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ANALYSES OF TRAINING NEEDS OF IN-SERVICE TEACHERS IN FOSTERING HIGHER ORDER THINKING SKILLS IN SCIENCE TEACHING

PARAMESVARY A/P PERUMAL

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DISSERTATION SUBMITTED IN FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF EDUCATION (PHYSICS)
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ABSTRAK

Kajian berbentuk tinjauan ini dijalankan bertujuan menganalisis keperluan latihan guru menengah rendah dalam perkhidmatan bagi memupuk kemahiran berfikir aras tinggi (KBAT) dalam pengajaran sains. Populasi kajian ialah guru sains menengah rendah di Semenanjung Malaysia. Sampel kajian dipilih menggunakan pensampelan rawak berperingkat dan seramai 220 responden (kadar respon 65.3%) mengambil bahagian dalam kajian ini. Data dikumpul menggunakan instrumen soal selidik yang dibangunkan khas bagi kajian ini dan mempunyai kesahan dan kebolehpercayaan yang tinggi. Statistik diskriptif dan inferensi digunakan bagi menganalisis data kajian. Formula Borich diadaptasi bagi menentukan jurang dan penyusunan keperluan latihan mengikut keutamaan. Dapatan kajian menunjukkan kefahaman guru tentang KBAT dan pedagogi pemupukan KBAT adalah terhad. Terdapat keperluan latihan dalam semua kaedah/aktiviti/teknik pemupukan KBAT bagi dimensi pengetahuan dan prestasi. Sepuluh item dikenalpasti sebagai 'Keperluan Latihan Kritikal' yang perlu diutamakan bagi tujuan latihan. Dapatan juga menunjukkan tiada perbezaan signifikan antara kumpulan mengikut bilangan tahun pengalaman mengajar sains dengan 'Keperluan Latihan Kritikal'. Namun, terdapat hubungan signifikan antara tahap keyakinan dengan 'Keperluan Latihan Kritikal' dimana apabila tahap keyakinan tinggi, keperluan latihan adalah rendah. Walaubagaimanapun, ujian Regresi Berganda menunjukkan hanya kekerapan 'amalan' merupakan penunjuk yang baik bagi menentukan 'Keperluan Latihan Kritikal' (menerangkan 21.9% daripada varians). Kesimpulannya, guru memerlukan latihan dalam semua aspek kompetensi bagi memupuk KBAT dalam pengajaran sains tanpa mengira bilangan tahun pengalaman mengajar sains. Disamping itu, tahap keyakinan yang tinggi tidak semestinya bermaksud, guru tidak memerlukan latihan dalam aspek tersebut. Faktor penentu sama ada latihan diperlukan atau sebaliknya ialah kekerapan amalan. Implikasinya, dapatan kajian ini boleh menjadi maklumat penting dalam perancangan, reka bentuk, atau pembangunan program latihan dalam perkhidmatan guru.

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ANALYSES OF TRAINING NEEDS OF IN-SERVICE TEACHERS IN FOSTERING HIGHER ORDER THINKING SKILLS IN SCIENCE TEACHING

ABSTRACT

This survey study aims to analyse training needs of lower secondary in-service teachers to foster higher-order thinking skills (HOTS) in science teaching. The population of the study were lower secondary science teachers in Peninsular Malaysia. Multistage random sampling was employed and 220 respondents (a response rate of 65.3%) took part in this study. Data were gathered using a questionnaire that was specifically developed for the purpose of this study and has high validity and reliability. Descriptive and inferential statistics were used to analyse the data. Borich formula was adapted to determine the discrepancy and to prioritise training needs. Results show that teachers have limited understanding of HOTS as well as the pedagogy to foster HOTS. The finding indicates that there is a need for training in all methods/activities/techniques to foster HOTS both in knowledge and performance dimensions. Ten competency items were identified as 'Critical Training Needs' that should be prioritised for training purposes. The finding also shows that there is no significant difference between the years of teaching science experience and the 'Critical Training Needs'. However, there is a significant difference between level of confidence and 'Critical Training Needs' whereby when the level of confidence is high the training needs is low. On the other hand, Multiple Regression test shows that only the frequency of 'practice' is a good predictor for determining 'Critical Training Needs' (explains 21.9% of the variance). In conclusion, the study affirms teachers need training in all competency items to foster HOTS in science teaching regardless of years of science teaching experience. In addition, a high level of confidence does not guarantee that the teachers do not need training in that aspect. The determining factor whether training is needed or not is the frequency of practice. The implication of the study is that the findings can be important information in planning, designing, or developing training programmes for in-service teachers.

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LIST OF ACRONYM

AKEPT	Akademi Kepimpinan Pendidikan Tinggi
ANOVA	One-Way Analysis Of Variance
CTN	Critical Training Needs
CVI	Content Validity Index
EMIS	Education Management Information System
EPRD	Education Planning and Research Division, Ministry of Education Malaysia
ETeMS	English for Teaching Science and Mathematics
HOTS	Higher order thinking skills
KSA	Knowledge, skills and attitude
MWDS	Mean Weighted Discrepancy Score
NSTA	National Science Teachers Association
OECD	Organization for Economic Co-operation and Development
PISA	Programme for International Student Assessment
RECSAM	Regional Centre for Education in Science and Mathematics
SEAMEO	Southeast Asian Ministers of Education Organization
SPSS	Statistical Package for the Social Science
STIN	Science Teacher Inventory of Needs

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TENAQ	Teacher Educator Need Assessment Questionnaire
TIMMS	Trends in International Mathematics and Science Study
TNAITFHSTQ	Training Needs Assessment of In-service Teachers to Foster HOTS in Science Teaching Questionnaire'
TNAQ	Teacher Needs Assessment Questionnaire
UNESCO	United Nations Educational, Scientific and Cultural Organization

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CHAPTER 1

INTRODUCTION

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1.1 Introduction

In an attempt to gauge the quality of education using international benchmarking, an unfavourable score by Malaysian students as reflected in the recent TIMSS and PISA recognised a dire need for improved science teacher training namely, pedagogical content knowledge in fostering Higher Order Thinking Skills (HOTS). In 2013, collaboration between Ministry of Education, Teacher Training Division and SEAMEO RECSAM resulted in a national level professional development training for science, mathematics and history teachers which recognises the transmission of information about HOTS rather than promoting teachers' ability to foster HOTS in their teaching (Malaysia Education Blueprint, 2013). Improved cascade training model was implemented in stages for this purpose. As of current practice, there is no evidence of

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individual teachers' perceived training needs taken into consideration in determining the training objectives or the contents specifically in fostering HOTS in science teaching. Since teachers are directly involved in the core education process that is, student learning, teachers involvement in the planning process of the training is integral. Therefore an investigation to identify the actual needs and problems as perceived by teachers in fostering HOTS in science teaching is crucial for a successful design and implementation of an in-service training programme.

A deliberate intervention in the form of improved in-service teacher training is needed to raise Malaysian students' HOTS science-testing outcome and further reduce the gap with high achieving countries. Internationally, 43 percent of 15-year-olds, failed to meet the OECD average in science in PISA 2009+[1](Malaysia Education Blueprint, 2013). Ensuring a strong foundation in science learning at lower secondary is imperative in meeting the demand of the future workforce (Keeley, 2009, as cited in Carver, 2012). Therefore, building the capacity for teachers to deliver highly effective science lessons at lower secondary level is important.

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High competency in science content knowledge as well as HOTS is one of the determinant factors in Malaysia's journey to educational excellence. Teachers are held accountable and responsible in shaping students' competencies. A collaborative and constructivist learning environment which are conducive in fostering HOTS calls for assistance of facilitator or manager instead of instructors(Gabrscek & Roeders, 2013). Transformation of the role of teachers demands the updating, upskilling and upgrading

[1] PISA 2009+ is 2009 PISA assessment cycle when Malaysia participated for the first time in 2010. This internationally recognized assessment coordinated by OECD, conducted every 3 years evaluates proficiency in Reading, Mathematics and Science in real-world setting.

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of the teaching methods to improve on the quality of the teachers. The need for preparation to foster HOTS in aspiring teachers is addressed by teacher education programme in teacher training colleges and universities. However to prepare in-service teachers to meet the new demand, provision for an efficient, effective and relevant training programme is necessary. In-service training is recognised as central to the development of quality of the in-service teachers (Gabrscek & Roeders, 2013), as it is strongly related to change process (Hale, 1993). In-service training should take the shape as determined by its participant in order that the most learning of the most suitable type takes place (Harris, 1980). Hence, an attempt to identify existing and emerging training needs as defined by change and perceived by teachers is imperative to their effectiveness.

This research endeavours to analyse the needs of teachers in fostering HOTS in science teaching in Malaysian lower secondary level. Clarification of teachers' understanding of HOTS and fostering HOTS, in which teachers need to be trained as well as assessment of their desire or need for updating their competencies for fostering HOTS provide insight so that an effective in-service training programme can be formulated to address their concerns. This practical approach bridges the gap between teacher preparedness and teacher classroom practices to foster HOTS in science teaching.

This chapter presents the background information of the study, problem statement, research objectives, research questions, significance of research, scope and limitations of research, theoretical framework and operational definition of terms. The chapter concludes by summarising the entire chapter.

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1.2 Background of the study

HOTS has become a critical matter of concern when the performance of the Malaysian students showed an alarming decline in the international assessment. The latest cycle of published results in TIMMS, 2011 which specifically evaluates HOTS in two aspects: content and cognitive skills indicated “38 percent of Malaysian students failed to meet the minimum proficiency level in science”(Malaysia Education Blueprint, 2013, p. E-4). This figure amounts to a fourfold increase since 1999. A similar decline was also seen in PISA 2009+ which asseses the ability of applying knowledge in unfamiliar context, whereby 43 percent failed to meet the OECD average in science. Malaysia ranked 52 out of 74 participating countries, placing it in the bottom third with a mean score of 422. Comparison of mean scores indicate, 15-year-old students in Malaysia lagged behind their peers from high achieving countries like Singapore, Hong Kong, South Korea and Shanghai-China by three years of schooling as shown in **Figure 1.1**.

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3 Science

Rank	Negara	Mean score
1	Shanghai-China	575
2	Finland	554
3	Hong Kong	549
4	Singapore	542
5	Japan	539
⋮		
20	United States	502
	OECD Average	
21	Republik Czech	500
⋮		
40	Greece	470
	International Average	
41	Malta	461
⋮		
51	Thailand	425
⋮		
52	**MALAYSIA**	**422**
⋮		
65	Indonesia	383

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Figure 1.1. Comparison of Malaysia's PISA 2009+ ranking in science against other countries Reprinted from"*Malaysia Education Blueprint 2013-2025"* (p. E-6), by Ministry of Education Malaysia, Putrajaya: KPM. Copyright 2009+ by PISA. Reprinted with permission.

Benchmarking the learning of science to international standard demonstrates that Malaysian students are only able to process limited fundamental scientific concepts and are incompetent to solve contextual problems by applying scientific conceptual knowledge. In other words, Malaysian 15-year-olds face difficulties with new set of 21st century skills particularly HOTS.

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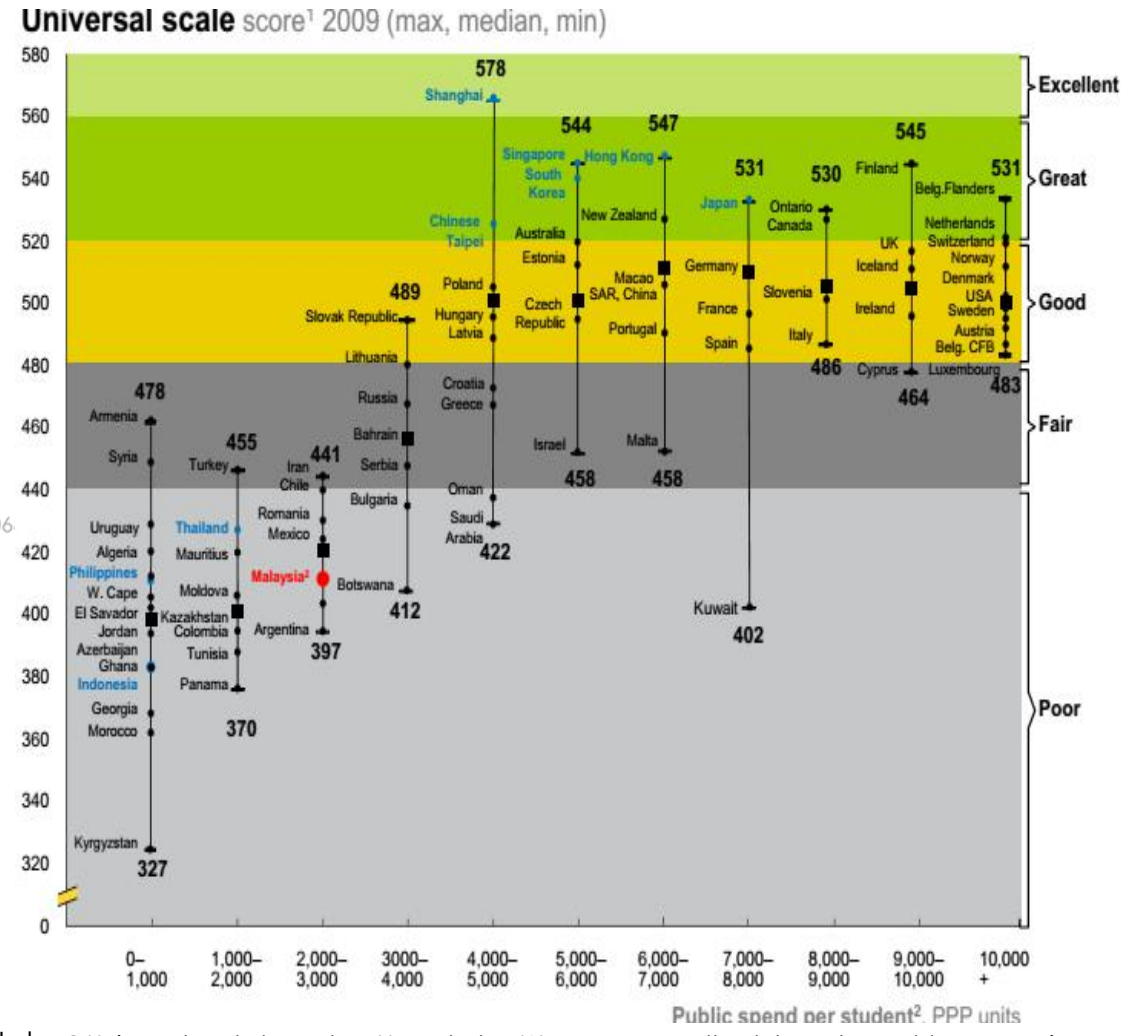
The quality of education resonated in PISA does not match the education spending of the Malaysian government. 16 percent of the federal spending in 2011 was on education (UNESCO, 2015). Even though, the education system was well-funded, students' performance fell behind the countries with similar or lower level of per student spending as indicated in the 2010 data as shown in the **Figure 1.2**.



Note: 1 Universal scale based on Hanushek & Woessmann methodology, to enable comparison across systems
2 Public spend per student for basic education (preschool, primary, and secondary school levels) for 2008 current price.
Note: Malaysia 2008 public spend is USD3000 per student

Figure 1.2. Country performance in international assessments relative to public spend per student. Reprinted from"*Malaysia Education Blueprint 2013-2025"* (p. E-8), by Ministry of Education Malaysia, Putrajaya: KPM. Copyright 2013 by World Bank EdStats; IMF; UNESCO; PISA 2009+, TIMSS 2007; PIRLS 2006; Global Insight; McKinsey & Company 2010. Reprinted with permission.

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This suggests the allocation was not directed towards the core factor that impacts student outcome such as improving teachers' pedagogical skills (Kementerian Pendidikan Malaysia, 2013). The need for training and upskilling teachers in terms of HOTS-fostering teaching strategies has become starkly evident in the years following the implementation of the Education Blue Print 2013-2025.

The need to train and upskill teachers to foster HOTS is necessary to provide access to quality education. In line with this, a revised curriculum, Secondary School Standard Curriculum (Kurikulum Standard Sekolah Menengah, KSSM) that functions as a platform to develop HOTS (UNESCO, 2015) will be launched in 2017 (Ministry of Education, 2016). This curriculum embeds knowledge and skills with the aim of training students to think and be able to make knowledge productive (Harrison & Kessel, 2004). International benchmarking will be used to align the curriculum with national examination and school-based assessment by steadily increasing the percentage of questions that test HOTS. The quality of science education will be strengthened through increased time as well as emphasis on laboratory and project-based work in student-centred and differentiated instructional environment (Malaysia Education Blueprint, 2013). The major changes in realigning curriculum and assessment system demands teachers to keep up and constantly improve practices to ensure effective implementation and assessment of HOTS.

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The greatest challenge in fostering HOTS in teaching science faced by Malaysia is teacher effectiveness (Malaysia Education Blueprint, 2013; UNESCO, 2015). According to a 2011 mini research by Higher Education Leadership Academy (AKEPT), despite meeting the professional qualifications, 70 percent of the observed lessons focused on superficial content understanding rather than analysing and

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interpreting data (15 percent) or synthesizing information (15 percent) (UNESCO, 2015). This reveals classroom practices are largely summative exam-orientated instead of fostering HOTS. Only 12 percent of the lessons were delivered effectively using best pedagogical practices, while 38 percent were sufficiently effective. Such statistics is rather worrying as the teaching workforce in Malaysia is largely young. According to Ministry of Education's Human resource statictics, 50 percent of the teachers are below 40 years old and another 30 percent are in their 40's (UNESCO, 2015). It is a matter of concern as 60 percent of the in-service teachers will still be teaching for the next 20 years (Malaysia Education Blueprint, 2013). This number also implies that during their pre-service training, teaching thinking was at its infancy stage. On the other hand, 20 percent of the teachers were already in service before teaching thinking was included in the curriculum and the likelihood of HOTS not included in their teacher preparation programme is high. Thus, they may struggle to teach in ways they have not encountered in their own learning. Noraini Othman and Khairul Azmi Mohamad, (2014) assert that despite the fact that critical and creative thinking was already been introduced in Secondary School Intergrated Curriculum in 1994, the rigorous transformational progress of thinking education only started with the introduction of the school-based assessment in 2012 where HOTS was embedded in syllabus while these teachers were in-service. Moreover in 2010, Ministry of Education Malaysia recorded 93 percent of Bachelor of Education applicants at Teacher Education Institutes failed to meet the minimum academic requirement (OECD, 2013). Low quality graduates that make up the pool of incompetent teaching force partly contribute to serious overall defect of the education quality. This recognises the need for bold measures to enhance the quality of the in-service teachers, as the quality of teachers is the determinant key factor of the quality of the education system.

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Professional development in the form of in-service training model is said to be the most cost-effective, efficient and systematic measure (Amir, 1993) to bring change not only to teachers' belief and attitude, but also teachers' classroom practices (Jones & Lowe, 1990). Researchers agree that in-service training is a conventional approach for education improvement, as the considerable changes generated by in-service training, impact student outcome (Amir, 1993; Gyamfi, 2003). Teachers' understanding and knowledge in fostering HOTS is very limited. This lack, in view of the non existence of an education or training that really meets the needs of science teachers to foster HOTS makes the situation much more pressing (Noraini Othman, 2014). The overarching aim of teachers fostering HOTS in teaching science is teachers' HOTS learning/training (Leou, Abder, Riordan, & Zollar, 2006) in order to produce HOT students. Thus, in-service training is imperative for science teachers to foster HOTS in their practice at lower secondary level to optimize student learning. Science teachers' competencies in fostering HOTS need to be improved to address the demand of the education system to align with new teaching methodologies, assessment strategies and classroom management practices. Hence, in-service education must be custom-designed to provide teacher with experiences to maximize acquiring of new skills and knowledge of the most appropriate type to improve their competencies in fostering HOTS.

Typically, the objectives and content of in-service training is a decision handed down from above. Nevertheless, optimal learning takes place through active involvement (Libermann, 1995). That is to say that teachers would consider change seriously, if they actively participate in identifying educational problems and needs they face and decide the ways to solve them. As adult learners, the autonomy in decision-making gives a sense of ownership of what they have helped in producing (OECD,

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