Development of Southeast Asia Regional Standards for Science Teachers: Implication for Equitable Outcome in Science and Technology Education

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Abstract

In any world-class educational system, quality teachers with passion for Continuing Professional Development (CPD) play important roles in the nation's human resource development especially in the fields of Science and Technology Education (STE). Hence a framework to support and improve teachers' quality is important to maintain the standards of science education especially in a fast growing region e.g., SEAMEO. These framework/standards should be developed as benchmarks to improve quality teachers and their science teaching in order to achieve the vision of raising students' achievement. This paper reports on the authors' involvement in the development as well as implementation of SEARS-ST in response to this call for quality teacher standards in which the 'Southeast Asia Regional Standards for Science Teachers'(SEARS-ST) was prepared through a series of development and editing workshops in 2014 and 2015. Participatory inquiry approach was adopted as research methodology to draft and edit SEARS-ST involving teams of SEAMEO's experts. The authors as lead researchers were involved as coordinator of workshops, consultant and seminar speakers to disseminate the refined version of SEARS-ST formulated through blended learning mode to groups of educators. Research questions that were formulated after the first workshop were sent to the participants of the second workshop who were mainly SEAMEO educators to solicit responses, As an output of collaborative and participatory inquiry-based study, four dimensions of SEARS-ST were identified also as main discussion topics in the SEARS-ST document, i.e., (1) Professional knowledge; (2) Professional practice; (3) Professional attributes and ethics; and (4) Professional development. An exemplary case for 'Malaysian Science Teachers' Quality Standards'(MSTQS) is reported on how Local Descriptors were developed in line with the Components and Elements in each Dimension of SEARS-ST. It is hoped that the lessons learnt from this participatory inquiry-based study would serve as models to develop 'Science Teachers Quality Standards' (STQS) in other SEAMEO countries. Implications of study and suggestions for future research are also deliberated.

Keywords: Science teacher standards; equitable outcome; continuing professional development; teacher professionalism in STE; dimensions of standards.

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Introduction

Background and Overview

Teachers and their development of teaching must be at the heart of any plan to improve any educational systems. In fact, quality teachers in educational settings of world-class standards with passion for Continuing Professional Development (CPD) play important roles in the human resource development of the nation especially in the fields of Science and Technology Education (STE). The Southeast Asian Ministers of Education Organization (SEAMEO) has uniquely represented the educational systems in the SEAMEO region with the collective aspirations of 'leading through learning' to provide quality education for the next generation of leaders emphasising on science and mathematics education that underpins the agenda of human resource needs of the region. Hence a framework as well as standards to support and improve the quality of science teachers is important for enhancing the standards of science education.

Standards have been used extensively to describe an expectation to be abided, maintained and implemented. It is important to recognize that standards lend precision to vague constructs and help to clarify what we want to achieve, to form a base for measurement so that we can produce more equitable outcomes and gauge our developmental readiness. Standards also serve as a mean to guide practice and development of policy, also as a basis of comparison in measuring quality, value or quantity with reference to a set of predetermined indicators or a certain benchmark identified.

Rationale and Objective

It is with these in mind that RECSAM initiated the development of the Southeast Asia Regional Standards for Science Teachers (SEARS-ST) between 2014 and 2015. Malaysian Science Teachers' Quality Standards (MSTQS) was also developed adapted from SEARS-ST. A golden rule for development of valid and reliable standards is the building of consensus among stakeholders in 2015. Hence, SEARS-ST was prepared through a series of development and editing workshops in 2014 and 2015 involving teams of experts from SEAMEO member countries with consensus to formulate a benchmark for quality science teachers in SEAMEO region. Various discussions and debates were made during the workshops and were later conducted within the respective country for it to be relevant, useful and valid for use in each country.

This paper captures the major processes incorporating digital tools and e-platforms involved in the development process of SEARS-ST. Illustration of exemplary MSTQS will also be briefly described. It is hoped that lessons learnt from this exercise would serve as models in the development of Science Teachers Quality Standards (STQS) in other countries.

Methodology

During the development of SEARS-ST (2014), participatory inquiry approach was employed as research method incorporating plenary presentations. The authors as lead researchers for the development of SEARS-ST were involved as the coordinator and consultants to lead the discussions of the drafting of framework in collaboration with other team members who were mainly groups of science educators. Some of them were also curriculum experts and policy makers in various educational settings in the SEAMEO region.

During the first workshop from 20 to 22 January 2014, two topics were delivered by curriculum experts from United Kingdom and New Zealand respectively as input for workshop participants. These included 'Developing and using standards for beginning, experienced and expert science teachers for continuing personal and professional development (CPPD)' (Windale, 2014) and 'Developing knowledge, skills and attributes of beginning science teachers' (Conner, 2014). The framework of standards was drafted and sent to the SEAMEO country experts who were mainly educators/officers from the respective Ministry of Education (MOE) prior to their participation in the second editing workshop from 16 to 18 June 2014, after which the refined SEARS-ST was completed. During the third workshop from 25 to 27 May 2015, SEARS-ST was presented to groups of Malaysian teachers, lecturers and MOE officers. Their feedback was obtained and together with the authors of this paper, local descriptors of SEARS-ST were developed for MSTQS.

Implementation and Discussion of Major Findings

The development of SEARS-ST and subsequently MSTQS involved two major phases.

Decision was firstly made through experts' input and discussions during the workshops conducted at the first phase (in 2014) with the suitability of the SEARS-ST being scrutinized by all involved in the workshops during and after the events. After much deliberations, SEARS-ST were finally presented in four major dimensions related to teachers' attributes and teaching activities. These standards are: (1) Professional knowledge; (2) Professional practice; (3) Professional attributes and ethics as well as (4) Professional development. Each of the dimension is further elaborated under components and elements. Apart from this, discussion was also made with reference to the Malaysia Teacher's Standard (*Standard Guru Malaysia* or abbreviated as SGM) that was developed by Malaysian MOE (*Bahagian Pendidikan Guru*, 2011). Other documents referred included professional standards for teachers (AITSL, 2014) as well as early learning, curriculum and assessment standards (Curriculum Development Division, 2013; *Bahagian Pembangunan*

Kurikulum, 2015). After much contemplation, the need to develop MSTQS was apparent as SGM is generic. Consensus agreement was made by workshop participants that in order to ensure quality teaching of science, the standards of science teachers need to be more precise and specific.

During the second phase (in 2015) when the MSTQS workshop was conducted, participants in various groups (each comprising of representatives from teachers, lecturers, MOE officers) scrutinised each dimension and component of SEARS-ST to produce the local descriptors relevant to Malaysian education settings. Criteria used in developing the local descriptors included consideration of local school culture, terminology used in describing certain teaching practice or teachers' attributes, the way forward as envisioned by the country as well the expected quality of teachers from the various perspectives of practitioners, teacher trainers, policy makers, school and ministerial administrators.

The following Figure 1 to Figure 4 illustrate part of the local descriptors for the respective elements presented in the MSTQS document for Dimension 1 to Dimension 4. The purpose of the local descriptor was to elaborate on each element of the component according to the focus and emphasis relevant to the country. But an element may have more than one descriptor.

Dimension 1: Professional Knowledge

Components	Elements	Local descriptors
Knowledge of Science	Knowledge of science content	Demonstrate an understanding of science knowledge comprises of science facts, concepts, principles, theories, philosophies, and ideas.
	Knowledge of nature of science	Demonstrate an understanding of the characteristic and basic principles underlying science and scientific endeavour including scientific belief and values
	Knowledge of scientific skills	Demonstrate an understanding of the knowledge and practice of basic and advance science process skills.
		Demonstrate an understanding of the knowledge and practice of scientific investigation.
		Demonstrate an understanding of the knowledge and practice of science manipulative skills.
	Knowledge of science in the cultural context	Knowledge and skills in relating science content to local religious and cultural practices in order to bring relevance and meaning to science learning among students.
		Knowledge and skills in critically searching for scientific evidence of the cultural beliefs, practices and indigenous knowledge.
	Knowledge of scientific attitude and noble values	Demonstrate an understanding of the knowledge and practice of scientific attitudes and noble values.
	Knowledge of the big ideas in science	Knowledge and skill in connecting/linking/relating various scientific facts and concepts and conceptualising them into related meaningful big ideas in science.
	Knowledge of application and implication of science	Knowledge and skills in providing ideas and examples of application and implication of science.
		Knowledge and skills in organising science activities e.g. green campaign, recycling, energy saving.
		Knowledge and skills in designing lessons or activities demonstrating application and implication of science.

Figure 1. Local descriptors for the Knowledge of Science Component in Dimension 1 (Professional Knowledge)*.

*Note: Not all the Local Descriptors for the Knowledge of Science Component are shown.

Dimension 2: Professional Practice

Components	Elements	Local descriptors
Plan and design effective learning experiences	Plan and design a range of meaningful and relevant learning activities that are aligned to the curriculum (e.g. learning objectives, methods and assessment)	Align the content of the curriculum, type of outcome, method of science, science process skill, formative and sumative and High order thinking skills
	Plan and design assessments to inform teaching and learning	Use a variety of assessment to know the strength and weakness of the student and teacher to improve learning.
	Plan to use appropriate teaching and learning technologies and tools that aid teaching and advance learning	Employ appropriate, relevant and a variety of learning resources including technologies commercially or self-developed to enhance students' meaningful learning and interest in science.

Figure 2. Local descriptors for the Plan and Design Effective Learning Experience Component in Dimension 2 (Professional Practice)*.

*Note: Not all the Local Descriptors for the Plan and Design Effective Learning Experience Component are shown.

Dimension 3: Professional Attributes and Ethics

Components	Elements	Local descriptors
Professional ethics	Comply with the Professional Code of Ethics for teachers	Conduct as professionals in accordance with the Code of Professional Ethics for Teachers
	Model personal and social responsibility for citizenship (e.g. sustainability of living environment, co-existence of humans, well-being, safety of children, etc.) to contribute to the harmony and betterment of the nation and the world at large	Use scientific information available for personal and public means for the development of society through community services
		Ensure that scientific knowledge and data is used ethically, not for destroying the communities through assessment of students' characters and behaviours
		Ensure protection and conservation of environmental resources and practice environmentally sustainable attitudes and behaviours

Figure 3. Local descriptors for the Professional Ethics Component in Dimension 3 (Professional Attributes and Ethics)*.
*Note: Not all the Local Descriptors for the Professional Ethics Component are shown.

Dimension 4: Professional Development

Components	Elements	Local descriptors
Reflecting on evidence	Collecting classroom evidence (e.g. students' work, portfolio, observation, etc.)	Carry out basic action research by collecting and compiling a range of evidence including student's work, portfolio, classroom observations, assessment data, questionnaires and interviews from a sample of classes taught
	Analyzing the evidence collected in relation to students' outcomes (e.g. student' work, portfolio, observation, etc.)	Evaluate the evidence collected to identify areas of strength and weakness with regard achievement of the teaching standards
	Identifying own professional strengths and weaknesses to inform professional development needs	Use the outcomes of the action research in addition to the teaching standards to personally reflect on practices to identify areas of professional strength and weakness
	Reflecting with peers (e.g. coach or mentor) to improve professional practice	Hold regular coaching/ mentoring sessions with colleagues to facilitate reflection on professional practice and action plan personal professional development goals

Figure 4. Local descriptors for the Reflecting on Evidence Component in Dimension 4 (Professional Development)*.
*Note: Not all the Local Descriptors for the Reflecting on Evidence Component are shown.

Conclusion

Science teacher plays a pivotal role in raising the standard of science education in the country as they are the main persons in charge of students' learning in the classroom.

Significance and Contribution

The development of SEARS-ST and MSTQS serves as important endeavour in raising teacher standards towards aspiring quality science teaching and students' achievement as well as towards achieving equitable outcome of the teacher professionalism in STE.

The process of developing SEARS-ST and subsequently MSTQS provided opportunities for some science educators to come together as well as collectively discuss in detail the requirements and needs of science teachers. Analysis of the attributes of quality science teachers bring forth the ethics that should be possessed by science teachers, their responsibilities towards the profession, students and communities they served.

For example, MSTQS provides a good set of indicators to the Teacher Training Division and Teacher Training Institutes in Malaysia for recruitment of new science teacher trainees. The set of indicators as identified will facilitate in getting the right persons to be teachers. The quality of science teachers will ultimately be related to the teaching practice. With MSTQS elaborating on each area of tasks the teachers need to undertake, the local descriptors provide a thorough breakdown of the specification of tasks science teachers should be proficient in. Moreover, this can give rise to a set of indicators to assess the teachers as well. MSTQS also listed the knowledge and skills of which science teachers should obtain, hence it can be used as a requirement of capacity building the teachers need to attend to in their duration employed as teachers. Most of all, the components, elements and descriptors of MSTQS give a glimpse of teachers' requirements and the needs for new novice teachers. These also provide a clear description for all teachers to reflect upon themselves of their proficiency in teaching as well as professional standing as science teachers. MSTQS will achieve its highest goal if teachers use it regularly for self-reflection and self-improvement.

Implication and the Way Forward

However SEARS-ST and MSTQS will remain as documents for display if science teachers are not brought together to discuss over each of the elements and descriptors that are included.

Science teachers need to embrace SEARS-ST and should be given the opportunities to further improve the descriptors as listed in MSTQS if need arises. Thus, the development of SEARS-ST and MSTQS is only the beginning of the journey, much more need to be done in order for these documents to fulfil its objectives.

Various follow-up activities were conducted, including dissemination of information through seminars to groups of educators (Ng, Ng, Devadason, & Lay, 2015; Devadason, Ng, Ng, & Lay, 2015; Ng, Devadason, Lay, & Ng, 2015) and reports to higher levels meetings (SEAMEO RECSAM, 2014). Research and Development (R&D) activities were also conducted on specific area such as Dimension 3 of SEARS-ST that focuses on 'Professional attributes and ethics' as reported by Lay, Ong, Ng, and Norazah (2016). The development of '**En**hancing **Tea**chers' **C**PD with **H**igher learning opportunities' (EnTeaCH) programme will also be implemented in the near future in line with the Dimension 4 of SEARS-ST that focuses on 'Continuing Professional Development' (CPD).

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