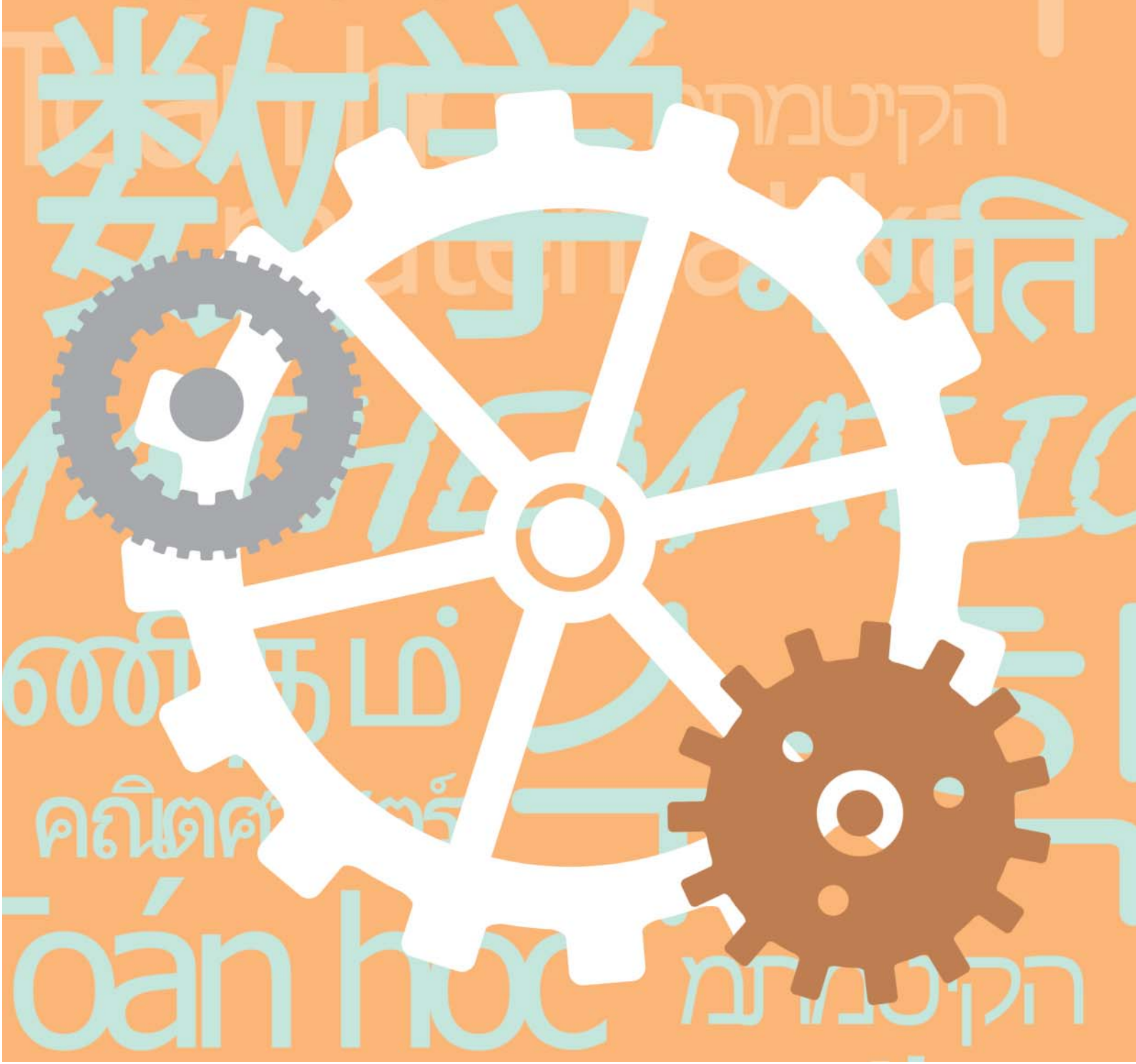
DEVELOPING MATHEMATICS TEACHERS' QUALITY STANDARDS:
A CASE STUDY IN MALAYSIA



INTRODUCTION & RATIONALE

In Malaysian context, the focus of mathematics teachers' quality has grown due to the challenge to improve the student achievement in international large scale assessment. The release of Trends in International Mathematics and Science Studies (TIMSS) 2011 and Program for International Student Assessment (PISA) 2012 has indicated that Malaysian Grade Eighth students lag behind their peers in other countries in mathematics subject. As such, there is a dire need to develop Malaysian mathematics teacher's quality standards that would facilitate student mathematics learning outcomes and in turn, informs pedagogical and local educational policy. In relation to this, the Malaysian Teacher Standard (MTS) 2009 which consists of three main content standards: (1) Professional values within the teaching profession, (2) Knowledge and understanding of education, subject matter, curriculum and co-curriculum, and (3) Skills of teaching and learning are found not specific to mathematics subject. To fill in this limitation, the Southeast Asia Regional Standards for Mathematics Teachers (SEARS-MT) is proposed to be used as an inspirational guide to conceptualise the Malaysian mathematics teacher's quality based on the characteristics and attributes of mathematics teachers which are unique to the Southeast Asian region. Differs from Malaysian Teacher Standard (MTS) 2009, SEARS-MT has formally articulated and outlined four dimensions of mathematics teacher's quality: (1) Professional knowledge, (2) Professional teaching and learning process, (3) Personal and professional attributes, and (4) Professional communities.

GOAL & OBJECTIVES

The goal of the Malaysian Mathematics Teacher's quality Standards (MMTQS) is to document a set of standards and its local descriptors that describe the characteristics and attributes of a mathematics teacher should attain in the 21st century. Specifically, the objectives of developing the MMTQS are as follows.

1. As a guide to provide benchmarks for relevant Malaysian educational divisions in formulating policies to improve and enhance the quality of in-service mathematics teachers,

2. As a guide in structuring teacher education programmes in in-service mathematics teacher preparation, and

3. As a guide for teacher professional development at personal level and performance evaluation at school level.

METHODOLOGY

Collaborative inquiry approach

Workshop: 12-13 June 2014 at SEAMEO RECSAM, Penang

Seminar:

"Southeast Asia Regional Standards for Mathematics Teacher" by Mr. Zulkifli Saleh from Ministry of Education, Malaysia, and

"Malaysian Teacher Standards" by Dr. Hj. Abd Razak Othman from Malaysian Institute of Teacher Education

Consultants:

25 educators from foreign and local universities, institute of teacher education, researchers, school senior teachers and officers from Ministry of Education

▲ International and local consultants and RECSAM staffs

▲ Workshop Session 1

▲ Workshop Session 2

▲ Prof. Masami Isoda from University of Tsukuba, Japan

RESULTS

Four dimensions and its standard, indicators, and local descriptors of Malaysian Mathematics Teacher Quality were identified:

(1) Professional Knowledge	(2) Professional Teaching	(3) Personal and Professional Attributes	(4) Professional Communities

Table 1 Dimension 1: Professional Knowledge

STANDARDS	INDICATORS	LOCAL DESCRIPTOR
Knowledge of Mathematics	Knowledge of the discipline of mathematics	Understanding the nature and scope of mathematical content expected to be taught throughout the curriculum
		Understanding a body of mathematical knowledge that is relevant to teaching and consistent with the fundamental principles of mathematics
		Ability to explain the fundamentals principles of mathematics in terms of precision (clear and unambiguous), definitions, reasoning, coherence (concepts and skills are interwoven) and purposefulness (every concept and skill is there for a purpose)
		Understanding of subject matter concepts and how these concepts related to from the larger body of knowledge
		Understanding of mathematics content expected to be taught at a particular level.
	Knowledge of the key mathematical concepts, procedures, and processes those are relevant to mathematics.	Know and define the facts(concepts and skills) as well as their explanations
		Knowing mathematical concepts and demonstrating procedural fluency as well as the mathematical processes that include problem solving, reasoning, communicating, representing, and making connections
	Knowledge of mathematics curriculum	Knowing the mathematics curricular goal and objectives, curricular content and learning standards as well as learning experiences, pedagogical emphases and assessment practices
	Knowledge of relationships within mathematics and with other disciplines	Knowing the relationships inherent in mathematical concepts and procedures as well as the processes that help to understand the relationships
		Knowing the connections within mathematics, between mathematics and other subject area
	Knowledge of students' diverse backgrounds	Knowing the differences of socioeconomics, cultural, ethnic and religious backgrounds of students
	Knowledge of physical, social, psychological and intellectual characteristics of the students	Knowing the differences of students' physical abilities, social competence, psychological states including motivational and engagement levels as well as students' prior knowledge of mathematics
	Knowledge of students' ICT knowledge	Knowing students' knowledge, preferences, experiences and competencies in ICT
Knowledge of Students' Learning of Mathematics	Knowledge of how students' prior knowledge impacts on learning	Understanding what students know in terms of prior mathematical knowledge and need to learn and then challenging and supporting them to learn it well
	Knowledge of students' conceptions and misconceptions about mathematics	Understanding students' thinking when listening to students' explanations
		Identify and remediate students' misconceptions
	Knowledge of potential difficulties faced by the students in learning particular mathematics concepts	Knowing that certain mathematics concepts can pose potential learning difficulties including conceptual understanding and procedural computation that require appropriate strategies
	Knowledge of the application of learning and instructional theories in the teaching of mathematics	Knowing how students learn mathematics from different perspectives of learning and instructional theories
	Knowledge of the repertoire of effective teaching strategies	Knowing various teaching strategies, methods, and techniques to help students construct mathematical understanding meaningfully

Table 1 Dimension 1: Professional Knowledge (cont.)

STANDARDS		INDICATORS	LOCAL DESCRIPTOR
	Knowledge of Intellectual Quality	Knowledge of strategies for supporting creativity and innovation	Employ a variety of higher order thinking strategies including inquiry methods, to explore new ideas and theories
		Knowledge of strategies for developing students' higher order thinking skills in mathematics	Stimulate students thinking using a variety of strategies and activities that is challenging
		Knowledge for making complex relations between and representations of core topics	Use instructional strategies that require students to apply and transfer mathematical knowledge within/between different content area
		Knowledge of supporting students to develop complex mathematical thinking and decision-making	Use of knowledge on how to provoke students to develop complex mathematical thinking and decision-making
		Knowledge of cross-curricular relations with mathematics	Expand and emphasise interdisciplinary connections to mathematics learning by using mathematical concepts in subjects other than mathematics
	Knowledge of ICT	Knowledge of ICT integration in the teaching and learning	Use technology as an essential tool to enhance students learning opportunities that take advantage of what technology can do efficiently and well-graphing, visualising and computing
		Knowledge of how particular software supports a mathematics concept	Select and use appropriate technological tools, such as but not limited to spreadsheet, dynamic graphing tools, computer algebra systems, dynamic statistical package, graphing calculators, data collection software and presentation software to facilitate understanding of mathematical concepts
		Knowledge of use of ICT to model context and solve problems	Use technology that can facilitate student's understanding of quantitative relationships and that can increase computational proficiency in solving problems situations and real world problems
		Knowledge of application/software development specifically on mathematics lessons	Aware of rapid development of application/software development in mathematics lessons

Table 2 Dimension 2: Professional Teaching

STANDARDS		INDICATORS	LOCAL DESCRIPTOR
	Mathematical Tasks and Discourse	Engage and enrich students in mathematical thinking through discourse	Engage in meaningful (local, students' personal experience) communication between teacher-student, student-student that includes student's questioning, questioning techniques that enhance mathematical thinking.
		Communicate thinking through various means of representations and reasoning	Present ideas, concepts and procedures clearly and effectively through diverse use of representations in terms of symbols, concrete/animated objects, pictorial, verbal representations, models and graphs.
		Facilitate student use of conjecturing, reasoning, proving, modelling, and verifying to solve mathematical tasks	Provide opportunities for students to make conjectures, reasoning, solve problem, proving and making conclusions through higher order thinking strategies
		Provide students with mathematical activities, problem solving tasks and real-life investigations to meet the needs of all students	Design tasks (open ended) that meet the needs of all students. While open-ended questions are essential to effective teaching, carefully –designed closed questions can also be valuable
			Set tasks and activities of increasing levels of complexity that continually develop, reinforce and extend learners' understanding
			Design activities that promote higher order thinking skills including analysing, reasoning, deduction, and creativity and that require students to apply their knowledge and skills to solve problems, modelling the real world and making connections

Table 2 Dimension 2: Professional Teaching (cont.)

STANDARDS		INDICATORS		LOCAL DESCRIPTOR
				Design activities that are sensitive to cultural diversity, related to Malaysian context and align to the Malaysian curriculum.
	Planning for Learning Process	Plan for an effective and safe learning environment to cater to the diversity of all students		Consider students' physical and emotional well-being when planning mathematics lesson
				Listen interpretively rather than evaluative or judgmentally to students' response.
		Incorporate a variety of learning resources and instructional materials with appropriate teaching strategies		Employ appropriate, relevant and a variety of learning resources commercially or self-developed, to enhance students' meaningful learning and interest in mathematics.
	Implementing Teaching Strategies	Use of effective communication and promotion of classroom discussion		Employ a variety of effective discussions (pair, group and whole class) maximising the opportunities for students to work collaboratively
				Utilise mathematically effective communication either verbally or in written form
				Encourage communications that promote justification and reasoning in the learning of mathematics
		Use of strategies to challenge students' thinking and engage them actively		Use a range of strategies to challenge students' thinking that ensures students are engaged and actively involved
		Manage the learning environment effectively		Create a conducive and well managed learning environment to enhance students' learning of mathematics
		Negotiate mathematical meaning and modelling mathematical thinking and reasoning		Compare, discuss and mathematise appropriate ideas which enable students to make generalizations and apply them to extended situations
	Monitoring, Assessment and Evaluation	Provide on-going, constructive and purposeful feedback for learning		Provide regular and on-going, constructive and purposeful written or verbal feedback to improve students' learning
		Develop and use a range of appropriate assessment tasks and strategies		Construct and use a variety of assessment tasks (written, verbal, computer-based)
		Regularly assess and report student learning outcomes		Evaluate and report students' learning outcomes consistently and assess for improvement
		Analyse students' learning through assessment		Use appropriate assessment techniques to diagnose students' learning for enrichment and remedial purposes
		Utilise the performance data to inform teaching practice		Continuously improve teaching based on students' assessment data in the class
		Maintain on-going and informative records of student progress and learning outcomes		Consistently update and document students' progress and learning outcomes for references and further actions
	Reflection of Teaching and Learning	Document the reflection of teaching practice post-lesson analysis		Write and document analysis of post-lesson reflections of teaching practice
		Utilise the record of reflection for self-improvement		Utilise information from the records of reflection for continuous improvement

Table 3 Dimension 3: Personal and Professional Attributes

STANDARDS	INDICATORS	LOCAL DESCRIPTOR
Personal Attributes	Exhibit enthusiasm and confidence for both mathematics and teaching mathematics	Appreciate the beauty and the importance of mathematics and model perseverance for mathematics and highly passionate about the teaching of mathematics
	Show a conviction that all students can learn mathematics	Having high confident in students' ability and setting high achievable standards for the mathematics learning of each student
	Exhibit care and respect to students	Accept and appreciate students' attempts, abilities, and their diverse background
Personal Professional Development	Commit to lifelong learning and personal development	Continuously enrich and upgrade knowledge and skills pertaining to mathematics and mathematics teaching
	Keep abreast with contemporary issues in mathematics education.	Have informed views on relevant current trends in mathematics education including knowledge of national priorities and associated policies, and actively participate in a range of professional activities
Personal Responsibilities towards Community	Involve in the community of mathematics teachers	Actively involved and contribute to the mathematics teachers' community
	Advocate for mathematics learning in their school and in their wider community	Promote mathematics learning, in school and outside school
	Facilitate effective communication with parents/careers and stakeholders regarding students' learning and progress	Effectively communicate about mathematics learning of students to parents/career and stakeholders
		Suggest solutions to overcome mathematical learning problems
	Create opportunities for mathematics learning beyond the classroom	Suggest worthwhile mathematical tasks to involve students in problem solving and decision making in the community

Table 4 Dimension 4: Professional Communities

STANDARDS	INDICATORS	LOCAL DESCRIPTOR
Professional Ethics	Adhere to the codes of conduct	Comply to the codes of conducts as outlined in the Malaysian General Order and Ethics of Teaching Professionalism (Etika Profesionalisme Keguruan)
	Demonstrate professionalism	Demonstrate professionalism in knowledge, autonomy and responsibility in teaching mathematics as described in the Ethics of Teaching Professionalism (Etika Profesionalisme Keguruan)
	Practise professional autonomy (e.g. willingness to perform duty above expectation)	Being responsible, accountable and independent in exercising and acting on professional judgement
Professional Communities at Schools	Enrich the educational context for students (e.g. co-curricular activities, advisor for mathematics club, mathematics competition, mathematics project)	Provide enriched educational experience for students through active participations in informal and formal activities
	Participate in the school-based professional learning community (e.g. mentoring, lesson study, action research, journal contribution)	Participate in school based staff development programs
		Volunteer to participate in school based research groups (lesson study, action research)
		Sharing best- practices in teaching mathematics
Professional Communities Outside Schools	Affiliate with professional organisation (national and local government, international organisation, private company, journal publication)	Establish networking and affiliations with mathematics associations and professional bodies
	Take part in professional community networking among various stakeholders	Participate in professional community networking among practitioners of schools, educational institutes, and/or universities

CONCLUSION

- It is hope that the application of the Malaysian Mathematics Teachers' Quality Standards will be able to sustain and stimulate teachers in their professional practice and support quality learning opportunities for all students.

- As a nation initiative, the Malaysian Mathematics Teacher could be an inspirational guidance for the other developing nations in the region which attempt to develop their own mathematics teachers' quality standards and indicators.

- Future research could be extended by revising the standards, indicators and local descriptors in primary and pre-school context.

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