The Value of ICT in Formative Assessment in Support of Learning in the 21st Century

Overview: Timely and informative feedback (a.k.a. formative assessment) is known to enhance and expedite learning, and it can be directly controlled by a teacher or a learning system. When learning tasks involve critical thinking and complex problem solving, determining relevant feedback for learners is not simple. Overemphasis in some places on summative assessments (grades, standardized test scores) and evaluations (comparative rankings, annual performance ratings) has resulted in too little emphasis on and support for formative assessment (individualized and constructive feedback during learning).

However, the ability of new technologies to provide support for formative assessment has risen considerably in recent years with the advent of intelligent agents, smart devices and cloud-based resources. The most promising technologies mentioned by the New Media Consortium and other groups include MOOCs (Massive Open Online Courses), Serious Games and Gamification. Those new technologies have the ability to generate and make use of large sets of data. Making use of big data requires sophisticated learning analytics of formative assessment data collected from many different learners in a wide variety of learning situations. Moreover, formative assessments can motivate individual learners, help teachers adjust individual learning paths, and inform parents and others of progress.

Issue: There is a shift in pedagogy towards dynamic problem-based and inquiry-based learning, in part to develop 21st century skills. Supporting effective problem-based and inquiry-based learning requires emphasis on timely and informative feedback to learners. The multitude of open education resources available to support learning can only be fully realized when coupled with meaningful formative assessments, especially in areas involving critical thinking skills. Digital literacy and reasoning literacy should be considered basic skills and require the support of new assessment strategies and techniques.

New forms of formative assessments and evaluations require new approaches, tools and technologies. One approach is to create an open assessments repository (OAR) that complements the open education resources (OER) already promoted by UNESCO. This repository could be used to leverage big data to support formative and summative assessments and evaluations and could include intelligent assessment technologies to ease the burden on teachers.

Significance: Without emphasis on formative assessment and support for new tools and an open assessments repository, significant barriers will remain. New technologies such as MOOCs, Serious Games, and Gamification will be unable to realize their full potential and impact on learning will be minimal.

It is not possible to support critical thinking and 21st century skills without meaningful formative assessments. Large classrooms in developing countries present a particular challenge, especially when multi-grade classrooms are involved, due to the variety of learning needs and learner backgrounds. The need for efficient formative assessments requires using ICT to implement and support real-time formative assessments for complex problem solving learning tasks and guided inquiry learning situations.
Prior Efforts: The most promising recent advances in providing meaningful just-in-time, just-when-needed ICT-based formative assessment for complex learning tasks involve a series of research efforts in Germany and the USA and tools that were consolidated in HIMATT (Highly Integrated Model Assessment Tools and Technology; see http://www.ifenthaler.info/?page_id=318). HIMATT provides a learner with a problem situation and then prompts the learner to indicate (in the form of text or an annotated graph) the key factors and their relationships involved in addressing the problem. This problem conceptualization can be compared to an expert conceptualization or reference model and analysed to indicate things for the learner to consider (see http://www.pirnay-dummer.de/research/comparison_measures_2011-03-30.pdf and https://sites.google.com/site/jmspector007/Home/selected-papers).

These formative assessment tools require refinements and user-friendly interfaces to be used in face-to-face and online settings. Promoting student engagement has become challenging in developing countries for large student cohorts with limited resources. A group at the Sri Lanka Institute of Advanced Technological Education have been experimenting with new teaching and assessing methodologies, combining team-based learning and guided inquiry learning. This approach enables staff to provide an engaging learning experience and develop collaborative work environment representing real world situations while integrating digital assessments. The ability to provide immediate meaningful feedback has facilitated significant improvements in learning. However, substantial training and mentoring of teachers is required.

Increasingly ePortfolio tools are embedded within learning content management systems, providing a holistic approach to recording achievements for formative assessment and in line with professional standards. Lock-down browsers are emerging which make a wider range of assessment styles available online. However, whether these are marked automatically or by humans, the limitations of this context require very large cohorts for sophisticated information tool use to become part of the assessment. Moreover, ePortfolios require much human time for human or sophisticated automated tools only in their infancy. Additionally, there is an issue of verifying that a particular learner created the ePortfolio. While they are promoted for their potential benefits to teaching, learning, assessment, and curricula, ePortfolios are seen as especially useful for extending and deepening assessment value beyond. However, empirical research into ePortfolio initiatives suggests the complexities and challenges are significant.

A research team at the Hong Kong Institute of Education recently investigated the relationship of individual differences and formative feedback orientation. Factors such as self-efficacy and accountability were found to be associated with learning goal orientation, whereas social awareness was associated with performance goal orientation. These and additional findings indicated that students with a learning goal orientation are more likely to feel usefulness of teacher feedback and feel personally responsible to respond to teacher feedback. What has not been explored is how these findings might change when formative feedback is being automatically generated by an intelligent assessment engine.

There are particular problems involved in providing large numbers of online learners with timely and meaningful feedback as they progress through a series of learning activities. The distributed basic education project in Indonesia required thousands of in-service teachers without degrees to complete a baccalaureate or lose their jobs. They had to do this while working. Being a full-time student while working full-time is a challenge. Those involved were constantly seeking ways to minimize such a heavy load. Getting immediate feedback on learning tasks was essential but extremely challenging to provide. Without the support of the Internet in remote areas, the only alternative was to send tutors to the countryside to help. The lesson from the experience in Indonesia is that ICT needs to be integrated into formative assessment.
Big data (e.g., large sets of data with regard to learner profiles, preferences, and performance in a variety of learning situations) has yet to find its way into the creation of dynamic formative assessment mechanisms. The same can be said with regard to small data (e.g., specific data collected by a learner’s portable or wearable device), although examples of small data being used to customize some learning scenarios is appearing in the form of augmented realities, especially in the area of informal learning. Particular emphasis on tools and technologies to integrate big and small data into learning and especially into formative assessment should be encouraged on the part of governmental funding agencies.

**Recommendations:** In order for the full potential of formative assessments in the context of supporting critical thinking, inquiry learning and 21st century skills, the first recommendation is that

- Key policy/decision makers at all levels need to be made aware of the significance of formative assessments and evaluations.

- The development of focused white papers clarifying and emphasizing the role of formative assessments and evaluations in learning and instruction should be developed and widely disseminated. These white papers should contain relevant theoretical and empirical grounding and short but poignant examples.

- Include digital literacy (skills associated with searching, evaluating, using, modifying and creating digital artifacts) and reasoning literacy (critical thinking skills) among the basic skills to be developed in primary and secondary education should be emphasized.

- Emphasize a change in learning from early (e.g., primary and secondary school levels) emphasis on static declarative knowledge to early emphasis on dynamic problem-solving activities.

- Integrate the use of small data devices in support of learning as well as in support of assessment.

- Determine to what extent assessments (both formative and summative) have been used to benefit a few rather than all learners. Issues of equity, meritocracy and social justice are, or should be, an integral concern with regard to both formative and summative assessments.

- Encourage the development of new tools and technologies especially well-suited for complex problem solving domains and personalized learning and use them for meaningful diagnostic and cross-cultural purposes to form the basis of informing and improving educational systems, rather than the false competition and rather onerous environment created by current high-stakes testing in some places.

- In summary, the recommendations of TWG5 for various constituencies, (e.g., ministries of education, governmental funding agencies, foundations supporting education, federal, state and local school administrators, teacher preparation programs, and educators in general) is to take seriously educational goals that include developing effective problem solvers, independent critical thinkers, and life-long learners – doing so then requires that particular emphasis be placed on providing space (scaffolding and support) for learners to explore, discover, learn from missteps, and gradually develop confidence and competencies across a variety of learning tasks.
and learning experiences. Formative assessments are critical for the associated processes of learning to occur effectively and efficiently. Given new learning approaches and the realities of life in the 21st century, new assessments tools and technologies are needed.
References:

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