: Teachers taking ownership through professional communities. *Voices from the Middle*, *25*(1), 56-60.

Shindler, J., Jones, A. Williams, A. D., Taylor, C., & Cardenas, H. (2016). The school climate-student achievement connection: If we want achievement gains, we need to begin by improving the climate. *Journal of School Administration Research and Development*, *1*(1), 9-16.

Schunk, D. H. (1996). Goal and self-evaluative influences during children's cognitive skill learning. *American Educational Research Journal*, *33*(2), 359–382.

Shute, V. J. (2007). *Focus on formative feedback*. Research Report. Princeton, NJ: Educational Testing Service.

Skibbe, L. E., Montroy, J. J., Bowles, R. P., & Morrison, F. J. (2019). Self-regulation and the development of literacy and language achievement from preschool through second grade. *Early Childhood Research Quarterly*, *46*, 240-251.

Stahl, G. K., Maznevski, M. L., Voigt, A., & Jonsen, K. (2010). Unraveling the effects of cultural diversity in teams: A meta-analysis of research on multicultural work groups. *Journal of International Business Studies*,*41*(4), 690–709.

Stefanou, C. R., Perencevich, K. C., DiCintio, M., Turner, J. C. (2004). Supporting autonomy in the classroom: Ways teachers encourage student decision making and ownership. *Educational Psychologist*, *39*(2), 97-110.

Stein, R. E., Colyer, C. J., Manning, J. (2016). Student accountability in team-based learning classes. *Teaching Sociology*, *44*(1), 28-38.

Stiggins, R. J. (2008). *Student-involved assessment for learning*. Upper Saddle River, NJ: Merrill Prentice Hall.

Stipek, D. (1996). Motivation and instruction. In D. Berliner & R. Calfee (Eds.), *Handbook of educational psychology.* New York, NY: Macmillan.

Suldo, S. M., Riley, K. N., & Shaffer, E. J. (2006). Academic Correlates of Children and Adolescents' Life Satisfaction. *School Psychology International*, *27*(5), 567–582. https://doi.org/10.1177/0143034306073411

Sun, M., Loeb, S., & Grissom, J. A. (2017). Building teacher teams: Evidence of positive spillovers from more effective colleagues. *Educational Evaluation and Policy Analysis*, *39*(1), 104-125.

Swanson, E., McCulley, L. V., Osman, D. J., Lewis, N. S., Solis, M. (2019). The effect of team-based learning on content knowledge: A meta-analysis. *Active Learning in Higher Education*, *20*(1), 39-50.

Szatkowski, H. D., & Brannan, L. R. (2019). Taking ownership of team accountability; The student-driven peer evaluation method. *The Journal of Faculty Development*, *33*(1), 39-48.

Tichnor-Wagner, A., Harrison, C., & Cohen-Vogel, L. (2016). Cultures of learning in effective high schools. *Educational Administration Quarterly*, *52*(4), 602-642.

Tolhurst, D. (2007). The influence of learning environments on students' epistemological beliefs and learning outcomes. *Teaching in Higher Education*, *12*, 219–233. http://dx.doi.org/10.1080/13562510701191992

Toth, M., and Sousa, D. (2019). *The power of student teams: achieving the social, emotional, and cognitive learning in every classroom through academic teams.* West Palm Beach, FL: Learning Sciences International.

U.S. Department of Education. (2017). *What Works Clearinghouse procedures handbook*, version 4.0. Washington DC: Author.

Valentine, K., Bolyard, J. (2018). *Creating a classroom culture that supports productive struggle: Pre-service teachers' reflections on teaching mathematics.* Paper presented at the annual conference of the American Educational Research Association, New York, NY.

Valls, R., & Kyriakides, L. (2013). The power of interactive groups: How diversity of adults volunteering in classroom groups can promote inclusion and success for children of vulnerable minority ethnic populations. *Cambridge Journal of Education*, *43*(1), 17-33.

Van den Bergh, L., Ros, A., Beijaard, D. (2014). Improving teacher feedback during active learning: Effects of a professional development program. *American Educational Research Journal*, *51*(4), 772-809.

VanLone, J., Freeman, J., LaSalle, T., Gordon, L., Polk, T., & Rocha Neves, J. (2019). A Practical Guide to Improving School Climate in High Schools. *Intervention in School and Clinic*, *55*(1), 39–45. https://doi.org/10.1177/1053451219832988

Vollmeyer, R., Rheinberg, F. (2005). A surprising effect of feedback on learning. L*earning and*

Instruction, *15*, 589-602.

Warshauer, H. K. (2015). Strategies to support productive struggle. *Mathematics Teaching in the Middle School*, *20*(7), 390-393.

Wehmeyer, M. L. (1997) Self-determination as an Educational Outcome. A Definitional Framework and Implications for Intervention. *Journal of Developmental and Physical Disabilities*, Vol. 9, 175-209.

Wehmeyer, M. L., Sands, D. J., Knowlton, H. E., & Kozleski, E. B. (2002). Teaching students with mental retardation: *Providing access to the general curriculum.* Baltimore, MD: Paul H. Brookes.

Wehmeyer, M. L., Shogren, K. A., Toste, J. R., & Mahal, S. (2017). Self-determined learning to motivate struggling learners in reading and writing. *Intervention in School and Clinic*, *52*(5), 295-303.

Wenjuan, G., Ling, L. K., & Jun, W. (2019). Teacher feedback and students' self-regulated learning in mathematics: A comparison between a high achieving and a low-achieving secondary school. *Studies in Educational Evaluation*, *63*, 48-58.

Wiliam, D. (2006). Formative assessment: Getting the focus right. Educational Assessment, 11(3 & 4), 283-289.

Wiliam, D, Lee, C.; Harrison, C., & Black, P. (2004). Teachers developing assessment for learning: impact on student achievement. *Assessment in Education: Principles Policy and Practice*, *11*(1), 49–65.

Williams, K. E., White, S. L. J., MacDonald, A. (2016). Early mathematics achievement of boys and girls: Do differences in early self-regulation pathways explain later achievement? *Learning and Individual Differences*, *51*, 199-209.

Zeybek, Z. (2016). Productive struggle in a geometry class. *International Journal of Research in Education and Science (IJRES)*, *2*(2), 396-415.

Ziebell, N., & Clarke, D. (2018). Curriculum alignment: Performance types in the intended, enacted, and assessed curriculum in primary mathematics and science classrooms. *Studia Paedigogica*, *23*(2), 175-203.

Zimmerman, B. J., Kitsantas, A. (2014). Comparing students' self-discipline and self-regulation measures and their prediction of academic achievement. *Contemporary Educational Psychology*, *39*, 145-155.

Zimmerman, B. J. and Schunk, D. H. (2011). *Handbook of Self-Regulation of Learning and Performance.* New York, NY: Taylor and Francis.

Zullig, K. J., Koopman, T. M., Patton, J. M., Ubbes, V. A. (2010). School climate: Historical review, instrument development, and school assessment. *Journal of Psychoeducational Assessment*, *28*(2), 139-152.