

# Using Classroom Assessment to Promote 21<sup>st</sup> Century Learning in Emerging Market Countries

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**Abstract:** Through initiatives like Assessment and Teaching of 21st Century Skills (ATC21S) Intel® has been collaborating with governments and policy-makers to create new national standards and national assessments. But Intel's professional development programs help teachers use assessment for learning as part of a 21<sup>st</sup> century learning environment. In this paper, we highlight the research on six assessment strategies that should be part of a 21<sup>st</sup> century learning environment and encourage ministries to consider how these strategies may play a role in their own reform efforts: 1) Rubrics, 2) Performance-based assessments (PBAs), 3) Portfolios, 4) Student self-assessment, 5) Peer-assessment, 6) Student response systems (SRS).

## Introduction

Today, educational systems across the globe are undergoing efforts to move beyond the ways they operated at the beginning of the 20th century, with traditional instructional practices that commonly ask students to work individually on exams that require them to recall facts or respond to pre-formulated problems within the narrow boundaries of individual school subjects. Reforms currently underway reframe what is taught, how it is learned, and how it is being evaluated in innovative ways that help personalize learning. Assessments that support learning must explicitly communicate the nature of expected learning. Research, in fact, shows the powerful effect that on-going assessment embedded into the learning process has on student learning, particularly for low ability students (Black & Wiliam, 1998). Creating such a system of personalized learning requires new forms of formative and summative student performance assessments that enable individual students to stretch onward from wherever they are in a learning continuum.

For over a decade, Intel® Corporation has been involved in a number of global initiatives such as Assessment and Teaching of 21st Century Skills (ATC21S) that support developing new national assessment strategies and new benchmarking tests. Through its partnerships with ministries of education, Intel Teach's teacher professional development programs have helped millions of teachers in developing countries integrate these innovative assessment strategies, as well as technology, into their classroom practice (EDC & SRI International, 2008; Light, Polin, & Strother, 2009). While these strategies support new assessments of learning, all of the Intel Teach professional development programs also use a variety of *assessment for learning* approaches. Assessment for learning is the idea that classroom assessments should support ongoing teaching and learning (Assessment Reform Group, 2002; Heritage, 2010), thus highlighting the vital role that teacher-made classroom-based formative and process-focused assessments could play in improving the entire education system. Intel's Getting Started course, teachers learn the technical skills to design rubrics and the Essentials course teaches teachers how to use rubrics to assess student products and encourages performance-based assessments. The Teaching Thinking with Technology and the Essentials V10 courses stress formative assessments for 21<sup>st</sup> century skills. The online Elements courses include one entirely devoted to assessing 21<sup>st</sup> century learning. Intel also offers a free online rubric maker. Additionally, courses like Getting Started and Essentials model good assessment practices when they have teachers assess and provide feedback on their work or when the courses ask teachers to reflect on their own learning in the course. But, these programs alone are probably not sufficient and local agencies and ministries may need to do more to support the needed shifts in classroom assessment strategies.

In its work collaborating with governments, policy-makers, and local agencies around the world, Intel has always maintained that education reform is a systemic process in which stakeholders need to consider how policy changes in one area affect other areas. Yet, one of the biggest challenges for ministries of education engaged in school reform is measuring whether they are having a real impact in the classroom. While, many of these teacher-designed assessment strategies are increasingly common in the classrooms of developing countries, they are still rarely used in emerging market countries. To truly improve student learning in emerging market countries it is important to transform how teachers' assess their students learning in the classroom. This paper highlights the research on a number of assessment strategies or tools for classroom-based assessment that can play a key role in creating and supporting the new 21<sup>st</sup> century learning environments and encourages ministries to consider how these strategies may play a role in their own reform efforts.

## **Classroom-Based Assessments**

### **Fostering 21<sup>st</sup> Century Learning with Classroom-Based Assessments**

Teachers have always evaluated student knowledge through recall test, or by asking content questions during a lecture, but researchers and practitioners are beginning to understand that a different type of teacher developed assessments can play an important role in supporting learning (Black & William, 1998; W. J. Popham, 2008b) and in helping to transform teaching practice. In fact, incorporating 21<sup>st</sup> century teaching practices should start with updating teachers' arsenal of assessment strategies that they use in the classroom to support their teaching (Jacobs, 2010). In a seminal review of the literature on how people learn, the National Research Council asserts that "appropriately designed assessments can help teachers realize the need to rethink their teaching practices" (2000, p. 141).

The research around classroom assessments suggests that the tools and strategies we wish to discuss share three important traits that in different degrees: high quality teacher-designed assessments provide insight on what and how students are learning in time for teachers to modify or personalize instruction; they allow teachers to assess a broader range of skills and abilities in addition to content recall; and these assessments give students new roles in the assessment process that can make assessment itself a learning experience and deepen student engagement in content.

1) Provide Insight on Student Learning so Teachers Can Modify Instruction: Because many of these assessment tools and strategies are formative in nature, the information garnered from their implementation can be used to immediately inform teachers' instructional decisions. For example, information garnered from portfolios can help teachers evaluate the effectiveness of their own instruction while helping them make informed decisions about future lessons. The implementation of portfolio assessments stimulates student self-reflection providing valuable feedback to both students and teachers, which in turn can be used to inform the teaching and learning processes. When employing the peer assessment strategy, if students and teachers assess a student differently it can open up productive dialogue to discuss student learning needs and goal creation (J. Ross, 2006). The teacher can then use that information to structure the following lesson around the needs and goals of those students. Whether taking a pre and post survey poll or asking multiple-choice questions to reveal student's subtle misunderstandings and misconceptions, a Student Response System (SRS) allows teachers to take a quick snapshot of where his or her teachers are on a learning continuum and devise the appropriate strategies to take them to the next level. As teachers become more aware of their students' interests, needs, strengths and weaknesses, they are better positioned to modify their instructional strategies and content focus to help maximize student learning.

2) Assess Broader Range of Skills and Abilities: Traditional forms of assessment like multiple-choice, fill in the blank, and true/false, privilege memorization and recall skills that demand only a low level of cognitive effort (Dikli, 2003; Shepard, et al., 1995). The assessment tools and strategies outlined in this paper provide more robust means to measure higher order thinking skills and complex problem solving abilities (Palm, 2008). Strategies such as performance bases assessment (PBA) and portfolios, take into account multiple measures of achievement, and rely on multiple sources of evidence, moving beyond the standardized examinations most commonly used for school accountability (Shepard, et al., 1995; Wood, Darling-Hammond, Neill, & Roschewski, 2007). Self-and peer-assessment both teach and assess a broader range of life skills like self-reflection, collaboration, and communication. As a tool to measure student learning, rubrics allow teachers to measure multiple dimensions of learning rather than

just content knowledge, and to provide a more detailed assessment of each student's abilities instead of just a number or percent correct.

3) Give Students New Roles in the Assessment Process that Make Assessment a Learning Experience: In contrast to the traditional teacher-designed, teacher-administered, teacher-graded tests, this cadre of assessments involves students throughout the assessing process. Involving students in the creation of assessment criteria, the diagnosis of their strengths and weaknesses, and the monitoring of their own learning, transfers the locus of instruction from the teacher to his or her students (Nunes, 2004). For example, the most successful rubrics involve students in the creation of the evaluation criteria. This creates buy-in, increases engagement, and fosters a deeper commitment to the learning process. In the assembly of a portfolio, students not only get to decide which work is graded, they have the opportunity reflect up and evaluate the quality of those submissions. This type of involvement fosters meta-cognition, active participation, and ultimately puts students at the center of the learning process (McMillan & Hearn, 2008). During peer-assessment students are asked to be the actual evaluator offering feedback and suggestions on how to improve their classmates' work. When created collaboratively, many of these assessments enable teachers and students to interact in a way that blurs the roles in the teaching and learning process (Barootchi & Keshavarz, 2002). When students are part of the assessment process they are more likely to "take charge" of their own learning process and products and will be more likely to want to make improvements on future work (Sweet, 1993).

## **Six Effective Assessment Strategies**

The following sections describe six assessment tools and strategies shown to impact teaching and learning as well as help teachers foster a 21<sup>st</sup> century learning environment in their classrooms: 1) Rubrics, 2) Performance-based assessments (PBAs), 3) Portfolios, 4) Student self-assessment, 5) Peer-assessment, 6) Student response systems (SRS). Although the list does not include all innovative assessment strategies, it includes what we think are the most common strategies, and ones that may be particularly relevant to the educational context of developing countries. Many of the assessment strategies currently in use fit under one or more of the categories discussed. Furthermore, it is important to note that these strategies also overlap in a variety of ways.

### ***Rubrics***

Rubrics are both a tool to measure students' knowledge and ability as well as an assessment strategy. A rubric allows teachers to measure certain skills and abilities not measurable by standardized testing systems that assess discrete knowledge at a fixed moment in time (Reeves & Stanford, 2009). This section discusses the research on rubrics, but because rubrics are frequently used as part of other assessment strategies (portfolios, performances, projects, peer-review and self-assessment), they will be discussed in those sections as well.

Unlike a standard checklist used to assess performance, a rubric is a set of criteria that articulates expectations and describes degrees of quality along a continuum (H. L. Andrade, Ying, & Xiaolei, 2008; Rezaei & Lovorn, 2010; Wiggins & McTighe, 2005). The rubric is not only utilized in conjunction with summative assessments; it is a tool that can enhance the entire learning process from start to finish by serving a number of purposes including communicating expectations for an assignment, providing focused feedback on a project still in process. Additionally, they encourage self-monitoring and self-assessment and give structure for a final grade on an end product (H. L. Andrade, et al., 2008; Lee & Lee, 2009; National Research Council, 2002).

Rubrics are considered "inclusive assessment tools" that can be used as class-wide assessment tools to help students at all levels make meaningful progress towards curricular goals (Lee & Lee, 2009). Andrade, et. al. (2010), in their research around assessment and middle school writing, found that students who are involved in three major components of rubric assessment (reading an exemplary sample, generating criteria, and using a rubric to self-assess) can actually produce more effective writing. In addition, students with access to the evaluation criteria for a project had higher quality discussions and better group products than their peers who did not know the grading criteria in advance (H. Andrade, Buff, Terry, Erano, & Paolino, 2009). Skillings (2000), in her two years observing an elementary school classroom noted that "both lower and higher achieving students were able to be successful in showing their knowledge" when they were assessed with a rubric (p. 454). Similarly, the awareness of lesson

objectives and the encouragement of self-monitoring associated with the use of rubrics increase engagement levels and help students with disabilities learn more successfully in an inclusive classroom (Lee and Lee, 2009).

One of the major strengths of the rubric as an assessment method is that it functions as a teaching as well as an evaluative tool (H. L. Andrade, et al., 2008; J. W. Popham, 1997). The development of high quality evaluation criteria is essential to the effectiveness of a rubric as both an instructional and assessment tool (Wiggins & McTighe, 2005). Popham (2008a) suggests that in fact, the evaluative criteria “should be the most instructionally relevant component of the rubric. They should guide the teacher in designing lessons because it is the students’ mastery of the evaluative criteria that ultimately will lead to skill mastery” (p. 73). In order to ensure the rubric criteria is rigorous and accurate, Wiggins and McTighe suggest designing and refining rubrics based on actual student work that has been collected, sorted and rated.

Collaborative rubric development can also promote cooperation between teachers and students as they work together to build and utilize the tool (Lee & Lee, 2009). As a result, students are more comfortable because they feel some ownership in the process, recognize that their opinion is valued and are more successful because they know what is expected of them (Lundenberg, 1997; Reeves & Stanford, 2009). Inviting students to participate in the generation of rubric criteria not only pushes students to think more deeply about their learning it helps foster a sense of responsibility for their own learning process and develop critical thinking skills that can be transferred to other learning situations (Andrade et. al., 2008; Lee and Lee, 2009; Skillings and Ferrell, 2000; National Research Council, 2002). Wiggins and McTighe (2005) in fact emphasize that the ultimate test of student knowledge is their ability to transfer what they know to a variety of contexts. Metacognition can also lead to more self-directed learning through self-monitoring and self-assessment (Lee and Lee, 2009).

### ***Performance-based Assessments***

Performance-based assessments (PBA), also known as project-based or authentic assessments, are generally used as a summative evaluation strategy to capture not only what students know about a topic, but if they have the skills to apply that knowledge in a “real-world” situation. By asking them to create an end product, PBA pushes students to synthesize their knowledge and apply their skills to a potentially unfamiliar set of circumstances that is likely to occur beyond the confines of a controlled classroom setting (Palm, 2008). Some examples of PBA include designing and constructing a model, developing, conducting and reporting on a survey, carrying out a science experiment, writing a letter to the editor of a newspaper, creating and testing a computer program, and outlining, researching and writing an in-depth report (Darling-Hammond & Pecheone, 2009; Wren, 2009). Regardless of the type of performance, the common denominator across all PBAs is that students are asked to perform an authentic task that simulates a real life experience and mimics real world challenges (Wiggins & McTighe, 2005; Shepard, 1995).

Performance-based assessments have been used in many countries for decades and offer many advantages not afforded by standardized paper and pencil multiple-choice exams. Wiggins and McTighe (2005) assert that in fact, “authentic assessments are meant to do more than “test”: they should teach students (and teachers) what the “doing” of a subject looks like and what kinds of performance challenges are actually considered most important in a field or profession” (p. 337). PBA, coupled with an well-designed measurement tool such as a scoring rubric, can provide the *how* and the *why* a student might be struggling, versus just the *what* of standardized tests; as a result, PBA can actually help teachers figure out how their students best learn (Falk, Ort, & Moirs, 2007; Shepard, 2009). PBA, used as a formative assessment, also provides more timely feedback than large-scale standardized tests. Standardized tests can take a number of months to produce results, but PBA allows teachers to make meaningful adjustments while they are still teaching their current students (Darling-Hammond & Pecheone, 2009; Wood, et al., 2007).

Additional benefits of PBA are that they are inherently more student-centered and are better at assessing higher order thinking and other 21<sup>st</sup> century skills (Wood, et al., 2007; Wren, 2009). In a yearlong study of 13 third grade teachers in Maryland, Shepard and her team (1995) noted “small but real gains” in students’ ability to explain mathematical patterns and tables; a skill previously exhibited by only the most adept students (p. 27). Not surprisingly, PBA helps students to be more engaged and invested in their learning (Wood et. al., 2007; Wiggins & McTighe, 2005). PBA also allows for differentiation of assessment so that all students have space to demonstrate understanding including special education and ELL students (Darling-Hammond, 2009).

In addition to impacts on student outcomes, research has shown that the implementation of performance-based assessment strategies can also impact other instructional strategies in the classroom. Though it can be challenging to change general teaching paradigms, a small study of teachers in the US found that “under some circumstances, performance-based assessment can change specific behaviors and procedures in the classroom” (Firestone, Mayrowetz, & Fairman, 1998, p. 11).

### ***Portfolio Assessment***

Portfolios are a collection of student work gathered over time that is primarily used as a summative evaluation method. The most salient characteristic of the portfolio assessment is that rather than being a snapshot of a student’s knowledge at one point in time (like a single standardized test), it highlights student effort, development, and achievement over a period of time; portfolios measure a student’s ability to apply knowledge rather than simply regurgitate it. They are considered both student-centered and authentic assessments of learning (Anderson & Bachor, 1998; Barootchi & Keshavarz, 2002). Portfolios are one of the most flexible forms of assessment because they can be effectively adapted across subject areas, grade levels and administrative contexts (i.e. to report individual student progress, to compare achievement across classroom or schools and to increase parent involvement in student learning) (Sweet, 1993; National Research Council, 2002). The content included in the portfolio, along with who chooses what to include, vary by the teacher and the learning goals associated with the portfolio. Some portfolios only include final products, while other portfolios will incorporate drafts and other process documents. Some will contain items chosen exclusively by the teacher, while others will fold in input from the student, their peers, administrators and even parents.

One of the strengths of the portfolio as an assessment tool is that it can be smoothly integrated into classroom instruction (as opposed to be an add-on style of the standardized summative test). The portfolio acts as a repository for work assigned and completed throughout the year. It does not necessitate additional tests or writing assignments. The additional inputs required (i.e. student reflection (written or spoken), student-teacher collaboration, rubric creation and implementation) aid rather than distract from the teaching and learning process. Barootchi and Keshavarz highlight that the student portfolio is an assessment that is “truly congruent with instruction” because of its ability to simultaneously teach and test (p. 286). In fact, when implemented effectively, portfolios can supplement rather than take time away from instruction (Sweet, 1993; National Research Council, 2002).

When the portfolio is well integrated into a teacher’s instructional practices, it can function as a strategy to increase student learning across a variety of subject areas. Studies in Iran and in Turkey showed increased student achievement in English as a foreign language (Barootchi & Keshavarz, 2002), science (Çakan, Mihaladiz, & Göçmen-Taskin, 2010), and writing and drawing (Tezci & Dikici, 2006).

All high quality portfolios involve students at some point in the process. In fact, the selection process can be hugely instructive and impactful for students as they are asked to collect, select and reflect upon what they want to include in their portfolio (Sweet, 1993). Portfolios foster self-reflection and awareness among students as they are often asked to review previous assignments and projects and assess strengths and weaknesses of both their processes as well as their final products (Sweet, 1993). Barootchi and Keshavarz (2002) also emphasize the role that portfolios can have in helping students to become more independent learners (p. 281). When well integrated, portfolios can also foster collaboration both among students and their peers as well as between students and their teacher (Tezci & Dikici, 2006). Students’ critiques and evaluations of classmate’s work can even be included as an additional artifact in the portfolio collection. Nunes (2004) believes that one of the underlying principles of portfolio development is that “it should be dialogic and facilitate ongoing interaction between teacher and students” (p. 328).

Technology is playing an increasingly important role enabling teachers to use portfolios. In the past decade portfolios have moved from paper folders and file cabinets to electronic databases in social networks imbedded within the online “cloud.” While e-portfolios offer many of the same benefits of conventional portfolios, there are additional advantages that affect learning, teaching and administration. Chang (2009) describes the e-portfolio as an “abundant online museum” connoting an ease of storage, a creativity of presentation, and the facilitation of collaboration (p. 392). Research suggests that e-portfolios can aid in the development of information technology (IT)

skills, but also increase learning in low-motivation students (Chang, 2009). Online portfolios also allow for real-time information collection, collaboration and editing with fewer physical resources required. Finally, students are pushed to consider a wider audience when they put their products online (Diehm, 2004). They also eliminate the space limitations normally associated with paper portfolios.

### ***Self-assessment***

While the previous assessment tools and strategies listed in this report generally function as summative approaches, self-assessment is generally viewed as a formative strategy, rather than one used to determine a student's final grade. Its main purpose is for students to identify their own strengths and weakness and to work to make improvements to meet specific criteria (H. Andrade & Valtcheva, 2009). According to McMillan and Hearn (2008) "self-assessment occurs when students judge their own work to improve performance as they identify discrepancies between current and desired performance" (p. 1). In this way, self-assessment aligns well with standards-based education because it provides clear targets and specific criteria against which students or teachers can measure learning.

Self-assessment is used to promote self-regulation, to help students reflect on their progress and to inform revisions and improvements on a project or paper (Andrade and Valtcheva, 2009). Ross (2006) argues that in order for self-assessment to be truly effective four conditions must be in place: the self-assessment criteria is negotiated between teachers and students, students are taught how to apply the criteria, students receive feedback on their self-assessments and teachers help students use assessment data to develop an action plan (p. 5).

A number of studies point to the positive effects self-assessment can have on achievement, motivation, self-perception, communication, and behavior (H. Andrade & Valtcheva, 2009; Klenowski, 1995; McMillan & Hearn, 2008). McDonald and Boud (2003) report that high school students who were trained in self-assessment not only felt better prepared for their external examinations, they actually outperformed their peers who had not received the training. Similarly, students across grade levels and subject areas including narrative writing, mathematics and geography outperformed their peers in the control group who had not received self-assessment training (Ross, 2006). Andrade and Valtcheva (2009) in their literature reviews cite numerous studies that found a positive relationship between the use of self-assessments and the quality of writing, depth of communication skills, level of engagement and degree of learner autonomy. Finally, self-assessment is also a lifelong learning skill that is essential outside of the confines of the school or classroom (McDonald and Boud, 2003).

An additional strength of self-assessment as a formative assessment tool is that it allows every student to get feedback on his or her work. Few classrooms allow teachers the luxury of regularly responding to each individual student, so when students are trained in self-assessment it makes them less reliant on teachers to advance their learning (Andrade and Valtcheva, 2009). While the focus is *self*-evaluation, the process can also be enhanced through peer and teacher based assessments that offer alternative interpretation and additional evidence to support a student's understanding of their own learning (Andrade and Valtecheva, 2009).

A number of channels can be used to aid students in their self-assessment including journals, checklists, rubrics, questionnaires, interviews and student-teacher conferences. As with the previous assessment strategies, the rubric is often the most effective tool to help monitor and measure student self-assessment, though Andrade and Valtcheva (2009) warn that simply handing one out to students before an activity does not guarantee any learning gains because students need to deeply understand and value the criteria. As the rubric section of this paper points out, students can benefit deeply from being involved in the process of developing evaluation criteria and benchmark targets (Ross, 2006). In addition to involving students in the process, the assessment criteria needs to be appropriately challenging in order for the evaluation to be meaningful (McMillan and Hearn, 2008).

Ross (2006) also notes the importance of creating a classroom climate in which students feel comfortable assessing themselves publicly. He urges teachers to focus students' attention on learning goals (with a focus on learning ideas) rather than performance goals (that tend to focus on outdoing one's peers).

### ***Peer Assessment***

Peer assessment, much like self-assessment, is a formative assessment strategy that gives students a key role in evaluating learning (Topping, 2005). Peer assessment approaches can vary greatly but, essentially, it is a process for learners to consider and give feedback to other learners about the quality or value of their work (Topping, 2009). Peer assessments can be used for variety of products like papers, presentations, projects, or other skilled behaviors. Peer assessment is understood as more than only a grading procedure and is also envisioned as teaching strategy since engaging in the process develops both the assessor and assessee's skills and knowledge (Li, Liu, & Steckelberg, 2010; Orsmond & Merry, 1996). Feedback that students are asked to provide can confirm existing information, identify or correct errors, provide feedback on process, problem solutions or clarity of communication (Butler & Winne, 1995).

The primary goal for using peer assessment is to provide feedback to learners. This strategy may be particularly relevant in classrooms with many students per teacher since student time will always be more plentiful than teacher time. Although any single student's feedback may not be as rich or in-depth as a teacher's feedback, the research suggests that peer assessment can improve learning. The research base has found peer assessment strategies to be effective in different content areas from language arts (Karegianes, Pascarella, & Pflaum, 1980; McLeod, Brown, McDaniels, & Sledge, 2009), to mathematics (Bangert, 2003; Jurow, Hall, & Ma, 2008) and science (Peters, 2008). Peer assessment has even proven beneficial for students as young as six years old (Jasmine & Weiner, 2007). There is research on peer assessment from the North America and Europe (Sluijsmans, Dochy, & Moerkerke, 1999; Topping, 2005), and there are a few research studies from Asian countries (Bryant & Carless, 2010; Carless, 2005).

Peer assessment is associated with performance gains and cognitive gains for students who receive feedback and for students as they give feedback. The research suggests that, when done properly, peer assessment strategies can improve the quality of learning to a degree equivalent to gains from teacher assessment (Topping, 2009). Giving and receiving feedback impacts meta-cognitive abilities like self-regulation (Bangert, 2003; Butler & Winne, 1995) influencing time on task and engagement in learning and improving learning outcomes. Asking students to provide feedback to others can also improve their own work as they internalize standards of excellence (Li, et al., 2010).

When used in conjunction with collaborative learning peer assessment can also improve interpersonal skills like group work, consensus building, or seeking and providing help (Brown, Topping, Henington, & Skinner, 1999; J. A. Ross, 1995). In collaborative peer assessment techniques, students could work in groups to review work, entire class might evaluate student presentations or students can even be asked to assess their own groups' work.

Peer assessment is usually used in conjunction with other types of teacher assessment so that the peer assessment is seldom the only evaluation provided. For example, peer editing maybe done on a draft report but the teacher evaluates the final draft or peers may provide part of the score on a student's performance but the rest of the score comes from the teachers' assessment.

*Peers* are generally defined as students of equal status in that they are in a similar grade and similar levels of proficiency with content, although there is often flexibility and slightly older students may assess younger students, or a student moving more quickly through the material may be asked to assess a less advanced students. Topping (2005) contends that peer assessment works best when students are asked to provide formative and qualitative feedback rather than merely grading or giving a score to peers since this often makes students uncomfortable.

### ***Student Response Systems***

Student response system (SRS), also known as classroom response system (CRS), audience response system (ARS) or colloquially as "clickers," is a general term that refers to a variety of technology-based formative assessment tools that can be used to gather student-level data instantly in the classroom. Through the combination of hardware (hand held clickers, receiver, PC, internet connection, projector and screen) and software, teachers can ask students a wide range of questions (both closed and open-ended), students can respond quickly and anonymously, and the teacher can display the data immediately and graphically. The value of SRS comes from teachers analyzing information quickly and then devising real-time pedagogical solutions to maximize student learning (Beatty & Gerace, 2009; Bruff; Caldwell, 2007). As with most teaching tools (including the rubric), an SRS is only as effective as the

pedagogy it is couched in (Beatty & Gerace, 2009; Rochelle, Penuel, & Abrahamson, 2004). As a result, this section discusses not only the tool but also the questioning strategies at the heart of its implementation.

At its core, SRS allows for the generation of data that can guide the ongoing modification of pedagogy and content coverage to better differentiate teaching strategies to meet all students' needs (Bruff; Caldwell, 2007; Salend, 2009). What makes SRS distinct from other assessment tools is its ability to collect and display data instantly rather than waiting days to present the outcome as with a test, essay or project. SRS has been found to be effective across grade levels and in a variety of subject areas (Beatty & Gerace, 2009; Bruff, 2007; Caldwell, 2007; Rochelle, et al., 2004).

The effectiveness of the SRS tool is closely linked to the type, quality, quantity, speed and sequence of the questions being asked (Bruff, 2007; Beatty & Gerace, 2009; Caldwell, 2007). SRS technology can be used to pose a variety of *types* of questions including recall questions, conceptual understanding questions, application questions, critical thinking questions, student perspective questions, confidence level questions, monitoring questions, and classroom experiment questions (Bruff). Depending on the learning goal for the lesson, a teacher can ask questions to help gauge understanding, foster discussion, elicit feedback or give student voice in what they are studying. An instructor may also choose from a number of questioning sequences including easy-hard-hard (a "warm-up" question followed by two more challenging questions meant to elicit student discussion and test transferability across contexts) or rapid fire (a series of moderately difficult questions around one concept). Some general examples of effective SRS questions include: given a graph, match it with the best description or interpretation; match the method of analysis with a particular data set; sort ideas or steps into the correct order; or apply a familiar idea to a new context.

One strand of questioning strategies that is highly effective at integrating SRS is a series of questions designed to promote peer learning. Peer learning is an active learning method where students spend time collaborating and discussing issues in small groups (Caldwell, 2007). To foster peer learning, SRS can be used to pose a question that a teacher knows students will have varying opinions on. Peer learning has been proven an effective teaching method that increases student engagement, improves learning outcomes, promotes the circulation of knowledge between students, fosters metacognitive learning, and provides feedback to the instructor (Beatty & Gerace, 2009).

Practitioners and researchers report many other benefits to the use of SRS in the classroom. The research suggests that when integrated effectively into instruction SRS can 1) improve engagement, 2) provoke critical thinking; 3) give students voice in classroom decisions, 4) improve classroom discussion, 5) increase attendance and retention, and finally, 6) increase enjoyment of class (Caldwell, 2007; Bruff; Salend, 2009; Beatty & Gerace, 2009; Johnson & McLeod, 2004). Though small studies show that SRS has been effective at increasing achievement levels among special populations like students with learning disabilities, on a larger scale, researchers have difficulty making a causal link between the tool and academic outcomes (Jerome & Barbeta, 2005; Caldwell, 2007; Roschelle et. al., 2004). In addition to enhancing instructional strategies, SRS can be used as an effective classroom management tool to help monitor participation (Rochelle et. al., 2004), manage a large classroom (Caldwell, 2007; Beatty and Gerace, 2009), practice and review for tests (Beatty and Gerace, 2009), and facilitate homework collection (Bruff).

## Conclusion

More and more, discussions concerning education reform are paying increasing attention on the role that classroom based assessment strategies play in fostering student centered teaching practices. Together, all of the research cited here strongly suggests that these assessment tools and strategies can positively impact a number of key areas that we know are important aspects of education reform: student/teacher relationships, teacher's ability to personalize instruction, acquisition of 21<sup>st</sup> century skills, student engagement and student metacognition. These practices are becoming more common in developed countries, but there is still little research on how to adapt these approaches to the school contexts of many emerging market countries.

It is important to note that with access to professional development resources, teachers and administrators can become proficient with assessment for learning approaches without returning to the university for continuing education courses. Many teachers who have participated in Intel teacher professional development program are beginning to use assessment for learning strategies and this has offered us a chance to see these new assessment strategies in action (León Sáenz, Castro, & Light, 2008; Light, et al., 2009). With support from the ministries of



education, the Intel education portfolio of professional development course is available online and face-to-face courses are available in over 30 countries. But there is still more work to be done for local governments, ministries, and NGOs both in researching and adapting these strategies to developing country contexts and to developing programs to promote their use in classrooms.

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