A study of the alignment of learning targets and assessment to generic skills in the new senior secondary mathematics curriculum in Hong Kong

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A R T I C L E   I N F O

A B S T R A C T

Education reform is now a worldwide phenomenon, and many countries are interested in the issue of alignment. The mathematics curriculum of the new three-year senior secondary (NSS) curriculum in Hong Kong aims to develop the proficiency of students or learners to think critically and creatively, to inquire and reason mathematically, and to use mathematics to formulate and solve problems in mathematical contexts as well as in daily life. Nine generic skills are expected to be developed through the acquisition of the mathematical knowledge and concepts. The Hong Kong Diploma of Secondary Education (HKDSE) Examination serves as the only public examination in the NSS. Presumably, it is expected that the HKDSE Examination aligns well with the curriculum expectations. In this article, we investigate and judge the alignment between such expectations and the HKDSE Examination. Our research findings show that there is a lack of learning strategies and collaboration and self-management capabilities acquired as expected from the learning targets, nor examined through the assessments in the current NSS Mathematics Education. Public examination is indeed not a good venue to access some generic skills. This clearly shows that there exist certain degrees of imbalance in the acquisition of the generic skills through the current NSS Mathematics Education. We suggest a revision of the general curriculum and assessment structure, an introduction of new forms of assessment, and an increase in the diversity of assessment as means for alleviating the aforementioned problems. We believe that the experience in Hong Kong would be of interest to other parts of the globe.

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Introduction

The unprecedented changes in the worldwide economic structure and the knowledge-based economy in the 21st century pose new challenges for the way people think and live (Education Commission, 2000). This leads to the education reform worldwide and the launching of the new Hong Kong three-year senior secondary curriculum (NSS) in 2009. In the NSS, Mathematics is a core subject. The mathematics curriculum at the NSS aims to meet the aforementioned challenges by developing the proficiency of students or learners to think critically and creatively, to inquire and reason mathematically, and to use mathematics to formulate and solve problems in mathematical contexts as well as in daily life (Curriculum Development Council & Hong Kong Examinations and

Assessment Authority, 2007). Nine generic skills[1] are expected to be developed through the acquisition of the mathematical knowledge and concepts. They can be considered as both process skills and learning outcomes in the Mathematics Education Key Learning Area (Curriculum Development Council & Hong Kong Examinations and Assessment Authority, 2007). These skills form a basis for one to build the capabilities for learning how to learn, so that they can apply them to pick up advanced knowledge as well as solving problems encountered in their daily lives.

Knowledge generation requires strong generic skills, or higher-order thinking skills (HOTS), including analytic reasoning, problem solving, and writing, and education serves as a vehicle for nurturing students by teaching generic skills and measuring the progress with respect to the desired goals (Benjamin et al., 2012). To fulfill the rationale and overall curriculum aims of the NSS

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[1] Generic skills are skills, qualities, and trait that an individual needs to develop for personnel development (Hamzah & Abdullah, 2009).

Mathematics Education, the curriculum serves as a means for students to foster generic skills, together with thinking abilities and positive attitudes towards the learning of mathematics (Curriculum Development Council & Hong Kong Examinations and Assessment Authority, 2007). Thus, the development of generic skills for students is a central theme in such education. A properly aligned curriculum helps learners master these generic skills in the most balanced, efficient, and effective manner through the acquisition of mathematical knowledge and concepts (expressed in the form of learning targets). Not only does aligning assessments with generic skills encourage students to adopt a deep approach to learning, but also teachers to give more credence and value to pedagogy as described in the curriculum document. Both students and teachers can hence find an effective linkage between the performance in assessment and approaches in teaching and learning that assists students to develop the knowledge and skills for acquiring new information and solving real-life problems. Therefore, an objective of this work is to investigate the alignment of the intended generic skills to the curriculum and assessment.

Educational assessment refers to all activities that can be employed to assist learners to learn effectively and gauge the learning progress (Black & Wiliam, 1998). The Hong Kong Diploma of Secondary Education (HKDSE) Examination (Hong Kong Examinations and Assessment Authority, 2011b) serves as the only public examination in the NSS. The HKDSE Examination is a standards-referenced, standardised test to evaluate the performance of learners reported against a set of pre-defined level descriptors. Presumably, it is expected that the HKDSE Examination aligns well with the curriculum expectations that can yield a positive backwash effect[2], which can in turn offer incentives to learners to acquire what they are expected to learn in the curriculum. The learner perspective of the curriculum is hence defined by assessment (Ramsden, 2003). However, a misalignment may mean that the assessed performance of a learner does not properly reflect the extent of what he/she is expected to learn and acquire (e.g., the underlying generic skills) during the study. This results in a negative backwash so that learners would not pick up those knowledge and skills in the curriculum that are expected not to be assessed. This in turn defeats the learning goal. Therefore, there is a need to investigate and judge the alignment between the curriculum expectations and the HKDSE Examination. This also helps discover deficiencies and thus search for remedies to improve the efficiency and effectiveness of the NSS so as to benefit the learners.

In the literature, some international studies on assessing generic skills have been reported, such as (Benjamin et al., 2012; Ito, 2014). (Benjamin et al., 2012) advocated that Collegiate Learning Assessment (CLA) is an effective standardised, performance-based assessment for accessing HOTS across all domains. By employing CLA, students are asked to solve problems encountered in scenarios that are typical in the real world. (Ito, 2014) gave an account of the Progress Report on Generic Skills (PROG), which is an assessment tool similar to CLA for measuring learning outcomes of college students in Japan. The study confirmed a weak correlation between PROG and grade point average (GPA). It also found that PROG might fail to measure some generic skills and needed to be complemented by other assessment techniques. Both studies have shown that generic skills can be identified and measured. Though the studies were focused for higher education, the inferences made could be applicable to secondary education as well. Our work aims to investigate the alignment between assessment and the generic skills embodied within the curriculum. It offers an effective framework on how an alignment study of assessment to a set of generic skills can be conducted. This bridges the gap between what concepts and knowledge learners have picked up and what generic skills they have ultimately acquired from the learning process.

Our contributions

The focus of this work is to study the assessment alignment of the HKDSE Mathematics Examination with the acquisition of the nine generic skills expected for the NSS Mathematics Education. In other words, we investigate whether the intended generic skills are covered in the curriculum and assessment. Therefore, the curriculum is studied from the curriculum policy designers' perspectives, which may differ from the doers' perspectives (Cooper & Dunne, 1998). The investigation is carried out in two phases. In the first phase, we analyse the extent to which these generic skills can be acquired based on the stated learning targets. Some deficiencies and inconsistencies among the learning targets with respect to the generic skills are identified, and possible remedies are then suggested.

In the second phase, we evaluate the assessment questions in the first HKDSE Examination in 2012 by finding out whether these questions reflect an appropriate balance in the acquisition of the captioned nine generic skills. Based on the findings, several recommendations are suggested for improving the efficiency and effectiveness of the NSS Mathematics Education.

We will investigate the efficiency and effectiveness of the NSS Mathematics Education by examining four basic questions:

- Are the nine generic skills properly reflected in the learning targets in the NSS Mathematics Curriculum Framework? What are the deficiencies?
- Can the assessment questions in the HKDSE Examination reflect an appropriate balance in the acquisition of the generic skills? What are the limitations?
- What are the possible remedies to alleviate these deficiencies and limitations?
- What are the implications of the experience in Hong Kong for other parts of the world?

This study should contribute to better understanding of alignment theory. In alignment theory, it is hypothesised that agreement in education components implies coherence and efficiency for an education system. The degree of alignment is generally judged on subject-specific knowledge or skills. However, there are limitations in the method of studying alignment when alignment is established in the context of transferable skills, such as generic skills, as they may be achieved through learning various subjects and cannot be assessed directly. In other words, the attainment of generic skills inferred from the assessment does not necessarily mean that they are acquired through the curriculum. Yet, as inferred from our findings in the Findings section, the existence of some generic skills not assessed in the assessment reveals inconsistency or misalignment of learning targets and assessment to generic skills in the NSS Mathematics Education curriculum. This inference is applicable to transferable skills in general.

Organisation of the paper

The rest of this paper is organised as follows. First, we present a literature review on curriculum alignment. We then give a comprehensive overview of the evolution of the Hong Kong education system and mathematics curriculum, and discuss the NSS Mathematics Education as the background for this research.

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[2] The backwash effect, also known as washback effect, is a phenomenon describing the impact of assessment on learning and teaching that learners tend to acquire and teachers incline to teach on what they consider to be examined (Elton, 1987; Prodromou, 1995). Backwash effect is positive when the assessment results in favourable changes in learning and teaching strategies, matching a variety of teaching-learning situations with different educational aims (Biggs, 1996).