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**DRAFT**

**Creating Thinking Schools through Authentic Assessment: The Case in Singapore**

**Kim Koh, Charlene Tan & Pak Tee Ng**

**Abstract**

Using Singapore as an example, we argue that schools need to equip and encourage teachers to adopt authentic assessment in teaching and learning so as to develop the students' higher-order thinking. The importance of teaching and assessing higher-order thinking in Singapore classrooms is encapsulated in the vision of 'Thinking Schools' launched by the Ministry of Education in 1997. Underpinning this vision is a shift from conventional assessment to authentic assessment. Unlike conventional paper-and-pencil tests that focus on knowledge reproduction and low-level cognitive processing skills in artificial, contrived contexts, authentic assessment tasks underscore knowledge construction, complex thinking, elaborated communication, collaboration and problem solving in authentic contexts. However, the creation of thinking schools in Singapore remains a constant challenge as many teachers tend to rely on conventional assessment and are often ill-prepared to implement authentic assessment. By presenting the findings from a recent empirical study, we propose that schools build teacher capacity by providing ongoing and sustained professional development on authentic assessment for teachers.

**1 Introduction**

The notion of a *thinking school* conjures up images of educators and students who confidently demonstrate higher-order thinking such as critical thinking, creative thinking, innovative thinking, and problem-solving. In the 21<sup>st</sup> century where intellectual capital is highly prized, many schools have shifted their emphasis from content knowledge to thinking skills (Trickey and Topping 2004). The importance of teaching and assessing higher-order thinking in Singapore classrooms is encapsulated in the 'Thinking Schools, Learning Nation' (TSLN) vision launched by the Ministry of Education in 1997. This vision aims to develop creative and critical thinking skills, a lifelong passion for learning and nationalistic commitment in the young. In elucidating the concept of 'Thinking Schools', the former Prime Minister, Goh Chok Tong stressed the urgency for Singapore schools to nurture thinking and committed citizens to keep Singapore vibrant and successful in future. Mr Goh explained that 'thinking schools' are 'the crucibles for questioning and searching, within and outside the classroom, to forge this passion for

learning among our young' (1997). Schools in Singapore, in his view, should nurture innovative thinkers and problem solvers to keep Singapore vibrant and successful in the future.

To achieve that goal, the Ministry of Education in Singapore has, since 1997, fundamentally reviewed its curriculum and assessment system to better develop the thinking and learning skills required for the future. Teachers are encouraged to expand their repertoire of teaching and learning strategies to include new and innovative pedagogies, communicate effectively, collaborate widely and solve problems reflectively. New educational reforms that aim to bring thinking schools into fruition include "Innovation and Enterprise" (I & E), "Teach Less, Learn More" (TLLM), and Curriculum 2015 (C2015). These initiatives have advocated teaching for deep understanding and higher-order thinking skills rather than rote memorisation of factual and procedural knowledge. Using Singapore as an illustrative case study, this paper argues that 'thinking schools' can be created when schools emphasise authentic assessment and provide more professional development for teachers in authentic assessment. This paper begins by discussing how the TSLN vision implies a shift from conventional assessment to authentic assessment. Next, we argue that the creation of thinking schools in Singapore remains a constant challenge as many teachers tend to rely on conventional assessment and are often ill-prepared to implement authentic assessment. In the third section of our paper, we present the findings of a recent empirical study and propose that schools build teacher capacity by providing ongoing and sustained professional development on authentic assessment for teachers. The experience of Singapore provides an instructive example in the international literature on the endeavour, challenges and prospects of creating thinking schools in the 21<sup>st</sup> century.

## **2 Thinking schools and authentic assessment**

Underpinning the TSLN vision is a shift from passive learning to engaged learning. The accent on engaged learning was mentioned by then Minister of Education Tharman (2005) when he stated that schools should have "less dependence on rote learning, repetitive tests and a 'one size fits all' type of instruction, and more on engaged learning, discovery through experiences, differentiated teaching, the learning of life-long skills, and the building of character through innovative and effective teaching approaches and strategies."

This shift in pedagogical approach is part of the wider policy 'Teach Less Learn More' (TLLM), which aims to change the emphasis of education from quantity to quality. According to [Ng \(2008\)](#), engaged learning in TLLM does not simply refer to higher attention by students to their teachers, while doing the same drill and practice. Engaged learning is a different learning paradigm. Beyond the basic level of being consumed by the learning task, learners are the proactive agents in the learning process, facilitated by their teachers, as opposed to the traditional models of teaching and learning, where teachers provide information for students to memorise and regurgitate, while students participate passively in the learning process. According to [Jones et al. \(1994\)](#), engaged learners are responsible for their own learning; strategic in their learning process; collaborative with others; and are energised throughout the learning process. In such a

paradigm, the role of teachers is also different. Teachers of engaged learning are designers of learning opportunities. They create a learning environment where students work collaboratively to solve problems, do authentic tasks and construct their own meaning. They are co-learners with their students, instead of providers of solutions. [Ng \(2008\)](#) opines:

Therefore, engaged learning is a mental disposition that has to be nurtured through the entire student life of the young learners. Philosophically, under this paradigm, a student who can get a distinction in a subject but who does not appreciate the content or the learning process would mean that the education system has failed, at least for this student. On the other hand, a student who leaves the education system with a passion for learning more and learning continuously would mean that the education system has succeeded for him (p. 10).

The focus on engaged learning in turn implies a shift from conventional assessment to *authentic assessment*. Conventional or traditional assessment of student learning outcomes historically has focused on the reproduction of factual and procedural knowledge from students ([Moss, Girard and Haniford 2006](#)). The items on such assessments typically claim to objectively measure recall of discrete facts, retrieval of given information, and application of routine computational formulas or procedures ([Newmann, Lopez and Bryk 1998](#)). These ‘snapshot’ conventional assessment results only give a partial representation of students’ ability at a given moment and in a contrived context ([Wiggins 1989](#)). However, they have often been used for high-stakes decision making, which includes the ranking of students for certification and placement, the judgments of teachers’ professional capacity and performance, and the evaluation of overall school and system efficacy ([Nichols, Berliner and Glass 2006](#)). Several decades of research on human learning and performance has shown that conventional assessments failed to establish valid assessment of students’ higher-order thinking skills or to support their capacities to perform real-world tasks ([Resnick 1987](#)).

In contrast to conventional paper-and-pencil tests that focus on knowledge reproduction and low-level cognitive processing skills in artificial, contrived contexts, authentic assessment tasks emphasise knowledge construction, complex thinking, elaborated communication, collaboration and problem solving in authentic contexts. Proponents of alternative, authentic assessment have long advocated holistic assessment of student outcomes and learning progress on authentic tasks that are closely aligned with higher order instructional goals. Authentic assessment is deemed to measure the true ability of students or to capture what students know and can do in real-world context ([Pellegrino, Chudowsky and Glaser 2011](#); [Wiggins 1989](#)). The validity of authentic assessment relies on the need for learning and assessment of learning to be contextualised and meaningful for students ([Cumming and Maxwell 1999](#)). In the context of 21st century learning, the preparation of students to become critical thinkers, productive workers, and lifelong learners in the new knowledge-based economies, requires classroom assessment to move toward constructivist learning approaches to promote students’ higher-order thinking skills, in-depth conceptual understanding, real world problem-solving abilities, and communication skills ([Shepard 1989, 2000](#); [Newmann et al., 1996](#); [Darling-Hammond and Falk 1997](#)). These are the essential skills for students to

succeed in the 21st century knowledge-based economy. It is instructive to elaborate on what authentic assessment entails for teachers and students.

## 2.1 Assessment literacy

The successful implementation of authentic assessment requires teachers who are assessment literate. The term *assessment literacy* was first coined by Stiggins (1991) as an understanding of the principles of sound assessment. According to Stiggins (1991), teachers who are assessment literate for the 21st century classroom should know how to:

- start with clear purposes of assessment;
- understand the importance of assessing different kinds of interrelated achievement targets (i.e., mastering of content knowledge, developing reasoning proficiencies, attaining performance skills, and developing high-quality products);
- select proper assessment methods for the different kinds of achievement targets;
- sample and collect student achievement based on representative performance tasks; and
- avoid assessment bias and distortion that arise from technical and practical problems.

Although the term authentic assessment has not been used directly in his article, all the five standards spelt out by Stiggins correspond to the ideas and principles of authentic assessment. In order to be assessment literate, teachers must not only be competent to develop and use high-quality authentic assessments and scoring rubrics, but also be able to master evaluative skills to make sound judgments about student performance so as timely and formative feedback can be shared with students (Sadler 1998).

According to Cizek (cited in Pellegrino, Chudowsky and Glaser 2001), there is a need to improving teachers' assessment literacy in the form of authentic assessment task design and rubric development that would allow them to elicit students' higher-order thinking skills and that matches the higher-order goals in teaching and learning (William et al., 2004). Many experts in educational assessment and learning theory have agreed that assessment is an integral part of instruction and assessment should be used to support student learning in the process of day-to-day classroom teaching and learning (Shepard 2000). Hence improving the quality of classroom assessment tasks will enrich the quality of instruction, which will lead to engaged learning and ultimately to the creation and flourishing of thinking schools in Singapore.

## 2.2 Authentic intellectual work

For students, authentic assessment involves what Newmann et al. (1996) call *authentic intellectual work* which enables students to engage in higher-order thinking and real

world problem solving rather than just routine use of facts and procedures. Where teachers aim for authentic student performance, they create assignments or assessment tasks that called upon students to construct their own meaning or knowledge, through in-depth disciplined inquiry. The tasks are related to real world problems that have meaning and applicability beyond success in school. The literature has documented that authentic assessment is instrumental in promoting students' engaged learning through the formative use of complex, engaging, and meaningful assessment tasks (Wiggins 1989; Newmann et al., 1996; Cumming and Maxwell 1999). This is because the assessment tasks are designed in such a way that the learners are responsible for their own learning (i.e., self- and peer-assessment), they are strategic in their learning process, they collaborate with others, and they energised throughout the learning process.

According to Koh and Luke (2009, pp. 294-296), there are at least five criteria, which can be used to assess the authentic intellectual quality of teacher assignments/assessment tasks and student work across subject areas. They are described as follows:

### *2.2.1 Depth of knowledge*

According to the revised Bloom's taxonomy of intended student learning outcomes, there are three main types of knowledge, namely factual knowledge, procedural knowledge, and conceptual or advanced knowledge (Anderson and Krathwohl 2001). Factual knowledge is knowledge of discrete and decontextualised content elements (i.e., bits of information), whereas procedural knowledge entails knowledge of using discipline-specific skills, rules, algorithms, techniques, tools, and methods. Conceptual knowledge involves knowledge of complex, organised, and structured knowledge forms (i.e., how a particular subject matter is organised and structured, how the different parts or bits of information are interconnected and interrelated in a more systematic manner, and how these parts function together). All three types of knowledge are essential for engaging student learning.

### *2.2.2 Knowledge criticism*

Based on models of critical literacy and critical pedagogy, knowledge criticism is a predisposition to the generation of alternative perspectives, critical arguments, and new solutions or knowledge (Luke 2004). A new observational category that was first included in the Queensland studies of authentic pedagogy and student achievement (Ladwig 2007), it is based on the assumption that assessment tasks require students to judge the value, credibility, and soundness of different sources of information or knowledge through comparison and critique, rather than to accept and present all information or knowledge as given. Accordingly, it draws together the imperatives of critical education with models of education for new economies (New London Group 1996).

### *2.2.3 Knowledge manipulation*

Knowledge manipulation calls for an application of higher order thinking and reasoning skills in the reconstruction of texts, intellectual artefacts and knowledge (e.g., Cole 1996).

It involves organization, interpretation, analysis, synthesis, and/or evaluation of information (Anderson and Krathwohl 2001). Authentic assessment tasks should provide students with more opportunities to make their own hypotheses and generalizations in order to solve problems, arrive at conclusions, or discover new meanings.

#### 2.2.4 *Sustained writing*

The task asks students to elaborate on their understanding, explanations, arguments, or conclusions through the generation of sustained written prose. This is a relative measure for use by teacher/markers, rather than affiliated with a single subject or age benchmark for the production of lexical volume or semantic complexity.

#### 2.2.5 *Connections to the real world beyond the classroom*

Similar to Newman et al. (1996), this criterion emphasises the degree to which the assessment task and affiliated artefact had an ostensible connection to an activity, function or task outside of the school context. To be authentic for student learning and serve as the assessment of authentic achievement, assessment tasks need to “cultivate the kind of higher-order thinking and problem solving capacities useful both to individuals and to the society” as the “the mastery gained in school is likely to transfer more readily to life beyond school” (Newmann and Archbald 1992, p. 75).

### **3 A challenge to the creation of thinking schools in Singapore**

It has been more than a decade since the launch of the TSLN vision. Despite the implementation of a number of reforms to promote thinking schools, the creation and proliferation of such schools remain a challenge. This is due to the tendency for many teachers in Singapore to rely on conventional assessment rather than authentic assessment. As discussed earlier, conventional assessment underlines the reproduction of factual and procedural knowledge from students. That many teachers in Singapore adopt conventional assessment is due to their conception of what ‘higher-order thinking’ entails. Educators in Singapore tend to interpret a ‘thinking school’ as one where ‘thinking skills’ are taught explicitly with the help of ‘thinking worksheets’ and other paraphernalia taken from various ‘thinking programmes’ (Tan 2007; Nathan 2001). As a result, students are immersed in an environment where standardised and high-stakes assessments are emphasised. It is common for teachers to focus on drilling students with skills such as the identification of deductive and inductive arguments, rules on validity and soundness, acronyms such as CAF (consider all factors), and specific steps to ‘think out of the box’. These techniques and strategies may become ends in themselves and one’s result in test scores becomes the criterion of success for higher-order thinking (Bonnett 1995; Tishman, Perkins and Jay 1995).

The interpretation of thinking schools as thinking skills is due to the tendency for teachers and students in Singapore to rely on textbook answers, didactic teaching and conventional assessment in the classrooms. The curriculum in Singapore schools is generally presented in clearly structured forms where there is a right and wrong answer for almost everything (Moo 1997; Deng and Gopinathan 1999). Knowledge is gained



mainly from standard textbooks and students are rewarded in exams for giving the 'correct answers'. That the dominant approach in Singapore schools is teacher-centred has been noted by a number of researchers (e.g. see [Tan 2005; 2007](#); Chew et al., 1997; Deng and Gopinathan 1999). Deng and Gopinathan (1999) note that students in Singapore are expected to absorb facts and numbers through passive listening, watching, drilling, and practising. Students in Singapore tend to prefer traditional ways of teaching where they can observe, listen and reflect (Lim 1996). Most teachers in Singapore see their responsibility to be preparing students to do well in the examinations and to raise the percentage of passes in the school (Cheah 1998; Kim and Luke 2009). Consequently, the teaching style in Singapore is one where accuracy of responses and correction of errors are emphasised at the expense of spontaneous participation and personal engagement (Sripathy 1998). Consequently, there exists an exam-oriented culture in Singapore where learning is reduced to a set of skills measurable through the national examinations. Teachers in Singapore are also highly focused on testing and are known to drill the students to help them to ace the examinations (Ho and Lin 2004). School principals are also constrained by the examination-oriented environment in Singapore since they are ultimately responsible for their schools' performance in the national league tables ([Tan 2008](#)).

The exam-driven learning environment applies not only to the curriculum and pedagogy but to assessment as well. Koh and Luke (2009) found that teachers' assessment practices in Singapore classrooms remain focused on the format of drill and practice of basic knowledge and skills as well as the reproduction of factual and procedural knowledge to prepare students to do well in high-stakes examination. In a survey of the teachers studied in Singapore by [Koh and Luke \(2009\)](#), the strongest stated rationale that Maths, Science and English teachers used to justify their assessment practices was 'to prepare students for the exam' According to them, Singapore students can and do perform well in the high-stakes national exams and international assessments. Yet if curriculum and instruction are viewed as a series of 'trade-offs' in emphasis and focus, it would appear from the findings that higher order and intellectually demanding work 'counts' less in Singapore classrooms. The most common practice is that school principals, teachers and focus on the drill and practice of thinking skills such as specific algorithmic strategies on problem-solving, creative thinking and logical thinking. This approach may help the students ace the tests and examinations, but it is doubtful that 'thinking schools', where there is a culture of questioning and searching, within and outside the classroom, can be created.

To achieve the goal of thinking schools, it is important not to reduce thinking to thinking skills, techniques, strategies, mental processes, procedures, or 'correct' exam answers. Endres (1996) cautions against reducing thinking to a fixed set of rules which can be applied to solve all problems across a nearly universal range of subject matter. Such an approach views critical thinking as basically concerned with specific exercises in comprehending, analysing, predicting and evaluating ([Bailin et al., 1999](#); [Case and Daniels 2002](#)). Proponents of thinking regard dispositions as essential to a higher-order thinker. Siegel (1988) describes a critical thinker as one who possesses a critical spirit to seek reasons and evidence. Ennis (1987; 1996) maintains that a critical person should have a tendency to seek reasons while Paul (1988) describes a critical thinker in the strong sense as one who has the disposition to seek clarity, accuracy and fair mindedness.



The implication is that teachers need to be skilful facilitators and adept at probing with suitable questions in order to foster higher-order thinking among the students. This means that they need to go beyond seeing thinking as a set of techniques, and promote it as a 'form of life' (Splitter and Sharp 1995). To achieve this, time is needed for the teachers to develop their skills as questioners and facilitators since inquiry cannot be reduced to foolproof steps that a teacher can learn quickly. Teachers also need to change the mode of assessment so that the focus goes beyond the traditional repetitive tests and rote learning of knowledge. How then can thinking schools be created in Singapore so that students can go beyond exam techniques in a teacher-centred learning environment?

Given the tendency of teachers to mirror classroom instruction to assessment, an obvious educational reform strategy is to change the content and format of assessments. After all, assessment shapes student performance and behaviour in normative and deliberate ways. This is particularly the case in test- or examination-driven educational cultures, where what counts as pedagogy and curriculum is strongly mediated by what is set as the assessable task for student performance and affiliated target outcomes for students. In other words, assessment drives pedagogy and curriculum in school cultures that focus on the use of assessment for accountability purposes. In addition, teacher-centred approach to teaching thinking skills is given a greater emphasis than learner-centred approach because of the traditional assessment mindsets of teachers and students. It follows that a key way to promote thinking schools is to review the mode of assessment in the day-to-day classroom practice. Changes in classroom assessment practices are imperative if the ultimate goal is to foster engaged learning and enhance students' mastery of 21st century competencies. There is a need to enhance the coverage of higher intellectual learning outcomes and to move curriculum and instruction toward the development of these outcomes (Smith and O'Day 1990). Only then can teachers in Singapore succeed in developing their students' higher-order thinking skills, real-world problem-solving skills, habits of mind for lifelong learning.

To be sure, the Ministry of Education in Singapore has revised the mode of assessment in recent years to reflect more intellectually challenging learning goals and to include more authentic, open-ended assessment tasks. Examples are the Primary Education Review and Implementation (PERI), Strategies for Active and Independent Learning (SAIL), Strategies for Effective Engagement and Development (SEED), and Science Practical Assessment (SPA). However, these changes are only in the early stage and the learning environment is still predominantly exam-centred and driven by conventional assessment. Furthermore, teachers in Singapore, like those elsewhere, are inadequately trained and ill-prepared to develop, administer, and interpret the results of various types of assessments (Bol et al., 1998; Stiggins and Conklin 1992; [Wiggins 1989](#)). In general, teachers who were less prepared and skilled in developing authentic assessments perceived the assessments as being more difficult to develop than traditional paper-and-pencil tests. Moreover, teachers' assessment practices were not well aligned with their instructional goals and tended to demand a low level of cognitive processing in classroom assessment tasks ([Koh and Luke 2009](#)). Many teachers were also not good judges of the quality of their own assessment tasks ([Black and Wiliam 1998](#); [Bol and Strage 1996](#)). Teachers' low level of assessment literacy in designing and implementing high-quality classroom assessment tasks and related rubrics might have hindered their formative assessment practices in the quest to advocate for assessment for learning in the

21st century classroom. In the next section, we propose a strategy for schools to build the teacher capacity in authentic assessment.

#### **4 Building teacher capacity in authentic assessment through professional development**

##### 4.1 Background of research

A two-year empirical study in Singapore on building teacher capacity in authentic assessment has shown that teachers were able to improve the quality of classroom assessment tasks after their active and collective participation in ongoing, sustained professional development. A quasi-experimental design was employed to examine the effects of professional development on teacher assessment and student work. Teachers are divided into two groups: intervention group and comparison group. In the study, teachers in the intervention group were involved in ongoing and sustained professional development over two school years whereas teachers in the comparison group were merely given 1-2 day workshops. All the teachers taught in primary 5 English, science, and mathematics in mainstream schools of average academic performance. The intervention schools and their counterparts were matched on their ranking of students' high-stakes achievement scores by the Ministry of Education.

The training and support given to the teachers in the intervention group were as follows:

- (1) the teachers were taught the principles of authentic assessment and the criteria for authentic intellectual quality and rubric design;
- (2) the teachers co-designed authentic assessment tasks and rubrics according to the criteria for authentic intellectual quality; and
- (3) feedback regarding the authentic assessment tasks and rubrics was given by the assessment specialists and content experts to the teachers prior to the implementation of the authentic assessment tasks in their day-to-day classroom instruction.

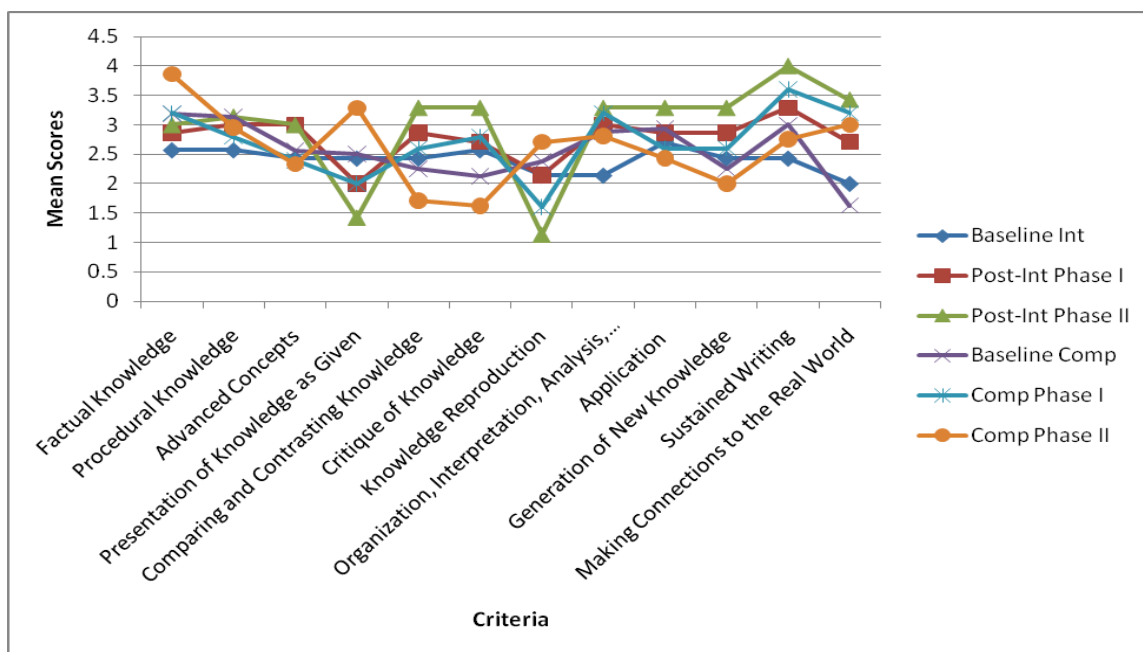
The problems arising from the implementation were also addressed by the researchers and teachers during the monthly professional learning community meetings at the schools. To reduce teachers' cognitive burden and enhance their understanding of authentic assessment tasks with high intellectual demands, the following five criteria were used in the professional development: depth of knowledge, knowledge criticism, knowledge manipulation, sustained writing, and making connections to the real world. These five criteria have been discussed in an earlier section of this paper. In analysing the quality of classroom assessment tasks, the following 12 tasks were used: factual knowledge, procedural knowledge, advanced concepts, presentation of knowledge as a given, comparing and contrasting knowledge, critique of knowledge, knowledge reproduction, organization, interpretation, analysis, synthesis and/or evaluation of

information, application, generation of new knowledge, sustained writing, and making connections to the real world.

## 4.2 Research findings

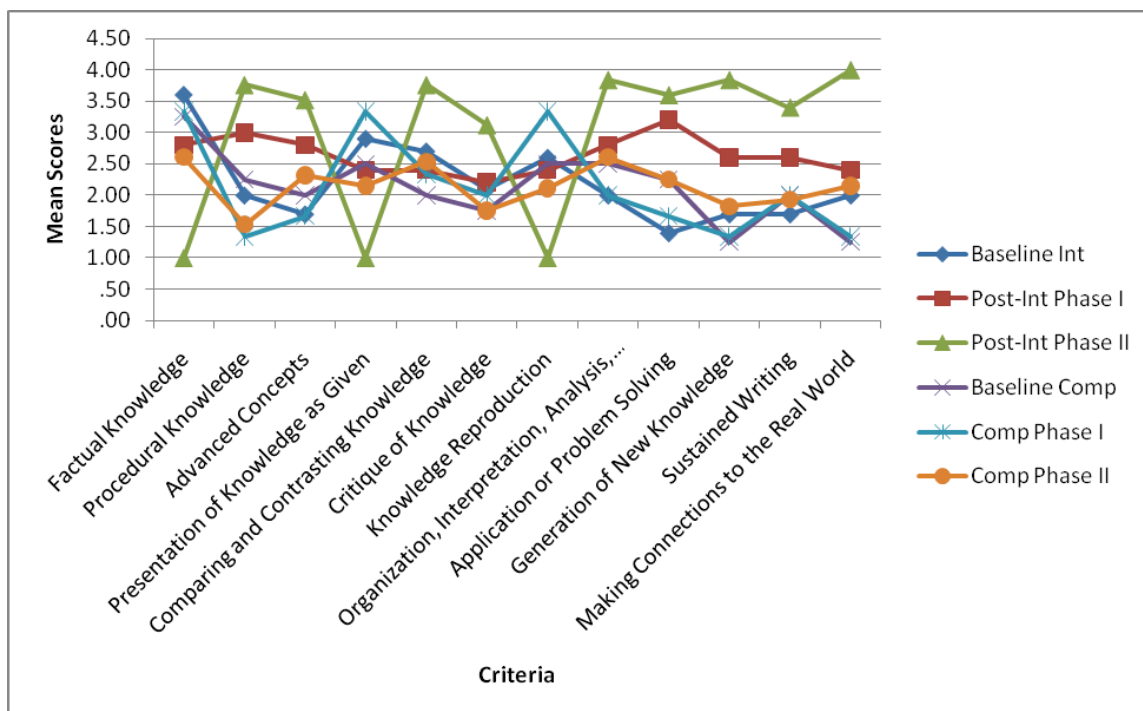
The two-year study revealed that ongoing and sustained professional development in designing and implementing authentic assessment and rubrics was more effective than ad-hoc, 1-2 day workshops to build teachers' capacity in improving the quality of classroom assessment tasks in English, science, and mathematics. As a result, there was also significant improvement in the quality of student work in response to the high intellectual demands of the assessment tasks. Figures 1-3 showed that most of the changes in mean scores from baseline to Phase II were significantly larger in the intervention schools than the comparison schools. Most of the English, science, and mathematics assessment tasks designed and implemented by the teachers in the intervention schools placed a greater emphasis on assessing students' *higher-order thinking skills* such as generation of new knowledge, as well as *sustained writing*, and *real-world application*. There were significant fewer assessment task demands on *presenting knowledge as given* and *knowledge reproduction*, which only assessed lower-order thinking skills. In contrast, the assessment tasks collected from the comparison schools from baseline to Phase II showed an increased demand for *factual knowledge*, *presentation of knowledge as given*, and *knowledge reproduction*. The focus of teachers' assessment tasks in the comparison schools was mainly for summative purposes.

**Figure 1.** Comparisons of the Quality of English Assessment Tasks



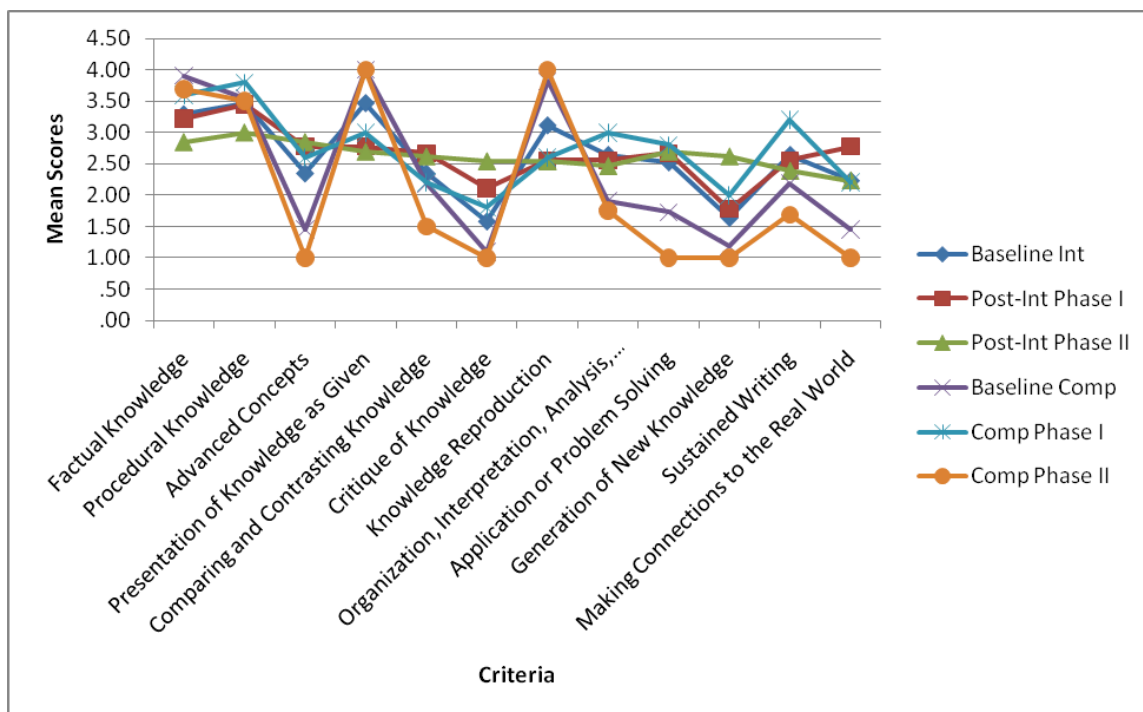
*Note.* \* Baseline int = Baseline in intervention schools; Post-int Phase I = Phase I in intervention schools; Post-int Phase II = Phase II in intervention schools; Baseline Comp = Baseline in comparison schools; Comp Phase I = Phase I in comparison schools; Com Phase II = Phase II in comparison schools.

**Figure 2.** Comparisons of the Quality of Science Assessment Tasks



*Note.* \* Baseline int = Baseline in intervention schools; Post-int Phase I = Phase I in intervention schools; Post-int Phase II = Phase II in intervention schools; Baseline Comp = Baseline in comparison schools; Comp Phase I = Phase I in comparison schools; Com Phase II = Phase II in comparison schools.

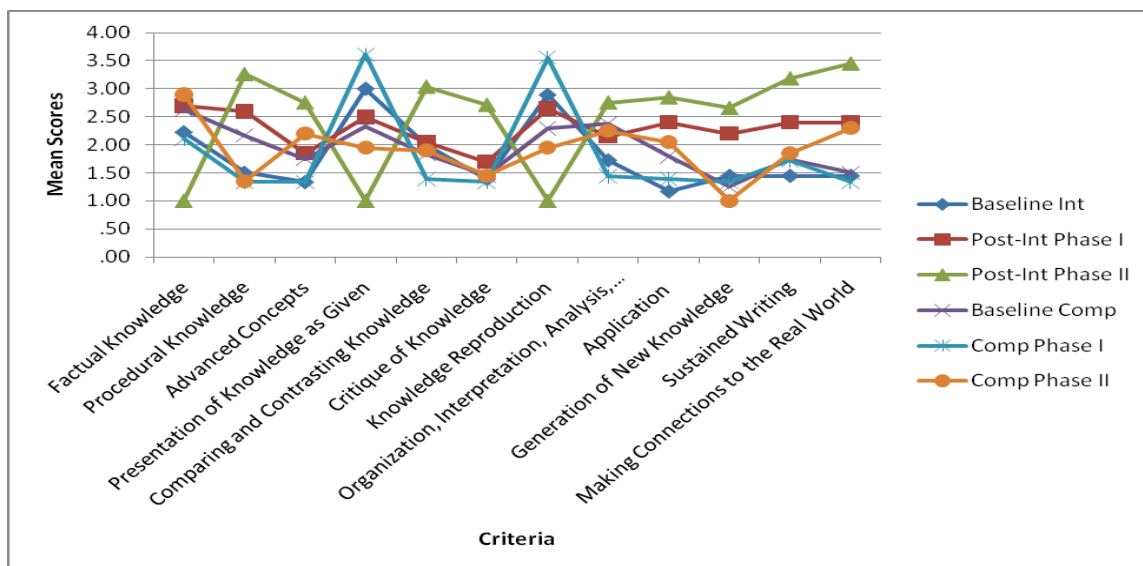
**Figure 3** Comparisons of the Quality of Mathematics Assessment Tasks



*Note.*\* Baseline int = Baseline in intervention schools; Post-int Phase I = Phase I in intervention schools; Post-int Phase II = Phase II in intervention schools; Baseline Comp = Baseline in comparison schools; Comp Phase I = Phase I in comparison schools; Com Phase II = Phase II in comparison schools.

Similar to the quality of the assessment tasks in English, science, and mathematics, the changes in scores of the student work from baseline to Phase II in all three subject areas on the authentic intellectual criteria were significantly larger in the intervention schools than the comparison schools (see Figures 4-6). Majority of the students' work demonstrated a significant decrease in *presentation of knowledge as given* and *knowledge reproduction*, whereas there was a significant increase in *higher-order thinking skills*, *sustained writing*, and *real-world application*. An opposite pattern was observed in the quality of student work in the comparison schools, which tended to focus on students' presentation and reproduction of factual and procedural knowledge.

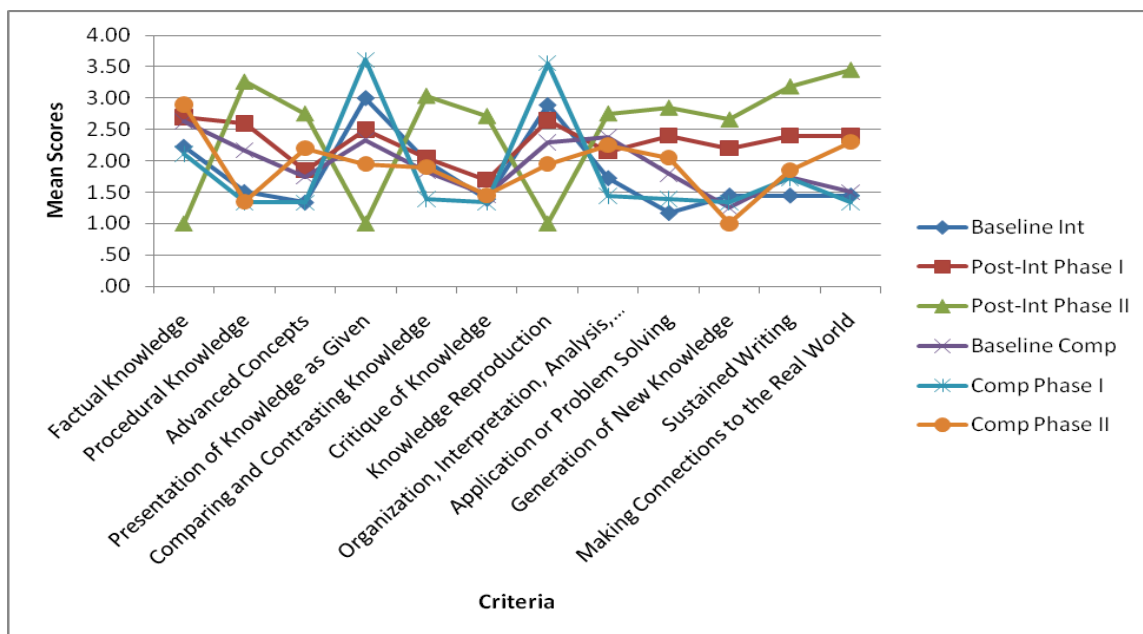
**Figure 4.** Comparisons of the Quality of Student Work in English



*Note.* \* Baseline int = Baseline in intervention schools; Post-int Phase I = Phase I in intervention schools; Post-int Phase II = Phase II in intervention schools; Baseline Comp = Baseline in comparison schools; Comp Phase I = Phase I in comparison schools; Com Phase II = Phase II in comparison schools.

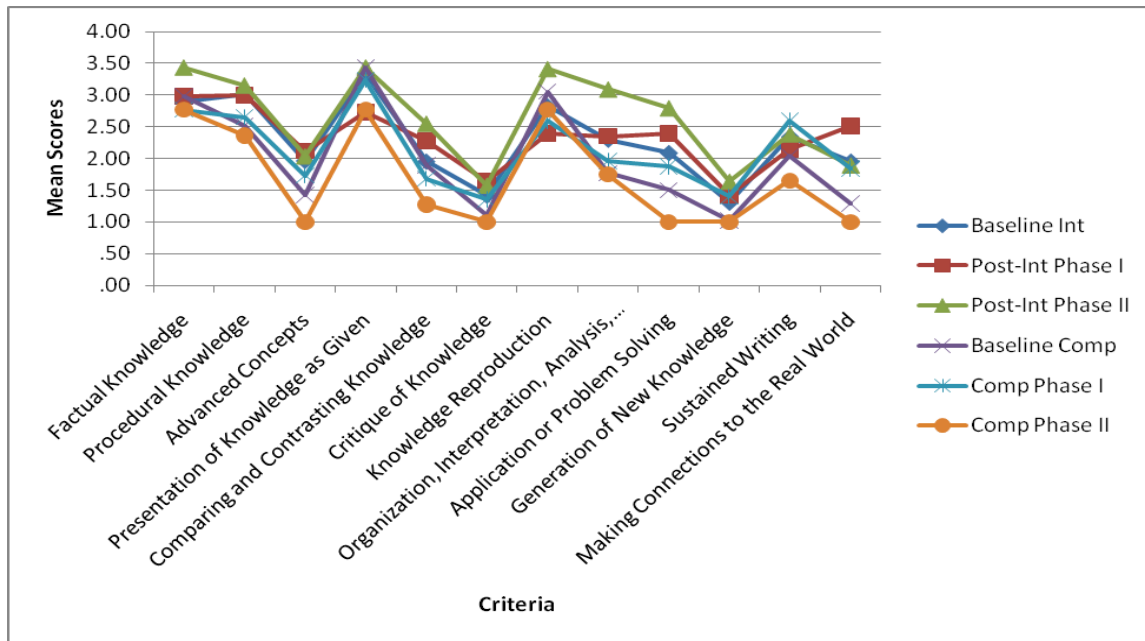
**Figure 5.** Comparisons of the Quality of Student Work in Science





*Note.* \* Baseline int = Baseline in intervention schools; Post-int Phase I = Phase I in intervention schools; Post-int Phase II = Phase II in intervention schools; Baseline Comp = Baseline in comparison schools; Comp Phase I = Phase I in comparison schools; Com Phase II = Phase II in comparison schools.

**Figure 6.** Comparisons of the Quality of Student Work in Mathematics



*Note.*\* Baseline int = Baseline in intervention schools; Post-int Phase I = Phase I in intervention schools; Post-int Phase II = Phase II in intervention schools; Baseline Comp = Baseline in comparison schools; Comp Phase I = Phase I in comparison schools; Com Phase II = Phase II in comparison schools.

## 5 Conclusion

The Singapore government's vision of 'Thinking Schools' is a bold step to equip and prepare its students with the critical apparatus needed in a new economy. The government is aware that critical thinking assumes and demands a supportive culture and social structure – hence the focus on 'thinking schools' rather than 'thinking skills'. The promotion of authentic assessment aligns itself well with the Singapore government's goal to shift from quantity to quality. However, the challenge is that this is not merely a change in education policy but a fundamental change of teacher and student identity and disposition. To transform an education system from a focus on quantity to a focus on quality requires a certain degree of 'maturity' in the students in 'taking ownership' of their learning and the teachers 'letting go' of their results (Ng 2008). This is a tall order in an environment where results still rule and many students find learning stressful rather than pleasurable (Ng 2005).

Moreover, a very important consideration in arguing for a shift in assessment practice is how one can propose an ideal that can really be implemented system-wide. An assessment is always part of a broader educational discourse and has wider societal significance because it concerns children's future. Therefore, while authentic assessments can equip students for lifelong learning and promote engaged learning, one

has to consider the other functions of assessment in the wider scheme of things. Assessments, while trying to encompass formative aspects for learning, have to play a summative role for certification. They, while facilitating a certain learning process, have to test the substantive content domain. Written examinations are artificially constructed worlds and therefore under human control. They can be made fair to all takers of the examinations. Authentic assessments are open to variations in the environment. Students and their parents can cry foul at the results. Authentic assessments also require a higher level of assessment literacy from the teachers. One great challenge is to pursue this agenda while teachers are already struggling with the dominant certification purpose of assessment. Time and resources will need to be displaced from the summative assessment function and redeployed to meet the broader educational objectives of authentic assessment. The challenge of authentic assessment is then a challenge of the will to make thinking students and engaged learners happen.

The exam-driven, teacher-centred and conventional assessment culture is not unique to Singapore; it is prevalent in other Asian-Chinese societies like China, Hong Kong, Taiwan and Japan (Stevenson & Stigler 1992; Feinberg 1993; Stapleton 1993; Tan 2007; Chan and Rao 2009). The challenge faced in Singapore is therefore not unique, and offers a useful case study on the endeavours of many states to promote thinking schools, as well as the accompanying promises and pitfalls. As we enter the second decade of the 21<sup>st</sup> century, assessment literacy will become increasingly essential because teachers are expected to master the knowledge and skills relevant to the teaching and assessment of 21<sup>st</sup> century competencies.

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