The need for realignment of primary science assessment to contemporary needs: Assessment of Learning and Assessment for Learning

Iris Chai Hong LEE

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Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in the School of Education at Murdoch University Perth, Western Australia
I declare that this dissertation is my own account of my research and contains as its main content work which has not previously submitted for a degree at any tertiary institution.

Iris Chai Hong LEE
ABSTRACT

The ultimate purpose of this study was to investigate how to best prepare Singapore students for the Knowledge-based Economy (KBE). Investigating the possible need for the realignment of the primary science assessment to the KBE was of utmost interest as assessment was viewed as the driver of the actual curriculum.

This was a mixed methods design study (Creswell, 2005). Fifteen teachers were first interviewed to ascertain the major features of primary school science assessment in both Perth, Western Australia and Singapore. A list of twelve questions was prepared for the eight teacher interviewees in Singapore and the seven teacher interviewees in Perth. The NUD*IST program was used to help organise trends in these teacher responses. Definitions of KBE skills were synthesised from literature reviews and validated by the fifteen teachers for the subsequent survey. The survey involved a list of demographic questions and two matrices. The first matrix required the teachers to rate, on a four-point scale, the use of the eleven assessment modes for the twelve 'process' and KBE skills. The second matrix was a frequency check to determine if the teachers had used a particular mode to assess a particular skill. One hundred and forty-five usable surveys were analysed. The Rasch analysis was performed through RUMM2020 program and unfolding model was sought through the program RateFOLD.

The interviews first established that KBE skills and a variety of assessment modes were needed for today's classes. The survey confirmed these needs and found that the paper and pencil test was the most frequently used assessment procedures in Singapore and
Perth. In both interviews and the survey, teachers were requested to match the skill(s) to the appropriate assessment mode(s) though the details and justification of such tasks were explained by the teachers in the interviews. In the process, other factors such as 'time constraints' and 'ranking of the teachers' were uncovered as 'hindrances' to teachers assessing the students appropriately for learning. The problems identified by the Singapore teachers were a lack of time, overloaded syllabi and the crucial perceived need of assessment of learning (high-stake summative tests).

The results of both the interviews and survey supported the need for a variety of assessment modes (Gray & Sharp, 2001; Hackling, 2004; National Research Council, 1996, 2001 & 2003; Sebatane, 1998; Sterenberg, 1998) to help students learn science in today's contemporary classes. The Singapore teachers in this study were also appealing for help from the policy-makers to use a variety of assessment modes as the system that stipulated the use of the paper and pencil testing was beyond their control and jurisdiction.

Recommendations that stemmed from this study include allowing teachers to use a variety of assessments to assess the students' learning in the high-stake Primary School Leaving Examination (PSLE) and not just the paper and pencil mode that has been in used for at least the last thirty years. There are important implications as the learning theories that are currently used to support the assessment of learning are no longer sufficient nor in total alignment with the needs for today's class. For example, a behaviourist taxonomy of skills emphasises the measurable output and not the process
of learning. Socio-constructivist approaches that focus on the individual constructing meaning in his/her context such as the use of ongoing formative assessment to encourage feedback (Black & Wiliam, 1998a & b) may assist in engaging the students in lifelong learning which is required in the KBE.

Lastly, the significance of this study lies in two aspects, the practical and the scholarly. This study provides the evidence for the need primary science assessment to be more aligned to contemporary needs. This in turn will assist in better preparing the young of Singapore, who are the nation’s only natural resource, for the workforce. This study also aims to contribute to the body of knowledge in three ways. Firstly, KBE needs will be connected to the primary science classroom via assessment of skills. Secondly, both KBE and process skills were found to be more appropriately assessed by assessment modes such as portfolio and paper and pencil respectively, as demonstrated through the analysis by Rasch and unfolding models. Thirdly, the gap between the implemented and official curriculum will be narrowed with this proposed change in assessment processes.
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List of commonly used terms

‘Assessment modes’ is synonymous with:
  assessment tools
  assessment strategies
  assessment instruments
  assessment methods
  assessment ways
  assessment techniques
  modes of assessment
  modes for assessment
  tools of assessment
  tools for assessment
  strategies of assessment
  strategies for assessment
  instruments of assessment
  instruments for assessment
  methods of assessment
  methods for assessment
  ways of assessment
  ways for assessment
  techniques of assessment
  techniques for assessment

‘Variety of assessment modes’ is synonymous with:
  multiple assessment modes
  multi-modal
List of Acronyms/Abbreviations

ANOVA: Analysis of variance

APEC: Asia-Pacific Economic Cooperation

KBE: Knowledge-based economy

MOE: Ministry of Education (Singapore)

NIE: National Institute of Education (Singapore)

NUD*IST: Non-numerical Unstructured Data Indexing Searching and Theorizing

OECD: Organisation for Economic Cooperation and Development

PISA: Programme for International Student Assessment

PSLE: Primary School Leaving Examination

RateFOLD: Unfolding analysis program for polytomous responses

RUMMM2020: Rasch Unidimensional Measurement Model

SCANS: Secretary’s Commission on Achieving Necessary Skills

SEAB: Singapore Examinations and Assessment Board

SPSS: Statistical Package for the Social Sciences

STAWA: Science Teachers Association of Western Australia