Chapter 3
Classroom Assessment: A Key Component to Support Education Transformation

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Abstract Through global assessment reform initiatives like the Assessment and Teaching of twenty-first century Skills (ATC21S) and the Collaborative Assessment Alliance, Intel® has been working alongside governments and policy-makers to create new national standards and national assessments. But understanding how classroom assessment can support education transformation is also the result of research on how Intel's professional development (PD) programs help teachers use assessment for learning as part of a twenty-first century learning environment. In this paper, we highlight the research on six assessment strategies that should be part of a twenty-first 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, and (6) Student response systems (SRS).

Keywords Classroom · Assessment · Reform

3.1 Introduction

Student assessments, once thought of primarily in terms of standardized tests are now increasingly recognized as classroom-based measures of student performance, critical for effective teaching and learning. Although traditional high-stakes

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R. Huang et al. (eds.), *ICT in Education in Global Context*,
Lecture Notes in Educational Technology, DOI: 10.1007/978-3-662-43927-2_3

assessments are still considered to be the most reliable measures of a student's content knowledge and comprehension, a change in assessment strategy is needed to meet the needs of increasingly global, and technology-rich twenty-first century critical thinking and problem solving. Teachers understand how classroom-based assessment strategies can benefit their teaching practices and their students' learning, but practice has been shaped by the policy demands of summative assessments.

For more than four decades, Intel Corporation has made education the primary focus of its strategic philanthropic activity. The corporation has invested more than $100 million US annually in programs that promote education, encourage women and girls to seek careers in technology, foster and celebrate innovation and entrepreneurship among the best and brightest young students in the world and help teachers to incorporate best practices and the effective use of technology in their work. As a result of participating in the Intel© Teach professional development (PD) program they learn how to plan, develop, and manage student-centered assessment and learn from other teachers who are implementing embedded and ongoing assessment methods in their classrooms. To date, the Intel Teach Program has trained over ten million teachers in more than 70 countries worldwide.

In addition to program and infrastructure investments, Intel has also invested in exploratory research and rigorous program evaluation to establish and sustain continuous improvement of these educational products and activities. The research and evaluation compiled for this purpose has not only enabled the improvements of the program development efforts, but now also comprises a comprehensive body of evidence that demonstrates program impact (Price et al. 2011). This data has provided critical evidence to inform classroom-based student assessment and has extended into other efforts designed to transform education strategy.

3.2 Intel Education Transformation and Assessment Reform

As a result of the research and evaluation efforts that have supported these education programs, the need for a comprehensive approach to systemic education reform became clear. Intel's model of education transformation is a systemic approach that supports best practices for achieving reform, and is based on data collected over 10 years examining educational policy and practice.

Intel has combined advocacy for policy reform, leadership, curriculum standards and assessment, sustained PD efforts, information and communications technology, support of research and evaluation, and sustainable resourcing to help countries create an effective approach to twenty-first century education. Components of the Intel Education Transformation Model include:

- Leadership—People respond to leaders who envision better outcomes, communicate them clearly, and implement a defined path to completion. It is important for organizations to support effective, empowered decision makers at multiple levels.

- Effective policies—Transformative policy is systemic, aligned, action-oriented, and sustainable. Reform efforts based on scalable policies that protect students, maintain data privacy, and advance teaching and learning with technology are critical.
- Information and communications technology (ICT) programs—ICT provides the foundation for systemic transformation. ICT delivers the tools needed to enhance teaching and learning and support student-centered learning environments.
- Professional development—Educators, like students, succeed when given the proper tools, training, and inspiration. PD resources that make the most of modern, personalized learning environments and technology tools enable effective use of tools provided.
- Research and evaluation—It is important to assess, refine, and improve the components of your educational programs continuously. Successful education reform should be based on future outlook, and should incorporate program data from the outset in regular evaluations and measurements.
- Sustainable resourcing—Wise technology choices set a path for long-term sustainability. Combining digital curriculums, online assessment, and classroom and learning management systems can improve resource and time management for more personalized learning.
- Curriculum standards and assessment—To ensure that students gain critical skills and knowledge to succeed, combine strong curriculum standards with accurate assessments. The result is more effective measures of students' knowledge, skills, and progress across various subjects.

A systemic model for education transformation is achievable by bringing together not only the right set of decision makers, but also the critical, essential areas impacting quality education practice. Intel is active in all these areas, and recognizes from experience and research that each component is required for effective systemic change—providing the technologies, tools, programs, and resources for success in diverse educational environments worldwide. This paper presents effective classroom based-assessment tools to inform teacher day-to-day practice and inform student centered instruction.

3.3 Assessment for Learning as a Catalyst for Change in Emerging Market Countries

Teachers have always assessed student knowledge with strategies such as recall tests or by asking content questions during a lecture, but researchers and practitioners are beginning to understand that other types of assessments can play an important role not only in supporting learning (Black and William 1998; Hattie and Timperley 2007; Popham 2008), but also in actually helping to transform teaching practice. *Assessment for learning*, the term we will use, is the idea that classroom assessments should support ongoing teaching and learning

(Assessment Reform Group 2002; Heritage 2010); should be administered frequently; should be embedded into the learning process (Black and William 1998); and can be effectively developed by classroom teachers (Popham 2008). The research cited below highlights the vital role that teacher-made, classroom-based assessments can play in transforming teachers' practice and ultimately improving teaching and learning. Black and William (1998) have found found that assessment for learning is one of the most powerful interventions available to improve student outcomes. In fact, in order to change daily teaching practices, teachers should *start* by updating their arsenal of assessment strategies (Jacobs 2010). In a seminal review of the literature on how people learn, the National Research Council asserts "appropriately designed assessments can help teachers realize the need to rethink their teaching practices" (Bransford 2000, p. 141).

Despite the potential for assessment for learning practices to improve teaching and learning, there is little focus on promoting their use in emerging market countries. Assessment for learning strategies are becoming increasingly common in the richer countries of Europe, North America, and Australasia (Assessment Reform Group 2002; Hume and Coll 2009; Organization for Economic Co-operation and Development 2005; Sluijsmans et al. 2004), but the research we have found in emerging market countries suggests that these practices are barely used, if at all, and in many countries they are not even part of the conversation.

3.4 Intel Evaluations Show Assessment for Learning Work in Emerging Market Countries

Over the past 10 years, through evaluation efforts for the Intel Teach teacher PD programs,[1] our observations suggest that many classroom assessment strategies *can* work within the contextual challenges that teachers in emerging market countries often face—large class size, short lesson periods, and limited resources. We have been able to observe the use of assessment for learning approaches in classrooms in countries as diverse as India, Turkey, Chile, and Costa Rica (Light and Rochmann 2008; Light et al. 2009; Light 2005). In our fieldwork with teachers trained through the various programs, we have seen assessment practices ranging from student- and teacher-designed rubrics in Chile to PBAs in Turkey and India.

As an accompaniment to our own empirical research, and to assess the extent of current efforts to support these strategies in emerging market countries, we conducted a brief literature scan for published research in English, Spanish, French, or Portuguese about assessment for learning strategies in countries in Sub-Saharan Africa, Latin America, East Asia, South Asia, and Southeast Asia. We limited our search to five common strategies: rubrics, PBA, portfolios, self-assessment, and peer assessment. The literature scan suggests that many ministries are thinking

[1] The portfolio of programs we have evaluated include: The Essentials Course, Getting Started, Teaching Thinking with Technology, and the Leadership Forums.

about the topic, but there is still little research around these practices in emerging market countries and few concerted efforts to promote their use (Braun et al. 2006; Kellaghan and Greaney 2003). Much of the effort on assessment is focused on national examinations (EFA Global Monitoring Report Team 2004). In East Asia and Southeast Asia, most countries have well-established examination systems in place whose high-stakes social functions, such as gaining admission to university, make it hard to move away from these traditional approaches (Fok et al. 2006). Additionally, the fact that countries such as Singapore, Korea, and Japan consistently top the lists on international examinations such as PISA or TIMMS adds validity to examinations (Tsuneyoshi 2004). The Spanish- and Portuguese-speaking countries in South America have developed new standardized assessments of student learning at the national levels and also new regional assessments (Valdés Veloz et al. 2009). But the limited amount of research on classroom practice finds that most teachers still use traditional assessment approaches (Chisholm 2004; Nenty et al. 2007; Otiato Ojiambo 2008; Prieto and Contreras 2008; Saldanha and Talim 2007; Vandeyar and Killen 2007; Zamora Hernández and Moreno Olivos 2009).

These approaches have a proven impact in a variety of wealthy countries and, we assert, can be similarly effective across a range of developing-country contexts. There are four main dimensions of teacher-made classroom assessments that the literature suggests can effectively push teaching and learning into the twenty-first century:

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 (Heritage 2010). The teacher can use information collected during the learning process to evaluate her own teaching and make changes to future lessons around the needs and goals of those students. 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 a broader range of skills and abilities to provide a more robust portrait of student ability*. Traditional forms of assessment, such as 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 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 et al. 2007). Self- and peer-assessment both teach and assess a broader range of life skills, such as 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. *Offer students feedback about their learning and guidance on how they can improve.* Giving feedback to students about their current knowledge, abilities, or performance, the desired level of knowledge, abilities, or performance, and the gap between the two is a critical function of formative assessment (Hattie and Timperley 2007; Sadler 1989) if it is to improve teaching and learning. Effective feedback should collect information about how and what students understand and misunderstand and allow teachers and students to find directions and strategies to improve (Hattie and Timperley 2007). The feedback should also help students understand the goals of their learning. This is especially important when we are talking about complex learning outcomes that are not measured by content recall tests (Sadler 1989). Final course grades, for example, are at such a distance from the day-to-day learning activities that students would not be able to identify specific strengths or weaknesses in knowledge or abilities, and that type of grade would not help them reflect on which learning strategies or practices had been most or least beneficial for them.
4. *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, assessment for learning strategies give students active roles throughout the assessment 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). Giving students these new roles fosters metacognition and active participation, and ultimately puts students at the center of the learning process (McMillan and 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 and 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).

3.5 Six Effective Assessment Strategies

There are many instructional practices and tools that could be classified as assessment for learning, but here we present six broad categories that can be easily promoted through the Teach PD programs, and which we feel they may be effective in typical classroom contexts of many emerging market countries. All of these strategies can be used with the whole class. They do not require teachers to tailor the assessment for each student, yet the assessment still provides personalized feedback. We felt this was important for teachers with many students. The six assessment tools and strategies are: (1) rubrics, (2) performance-based assessments (PBAs), (3) portfolios, (4) student self-assessment, (5) peer assessment, and (6) student response systems (SRS). Furthermore, it is important to note that these strategies also overlap in a variety of ways (Table 3.1).

Table 3.1 Six effective assessment strategies

Tool	Advantages	Disadvantages	Examples
Rubrics	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 and Stanford 2009). One of the major strengths of the rubric as an assessment method is that it functions as a teaching and an assessment tool (Andrade et al. 2008; Popham 1997)	One criticism is that it is not always easy or possible to test rubrics for validity and reliability, particularly the case with those that are developed locally, (Stein and Haynes 2011) Furthermore, simply handing out a rubric to students before an activity does not guarantee any learning gains because students must deeply understand and value the criteria (Andrade and Valtcheva 2009)	Research on the Intel Teach professional development programs, for example, finds that teachers in almost all countries are interested in learning about and using rubrics: On a survey of over 9,000 participants in 16 countries, 57 % of respondents reported increasing their use of rubrics (Light et al. 2006)
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)	Principles to guide constructive feedback contained within performance-based assessments must become part of the everyday practice of educators if students are to gain the best outcomes from these authentic assessment activities (Taylor and McCormack 2007)	PBA is another assessment for learning strategy presented in the Intel Teach courses that we have seen widely adopted among participant teachers. On the teacher survey in 2005, 67 % of participants in 16 countries increased their use of PBA (Light et al. 2006). Most of the PBA activities that we observed in various field studies of the Intel programs in emerging market countries generally consisted of students presenting PowerPoint presentations on research and taking questions from peers, although we have seen students in Turkey and India give presentations to parents and the community (Light et al. 2009)

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Table 3.1 (continued)

Tool	Advantages	Disadvantages	Examples
Portfolio assessment	Portfolios are a collection of student work gathered over time that are 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 and Bachor 1998; Barootchi and Keshavarz 2002)	Research remains scarce on portfolio validity. Little research has been done to demonstrate that portfolios are superior tools for assessment. Educator rating of student performance remains, at this time, largely objective (Cho 1999)	Technology is playing an increasingly important role in 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), p. 392 describes the e-portfolio as an "abundant online museum," connoting an ease of storage, a creativity of presentation, and the facilitation of collaboration
Self-assessment	Self-assessment main purpose is for students to identify their own strengths and weaknesses and to work to make improvements to meet specific criteria (Andrade and Valtcheva 2009). According to McMillan and Hearn (2008), p. 1 "self-assessment occurs when students judge their own work to improve performance as they identify discrepancies between current and desired performance"	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 (Ross 2006, p. 5)	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

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Tool	Advantages	Disadvantages	Examples
Peer assessment	Peer assessment, much like self-assessment, is a formative assessment strategy that gives students a key role in evaluating learning (Topping 2005)	Similar to Self-assessment, it is also important to create a classroom climate in which students feel comfortable assessing themselves publicly. Educators should 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) (Ross 2006: 5)	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)
Student response systems	Student response system (SRS), also known in general terms as "clickers," refers to a variety of technology-based formative assessment tools that can be used to gather student-level data instantly in the classroom	As with most teaching tools (including the rubric), an SRS is only as effective as the pedagogy in which it is couched (Beatty and Gerace 2009; Rochelle et al. 2004). As a result, this section discusses not only the tool but also the questioning strategies at the heart of its implementation	Through the combination of hardware (handheld clickers and increasingly cell phones, 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 and Gerace 2009; Bruff 2007; Caldwell 2007)

3.6 Addressing Concerns About Reliability

Reliability is the most frequently cited challenge associated with teacher-developed assessments, but this partly misconstrues the function or purpose of assessment for learning. Reliability—the degree to which a test consistently measures student knowledge—is a greater concern for summative assessments that are used to categorize or track students (Sadler 1989). Assessment for learning is formative; it is part of the learning process (Heritage 2010) and feeds back directly into changing students' knowledge. Accordingly, the purpose of assessment for leaning is to provide evidence that teachers and students can then use to guide learning. The research is fairly consistent that effective feedback to learners focuses on what they need to do to improve, and that comparing students can be counterproductive (Wiliam 2007).

However, there are important issues to consider in ensuring that criteria are demanding and clear, and that teachers and students can apply these criteria across a wide range of products or activities (Wren 2009; Darling-Hammond and Pecheone 2009). For example, creating an appropriate scoring model or rubric can help increase consistency, while Wren (2009) actually suggests field-testing the assessment criteria before they are implemented in a classroom. Rubric performance standards are open to interpretation; in order to ensure that all students are aiming for a similar quality of work, researchers and practitioners recommend the use of a sample product or model to help ensure more standardized interpretation of the desired outcome (Andrade et al. 2008; Wiggins and McTighe 2005).

Both self- and peer-assessment methods are also criticized for having potentially low reliability, based on the possibility that students will increase their assessment measures based on unrelated and inflated perceptions of achievement (Ross 2006). Some reviews raise concerns about validity when peer assessors are untrained (Dochy et al. 1999), but other surveys of the research consider that peer assessment has sufficiently high validity (Topping 1998, 2010). However, concerns about validity are mediated by the fact that both self- and peer-assessment are steps in a longer learning process and rarely the final grade; students do not replace the teacher's role in providing summative assessment, they provide an additional dimension.

3.7 Assessment for Learning as a Global Imperative

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. Many of these assessment strategies are increasingly common in the classrooms of emerging market countries, but 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.

The six assessment tools and strategies that have been discussed overlap not only in the ways in which they can push teaching and learning into the twenty-first century, but also in the types of supports that are needed to make that push successful. While all of the assessment strategies and tools discussed can be developed by a teacher in his or her classroom, in order to maximize the impact on teaching and learning teachers require support beyond the confines of the classroom walls. School administrators, as well as leaders at the local, state, and even national levels, must be prepared to offer various types of supports, including research and development grants, relevant PD, sufficient planning time, and access to high-quality resources. Moving beyond standardized testing and single-grade assessment used currently as indicators of learning at a single point in time, is a step in the right direction. However, the adoption and integration of classroom-based assessments designed as ongoing components of the learning process will be truly successful only if leaders take the vital next steps in ensuring that these necessary supports are in place.

Intel supports *assessment for learning* in many of its established teacher PD programs and encourages ministries to consider how these strategies may play a role in their own reform efforts. However, Intel also recognizes the importance of new global initiatives to assist leaders in transforming the most common use of student assessment, most often recognized as high stakes benchmark exams. These new initiatives utilize assessment for learning strategies as tools to empower students with the right skills to succeed in the twenty-first-century. Working in collaboration with other technology companies, development, and implementation of the tools and resources needed for classroom use are underway.

One such initiative is the global partnership, known as the Assessment and Teaching of twenty-first century Skills project, (ATC21S.org) that supports developing new national assessment strategies and new benchmarking tests. This collaborative effort involving more than 260 international researchers, developers, education specialists, practitioners, and other experts helped define policy implications, methodological issues, technology considerations, and broker common standards, assessments, and terminologies in twenty-first century skills around the world. Where the importance of twenty-first century skills were previously noted as important, the ATC21S project provided, "a system for understanding them, measuring them, reporting them, and helping teachers teach to them, whether at the individual, class, or system level (ATC21S 2013)." A collection of research papers has been produced to describe these methods and measures.

More recently, the work of the Collaborative Assessment Alliance (CAA21.ORG) extends the research and outcomes of the Assessment and Teaching of twenty-first century Skills project. Designed to build local ecosystems of knowledge and expertise in creating new types of assessments, this global multi-stakeholder collaboration is made up of a number of a member networks at local district, state, or country level, each working with experts to create collaborative assessment tasks, to measure twenty-first century Skills (Collaborative Assessment Alliance 2013).

3.8 Conclusion

These findings, based on over a decade of study, help illustrate how to transform teaching and learning for millions. One effective way is working through public/private partnerships between industry, NGOs, countries, communities, and schools worldwide to bring the resources and solutions needed for effectively integrating technology into educational systems to promote problem solving, critical thinking, and collaboration skills among students. 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, which stakeholders need to consider how policy changes in one area affect other areas. The consequences of making incomplete, poorly coordinated reforms could be tragic. 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. Viewing assessments as an external additive process misses out on the opportunity for assessments that focus on the effects of the teacher's direct actions and practice within a participatory classroom with the goal of improving the performance quality of the learners. Weaving technology into these reforms allows schools to monitor and measure academic performance where teaching and learning occurs.

Education reformers in the developed nations are paying increasing attention to the role that classroom-based assessment strategies play in fostering student-centered teaching practices, but this conversation is only beginning in emerging market countries. While the focus on reforming national tests should not be abandoned, we urge ministries, education administrators, researchers, and teachers to broaden their view and deepen their conversation around the use of classroom-based assessments to consider moving beyond assessments as a tool to obtain benchmark indicators, moving toward assessments for learning. Together, all of the research cited here strongly suggests that these assessment tools and strategies can positively affect 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 twenty-first-century skills, student engagement, and student metacognition.

References

Anderson, J. O., & Bachor, D. G. (1998). A Canadian perspective on Portfolio use in student assessment. *Assessment in Education: Principles, Policy and Practice, 5*, 353–379.

Andrade, H., & Valtcheva, A. (2009). Promoting learning and achievement through self-assessment. *Theory Into Practice, 48*, 12–19.

Andrade, H. L., Ying, D., & Xiaolei, W. (2008). Putting Rubrics to the test: The effect of a model, criteria generation, and Rubric-referenced self-assessment on elementary school students' writing. *Educational Measurement: Issues and Practice, 27*, 3–13.

Assessment Reform Group. (2002). *Assessment for learning: 10 principals*. London: British Educational Research Association (BERA).

ATC21S.ORG. (2013). Retrieved from http://atc21s.org/
Barootchi, N., & Keshavarz, M. H. (2002). Assessment of achievement through portfolios and teacher-made tests. *Educational Researcher, 44*, 279–288.
Beatty, I. D., & Gerace, W. J. (2009). Technology-enhanced formative assessment: A research-based Pedagogy for teaching science with classroom response technology. *Journal of Science Education and Technology, 18*, 146–162.
Black, P., & William, D. (1998). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan, 80*, 1–13.
Bransford, J. (2000). National Research Council (U.S.). Comittee on Developments in The Science of Learning & National Research Council (U.S.). Committee on Learning Research And Educational Practice. *How people learn: Brain, mind, experience, and school.* Washington, D.C.: National Academy Press.
Braun, H., Kanjee, A., Bettinger, E., & Kremer, M. (2006). *Improving education through assessment, innovation, and evaluation*. Cambridge: American Academy of Arts and Sciences.
Bruff, D. (2007). Clickers: A classroom innovation. *National Education Association Advocate, 25*, 5–8.
Caldwell, J. E. (2007). Clickers in the large classroom: Current research and best-practice tips. *CBE—Life Sciences Education, 6*, 9–20.
Chang, C.-C. (2009). Portfolio assessment system for various student motivation levels. *Journal of Educational Computing Research, 41*, 391–405.
Chisholm, L. (2004). The Quality of primary education in South Africa; Background paper for the Education for all global monitoring report 2005: The quality imperative; 2004. *Education for All Global Monitoring Report 2005.* Paris: UNESCO.
Cho, M. (1999). Portfolio development in a secondary teaching credential art programme. *Journal of Art and Design Education, 18*(2), 207–212.
Collaborative Assessment Alliance. (2013). Retrieved December 4, 2013, from http://www.caa21.org/
Darling-Hammond, L. & Pecheone, R. (2009). Reframing Accountability: Using Performance Assessments to Focus Learning on Higher-Order Skills. In L. M. PINKUS (Ed.) *Meaningful measurement: The role of assessments in improving high school education in the twenty-first century.* Washington, DC: Alliance for Excellent Education.
Dikli, S. (2003). Assessment at a distance: Traditional vs. alternative assessments. *The Turkish Online Journal of Educational Technology*, *2*, 13–19.
Dochy, F., Segers, M., & Sluijsmans, D. (1999). The use of self-, peer and co-assessment in higher education: A review. *Studies in Higher Education, 24*, 331.
EFA Global Monitoring Report Team. (2004). *Education for all: The quality imperative; EFA global monitoring report, 2005*. Paris: UNESCO.
Fok, P. -K., Kennedy, K., Chan, K. -S. J. & Yu, W. -M. F. (2006). Integrating assessment of learning and assessment for learning in Hong Kong public examinations: Rationales and realities of introducing school-based assessment. *32nd Annual Conference of the International Association for Education Assessment.* Singapore.
Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*, 81–112.
Heritage, M. (2010). *Formative assessment and next-generation assessment systems: Are we losing an opportunity? formative assessment for students and teachers*. Washington, DC: Council of Chief State School Officers.
Hume, A., & Coll, R. K. (2009). Assessment of learning, for learning, and as learning: New Zealand case studies. *Assessment in Education: Principles, Policy and Practice, 16*, 269–290.
Jacobs, H. H. (2010). Upgrading the Curriculum: 21st Century Assessment Types and Skills. In H. H. Jacobs (Ed.), *curriculum 21: Essential education for a changing world*. ASCD: Alexandria, VA.
Kellaghan, T., & Greaney, V. (2003). *Monitoring performance: Assessment and examinations in Africa*. Mauritius: Association for the Development of Education in Africa (ADEA) Biennial Meeting.
Light. (2005). REDAL (Redes Escolares de América Latina): Una investigación de las mejores prácticas. Montevideo: IDRC-Canada.

Light, D., & Rockman, C. (2008). *The emerging paradigm of teaching and learning in discovery schools, evaluation of the jordan education initiative*. Washington, D.C.: Education Development Center.

Light, D., McMillan Culp, K., Menon, R., & Shulman, S. (2006). *Preparing teachers for the 21st century classroom: Current findings from evaluations of the Intel Teach to the future essentials course*. New York: EDC/Center for Children and Technology.

Light, D., Strother, S, & Polin, D. (2009). *Emerging changes in ICT-rich learning environments: The Intel® Teach essentials course and changing teacher practice in India, Turkey, and Chile*. New York: Center for Children and Technology Education Development Center, Inc. Retrieved from http://download.intel.com/education/EvidenceOfImpact/Role_of_ICT.pdf

McMillan, J. H., & Hearn, J. (2008). Student self-assessment: The key to stronger student motivation and higher achievement. *Educational Horizons, 87*, 40–49.

Nenty, H. J., Adedoyin, O. O., Odili, J. N., & Major, T. E. (2007). Primary teacher's perceptions of classroom assessment practices as means of providing quality primary/basic education by Botswana and Nigeria. *Educational Research and Reviews, 2*, 074–081.

Nunes, A. (2004). Portfolios in the EFL classroom: Disclosing an informed practice. *English Language Teachers Journal*, *58*, 327–335.

Organization For Economic Co-Operation And Development. (2005). *Formative assessment: Improving learning in secondary classrooms*. Paris: OECD.

Otiato Ojiambo, P. C. (2008). Quality of education as a tool for development: A case study of Kenya's educational reforms. *The African Symposium: An On Line Journal Of African Educational Research Network, 8*, 102–108.

Palm, T. (2008). Performance assessment and authentic assessment: A conceptual analysis of the literature. *Practical Assessment, Research & Evaluation* [Online], 13. Retrieved from http://pareonline.net/getvn.asp?v=13&n=4

Popham, J. W. (1997). What's wrong-and what's right-with Rubrics. *Educational Leadership*, *55*(2), 72–75.

Popham, W. J. (2008). *Transformative assessment*, *association for supervision and curriculum development*. 1703 North Beauregard Street, Alexandria, VA 22311-1714. Tel: 800-933-2723; Tel: 703-578-9600; Fax: 703-575-5400. Retrieved from http://www.ascd.org

Price, J., Light, D., Michalchik, V. (2011). *Ten years of evaluation within intel education initiatives*. Retrieved December 5, 2013, from https://www-ssl.intel.com/content/www/us/en/education/evaluations/ten-years-of-evaluation-within-intel-education-initiatives.html

Prieto, M., & Contreras, G. (2008). Las concepciones que orientan las practicas evaluativas de los profesores: un problema a develar. *Estudios pedagÛgicos (Valdivia), 34*, 245–262.

Reeves, S., & Stanford, B. (2009). *Rubrics for the classroom: Assessments for students and teachers* (pp. 24–27). Fall: The Delta Kappa Gamma Bulletin.

Rochelle, J., Penuel, W. R. & Abrahamson, L. (2004). *Classroom response and communication systems: Research review and theory*. Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

Ross, J. A. (2006). The reliability, validity, and utility of self-assessment. *Practical assessment, research & evaluation* [Online]. Retrieved January 11, from http://pareonline.net/pdf/v11n10.pdf

Sadler, D. R. (1989). Formative assessment and the design of instructional systems. *Instructional Science, 18*, 119–144.

Saldanha, J. L., & Talim, S. L. (2007). Avaliação da Aprendizagem na Escola Plural: O que Ocorre na Prática? *Revista Electrónica Iberoamericana sobre Calidad, Eficacia y Cambio en Educación, 52*, 84–99.

Shepard, L. A., Flexer, R. J., Hiebert, E. H., Mario, S. F., Mayfield, V. & Weston, T. J. (1995). Effects of introducing classroom performance assessments on student learning. Boulder: National Center for Research on Evaluation, Standards and Student Testing, University of Colorado at Boulder.

Sluijsmans, D., Brand-Gruwel, S., Van Merrienboer, J., & Martens, R. (2004). Training teachers in peer-assessment skills: Effects on performance and perceptions. *Innovations in Education and Teaching International, 41*, 59–78.

Stein, B., & Haynes, A. (2011). Engaging faculty in the assessment and improvement of students' critical thinking using the critical thinking assessment test. *Change: The Magazine of Higher Learning, 43*(2), 44–49.

Sweet, D. (1993). Student Portfolios: Classroom uses. In O. O. E. R. A. I. (OERI) (Ed.). Washington, D.C.: Office of Educational Research and Improvement (OERI).

Taylor, M. J. & McCormack, C. (2007). Effective verbal feedback for project-based assessment: A case study of the graphic design critique. In S. Frankland (Ed.), *Enhancing teaching and learning through assessment: Deriving an appropriate model* (pp. 52–61).

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research, 68*, 249–276.

Topping, K. J. (2005). Trends in peer learning. *Educational Psychology, 25*, 631–645.

Topping, K. J. (2009). Peer assessment. *Theory Into Practice, 48*, 20–27.

Topping, K. J. (2010). Methodological quandaries in studying process and outcomes in peer assessment. *Learning and Instruction, 20*, 339–343.

Tsuneyoshi, R. (2004). The new Japanese educational reforms and the achievement "crisis" Debate. *Educational Policy, 18*, 364–394.

Valdés Veloz, H., Treviño, E., Castro, M., Costilla, R. & Acevedo, C. G. (Eds.) (2009). *Reporte Técnico del Segundo Estudio Regional Comparativo y Explicativo (SERCE): los aprendizajes de los estudiantes de América Latina y el Caribe,* Santiago: Oficina Regional de Educación de la UNESCO para América Latina y el Caribe.

Vandeyar, S. & Killen, R. (2007). Educators' conceptions and practice of classroom assessment in post-apartheid South Africa. *South African Journal of Education, 27*, 472–482.

Wiggins, G. P., & McTighe, J. (2005). *Understanding by Design*. Alexandria: Association for Supervision and Curriculum Development.

Wiliam, D. (2007). Keeping learning on track: Classroom assessment and the regulation of learning. *Making mathematics vital: Proceedings of the Twentieth Biennial Conference of the Australian Association of Mathematics Teachers.*

Wood, G. H., Darling-Hammond, L., Neill, M., & Roschewski, P. (2007). *Refocusing accountability: Using local performance assessments to enhance teaching and learning for higher order skills*. Washington, D.C.: Forum for Education and Democracy.

Wren, D. G. (2009). Performance Assessment: A key component of balanced assessment system. Research Brief. Virginia Beach: Virginia Beach City Public Schools, Department of Research, Evaluation, and Assessment.

Zamora Hernández, M., & Moreno Olivos, T. (2009). Para muestra un botón: la evaluación en las aulas de secundaria. *Revista del Centro de Investigación Universidad La Salle, 8*, 99–100.

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