SCIENCE/MATHEMATICS LOCUS OF CONTROL OF MALAYSIAN SCIENCE/MATHEMATICS EDUCATORS: IMPLICATIONS TO TEACHER-TRAINING PROGRAMMES

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The science/mathematics locus of control orientation of science/mathematics teachers is their belief about whether the outcomes of their actions as teachers are dependent on what they do or think they can do (internal control orientation) or on events outside their personal control (external control orientation). As revealed in many educational researches, locus of control has great influence on our beliefs, motivation, expectations, self-esteem, risk-taking behaviour, and even on the actual outcomes of our actions. Some studies suggest that what underlies the internal locus of control is the concept of "self as agent." This means that our thoughts control our actions and that when we realize this executive function of thinking we can positively affect our beliefs, motivation, academic performance, and career aspirations and objectives. This study sought to assess the science/mathematics locus of control of Malaysian science/mathematics teachers and how this locus of control was influenced by their participation in a seven-week science/mathematics teacher training programme at RECSAM. Respondents in the study included 209 science teachers and 124 mathematics teachers from all over Malaysia who were following through RECSAM's in-service teacher training programmes conducted in three different batches during the period from 28 January 2001 to 28 July 2001. Implications of the results of the study are discussed with respect to the design and implementation process of future teacher training programmes for Malaysian educators to be conducted at RECSAM to enhance quality and to achieve a better profile in terms of pedagogical innovation.

INTRODUCTION

RECSAM, an acronym that stands for Regional Centre for Education in Science and Mathematics, is one of the ten organisations that subsumes under the Southeast Asian Ministers of Education Organisation (SEAMEO), an intergovernmental organisation established in 1965 among governments of Southeast Asian countries to promote cooperation in education, science, and culture in the region. Based in the beautiful Island of Penang, Malaysia, RECSAM has been mandated in its mission to be committed to nurturing and enhancing the quality of science, mathematics, and technology education in SEAMEO Member Countries which include Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. In line with its mission, RECSAM constantly strives to design innovation and challenging training programmes as well as activities that address the needs of science and mathematics teachers and teacher educators in SEAMEO Member Countries.

RECSAM conducts its regular SEAMEO Regional In-service Training Courses for key science and mathematics educators from the SEAMEO Member Countries. As of the time of writing, RECSAM is now operationalising the training programmes as documented in the Programmes and Activities for the 7th Five-Year Plan (July 2000- June 2005). Apart from these RECSAM-supported regional training courses, RECSAM also undertakes customised courses that are tailored to the training needs of the SEAMEO Countries and beyond. For the customised courses, these are basically fee-paying in the sense that the requesting parties support fully the expenses incurred. The major customised courses are (i) Malaysian Customised Course (Cohorts 1-8) which has ended in 2000 where 1320 teachers were trained; and (ii) World Bank Customised Course (Cohorts 1-8) which saw to its final intake of Cohort 8 in Sept 2001 with an overall total of 1,170 teachers having been trained then.

With its role to train science and mathematics Malaysian teachers, RECSAM was also tasked by the Malaysian Ministry of Education, among others, the following expectations:

1. To encourage innovation and excellence in science and mathematics education at primary and secondary levels;

2. To elevate the quality level of teaching and learning to that of a higher prestige, particularly in rural and suburban schools;
3. To equip teachers with the research-based and research-validated approaches which could optimise the democratisation of education in terms of learning opportunity; and
4. To familiarise teachers with the use and integration of ICT that enhances problem solving ability and promotes higher order thinking skills.

To achieve the above objectives, RECSAM designed the courses in a way that will respond to these expectations. The course supervisors brainstormed and prepared course outlines that reflect the course objectives. Likewise course content delivery was conducted in such a manner that will widen the participants' perspectives to contemporary views of teaching and learning. One of the personality constructs that might be influenced in this training is the locus of control.

Locus of control is a personality construct referring to an individual's perception of the locus of events as determined internally by his/her own behaviour vs. external circumstances, fate, or luck. People who believe their rewards and punishments are due to their own behaviour, character, and efforts are said to have an internal locus of control. On the other hand, people who believe their rewards and punishments are controlled mainly by outside forces or other people are said to have an external locus of control.

The science/mathematics locus of control orientation of science/ mathematics teachers is their belief about whether the outcomes of their actions as teachers are dependent on what they do or think they can do (internal control orientation) or on events outside their personal control (external control orientation). Research literature revealed that locus of control has great influence on our beliefs, motivation, expectations, self-esteem, risk-taking behavior, and even on the actual outcome of our actions (Riechard & Peterson, 1998; Post & Robinson, 1998; Froelich, 1996; Wehmeyer & Kelchner, 1996; McClun & Merrell, 1998). Studies have further shown that people who have an internal locus of control are able to achieve more in school. They are also able to delay graftification, are more independent, and are able to cope with various stresses. An internal locus of control is one of the qualities that is helpful for gaining the persistence to achieve in school—and in life (Landine & Stewart, 1998; Onwuegbuzie & Daley, 1998; Gama & Jesus, 1997; Solomon, 1997; McLean, 1997; Rimm, 1997; Hart et al., 1997; Karnes & McGinnis, 1996; Thomas, 1993).

Some research (McCombs, 1991, cited in Locus of Control, [On-line]) suggests that what underlies the internal locus of control is the concept of "self as agent." The self agent can consciously or unconsciously direct, select, and regulate the use of all knowledge structures and intellectual processes in support of personal goals, intentions, and choices.

Motivated by the need to find out how the science/mathematics locus of control of the teacher participants was influenced by their participation to the seven-week teacher training, we conducted this study. This perspective has led us to address the following questions in our research:

1. What is the science/mathematics locus of control orientation of Malaysian science/mathematics teachers before and after they have participated in the seven-week training at RECSAM?
2. How do male and female Malaysian science/mathematics teachers differ in their science/mathematics locus of control before and after the training?
3. How is the science/mathematics locus of control orientation of Malaysian science/mathematics teachers influenced by their participation in the seven-week science/mathematics teacher training programme at RECSAM?

Hypotheses

The following hypotheses were tested in this study:

1. Male and female Malaysian science/mathematics teachers do not differ significantly in their science/mathematics locus of control orientation before and after the training.
2. There is significant difference in the science/mathematics locus of control of science/mathematics teachers before and after their participation in the seven-week science/mathematics teacher training programme at RECSAM.

Context of the Study

Situated in the South East Asia and one of the fast-developing countries, Malaysia is gearing towards becoming an industrialized nation by the year 2020: economically strong, dynamic, viable, and resilient. Concurrently, it is hoped that by then, Malaysia will also be a united country where her multi-racial society with diverse races living side by side harmoniously, displaying high moral and ethical values, and experiencing a caring climate. These aims, hopes, and wishes within the context of the proposed nine central strategic challenges, namely, (i) establishing a united Malaysian nation, (ii) creating a psychologically liberated Malaysian society, (iii) developing a matured democratic society, (iv) establishing a fully moral and ethical society, (v) establishing a matured liberal and tolerant society, (vi) establishing a scientific and progressive society, (vii) establishing a fully caring society, (viii) ensuring an economically just society, and (ix) establishing a prosperous society, are tangibly documented in "VISION 2020" by the visionary Prime Minister of Malaysia, YAB Datuk Seri Dr. Mahathir Mohamed who strongly believes that this marvelously architectured "VISION 2020" will materialize if each and every Malaysian is cooperative. As he beautifully phrases it: "This is not a big dream that we are aiming for. It is a vision that can be achieved, provided that we cooperate" (Abu Hassan Adam, 1991, p.3).

Hence, Malaysia, with the land area of 329,758 square km and 1998-estimated population of 22.18 million, gives prominence to the role of education in building its critical mass and human workforce for the 21st Century. While Table 1 depicts the number of teachers by level of training in Primary Schools for 1999, Table 2, on the other hand, shows the number of teachers by level of training in Secondary Schools for 1999.

Table 1
Number of Teachers by Level of Training in Primary Schools for 1999

	University	College	Untrained	Total
National		111,755	1,800	113,555
National Type (Chinese)		31,676	1,865	33,541
National Type (Tamil)		5,229	669	5,898
SPECIAL DELIVERY		480	6	486
Total		149,140	4,340	154,480

Table 2
Number of Teachers by Level of Training in Secondary Schools for 1999

	University	College	Untrained	Total
Regular	57,658	36,907	3,905	98,470
Fully Residential	2,223	334	4	2,561
Religious	1,833	570	39	2,442
Special	73	53	-	126
Vocational	113	35	2	150
Technical	2,672	2,283	58	5,014
Total	64,572	40,182	4,008	5,013

Source:
Educational Planning and Research Division. (April, 2000). Malaysian Education Statistics: Quick Facts. Kuala Lumpur: EPRD, Ministry of Education Malaysia. Page 9.

Malaysian Smart School Project

The Malaysian Government has also conceptualized 7 Multimedia Super Corridor (MSC) Flagship Applications, which include The Malaysian Smart School. In the early 1996 as a response to this, The Malaysian Ministry of Education (MMOE) held intense discussion about the concept of "Smart Schools" and its implications for the Malaysian education system. The conceptual model, as described in "The Malaysian Smart School: A Conceptual Blueprint" (1997a), defines a Malaysian Smart School as:

> *"... a learning institution that has been systematically reinvented in terms of teaching-learning practices and school management in order to prepare children for the Information Age. A Smart School will evolve over time, continuously developing its professional staff, its educational resources, and its administrative capabilities." (p. 10).*

Hence, MMOE aspires to gradually transform the Malaysian secondary schools to that of SMART schools. In its "The Malaysian Smart School Implementation Plan" (1997b), the MOE envisions that 90 schools shall feature the characteristics of the Smart School Model by January 1999 in the "pioneer" stage. Based on the lessons learnt and feedback gathered from the 90 pilot schools, a structured and accelerated programme will then be used for "broad deployment" for the remaining schools (about 8,500) throughout the country. It is planned that the broad deployment to all schools, be it secondary or primary, is spread over eleven years, beginning in 2000 through 2010. Guided by the principle of democratization and working with budget constraint, a strategy has been worked and designed whereby deployment of technology, even at its lowest level, the teaching-learning benefits will exceed that which exists currently.

The notable distinct feature of the Smart School will be teaching and learning environment built on international best practices in primary and secondary education. Therefore, the guiding principles in teaching and learning concepts entail realigning the following aspects: (i) curriculum, (ii) pedagogy, (iii) assessment, and (iv) teaching and learning materials.

Information Technology (IT) is significantly emphasized to prepare students for the challenges of the Information age. IT literacy is defined in the Conceptual Blueprint (1997a, p. 37) as the ability to use IT tools and IT sources to:

1. collect, analyse, process and present information
2. support, meaningful learning in a variety of contexts
3. prepare for working life

Nevertheless, a study by Kong & Lee (1998) of Curriculum Development Centre, MMOE reports that the IT proficiency among secondary school principals has yet to attain an encouraging level. With a sample of 66 secondary school principals who attended the sessions on "The Preparation for Implementation of the Smart Schools" in June 1998 and using "1997-1998 Self Evaluation Rubrics for Staff Use of Technology" developed by Bellingham Public School (1998) as the instrument, the results indicate that the percentages of the respondents achieved IT proficiency are 29% at Level 1 (without any proficiency in using computers), 68% at Level 2 (with limited proficiency), 3% at Level 3 (proficient in using computers), and none at Level 4 (with high proficiency). This revelation emerges despite the implementation of many IT projects in Malaysian schools prior to the Malaysian Smart School Project.

Malaysian Teachers

Malaysia is truly a nation of ethnic variety offering a kaleidoscope of culture and lifestyle. Malays number around half of the total population of over 22 million, while the other half comprises Chinese, Indians, Ibans, Kadazans, and other ethnic groups. Bahasa Malaysia is the national language with English being taught as the second language. Islam is the national religion, but freedom of worship is guaranteed and enshrined in the Malaysian Constitution.

There are two categories of teachers in terms of academic qualification. The non-graduate teachers are those that went into pre-service training with either SPM ("O" Level equivalent) or STPM ("A" Level equivalent) qualification. The graduate teachers, on the other hand, are those either entered the pre-service training with a university degree or direct entry into teaching profession upon securing a degree with education component incorporated. However, all serving teachers would have gone through a general educational foundation in which values have been deliberately infused in the curriculum. The 16 values that have been stipulated in the Smart School curriculum are: Compassion, Self-Reliance, Respect, Love, Freedom, Courage, Physical and Mental Cleanliness, Cooperation, Diligence, Moderation, Gratitude, Rationality, Public Spiritedness, Humanity, Honesty, and Justice.

The Training of Teachers

The Malaysian Ministry of Education realises that the successful implementation of the Smart School Project and the attainment of the Ministry's objectives can only be achieved through retraining of teachers. In its efforts to increase the content knowledge and pedagogical efficacy of science and mathematics teachers, the Malaysian Ministry of Education has put the training responsibility on RECSAM. Hence, findings of this study would be of great significance with respect to the design and implementation of future teacher training programmes to be conducted at RECSAM.

METHODOLOGY

Respondents

The respondents in this study were the 209 science teachers and the 124 mathematics teachers from all over Malaysia who were following through RECSAM's in-service teacher training programmes conducted in three different batches: 29 January to 17 March 2001, 2 April to 19 May 2001, and 11 June to 28 July 2001. The science teachers attended the first two batches while the mathematics teachers attended the last batch.

Data Gathering Instruments

The science locus of control and the mathematics locus of control instruments were adapted from the science locus of control instrument developed by Lopez, C. Jr. (1997). Both instruments were translated to Bahasa Melayu Language. The internal consistency index of the science locus of control and the mathematics locus of control instruments were established using the Cronbach alpha. The science and mathematics locus of control instruments have Cronbach alpha values of 0.59 and 0.61 respectively. Both instruments consist of five dimensions or factors. The factors include:

1. understanding science/mathematics principles and concepts,
2. making decisions in science/mathematics related concepts and activities,
3. academic achievement in science/mathematics
4. understanding and explaining science/mathematics ideas, and
5. interpreting science/mathematics message through media.

Additional data source included transcripts of interviews with the course supervisors.

Procedure

The science locus of control and the mathematics locus of control instruments were each administered at the beginning and at the end of the seven-week teacher training programmes. Data were then collated and analysed using the SPSS for Windows Package.

Descriptive statistics such as mean and frequency count were used to describe the science/mathematics locus of control of science/mathematics teachers before and after the training programme they have attended. To test the hypotheses, chi-square and Wilcoxon signed rank test were used. Significance levels were all set at .05. Results of quantitative analyses were validated using the data obtained from interviews with the course supervisors.

Results

Table 3 below shows the science/mathematics locus of control orientation of Malaysian science/mathematics teachers before and after they have participated in the seven-week training at RECSAM.

Table 3

Distribution of Teacher Participants When Classified According to Their Locus of Control Orientation Before and After the Training Programme

		Frequency	
Group	n[a]	External	Internal
		Science Locus of Control	
Male	101		
Before		48	53
After		45	56
Female	100		
Before		46	54
After		45	55
		Mathematics Locus of Control	
Male	75		
Before		31	44
After		35	40
Female	47		
Before		26	21
After		13	34

[a] number of participants in each group who completed all questionnaires

To determine whether there is any difference between the locus of control orientation among male and female participants, the chi-square test was used. Among the science teachers, there is no significant difference in the science locus of control between male and female participants before the training, χ^2 (1, 201) = .047, p = .829. Similarly, at the end of the training, male and female participants do not differ significantly in their science locus of control, χ^2 (1, 201) = .004, p = .949.

On the other hand, among mathematics teachers, there is no significant difference in the mathematics locus of control among male and female participants before the training, χ^2 (1, 122) = 2.270, p = .132. However, after the training, male and female mathematics teacher participants differ significantly in their mathematics locus of control, χ^2 (1, 122) = 4.374, p = .036. Female mathematics teachers became more internal in their locus of control orientation as compared to their male counterparts.

A Wilcoxon test was conducted to evaluate whether the participants changed significantly in their locus of control orientation after attending the seven-week teacher training programme. Among the science teachers, the results indicate no significance difference, Z = -1.812, p = .070. The mean of the ranks where the locus of control scores after the training are less than the scores before the training is 81.30, while the mean of the ranks where the locus of control scores after the training are greater than the scores before the training is 90.73.

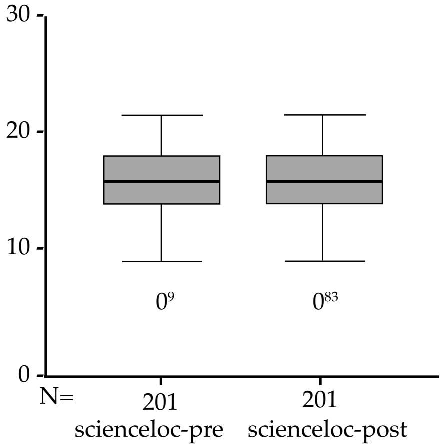

Figure 1: Distributions of science locus of control scores of teacher participants before and after the seven-week training.

However among mathematics teachers, the results reveal a significant difference, $\underline{Z}$ = -2.146, $\underline{p}$ = .032. The mean of the ranks where the locus of control scores after the training are less than the scores before the training is 50.67 while the mean of the ranks where the locus of control scores after the training are greater than the scores before the training is 59.91.

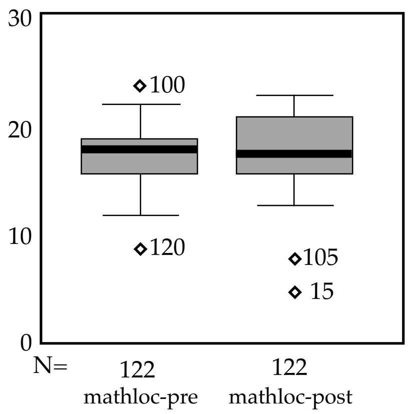

Figure 2: Distributions of mathematics locus of control scores of teacher participants before and after the seven-week training.

CONCLUSIONS

The results of the study indicate that mathematics teacher participants have become more internal in their locus of control orientation after their participation in the seven-week teacher training at RECSAM. This implies that mathematics teacher participants have begun to see themselves as responsible for being able to attain or not to attain their teaching goals. They now believe that they can have impact on the learning of their students. On the other hand, although a non-significant change is observed among science teachers, a cursory look at the frequency count shows that a few of the teachers have become internal in their locus of control orientation after attending the training. Hence, measures should be taken in the design and conduct of future training courses to impact more on how the participants see themselves as agents of change in the teaching learning process. This is clearly articulated in the views of one of the mathematics course supervisors:

When I planned the course, my main goal was not only for the participants to learn some new knowledge but that these knowledge should transform them...the knowledge that they received will make each of them a different teacher compared to what they were, before they came to the course and make them better teachers...What I did in the course, and I think what most lecturers did also, was to show them the pedagogy that they are supposed to use in teaching. I showed them the value of this pedagogy and how this pedagogy will help their students learn...What I did in most of my interaction with them was to show how these approaches are conducted in the classroom and let them be in-charge for themselves, even the difficulties they would face when they use these approaches...I tried not to really force upon them these approaches...what I did after they have seen these approaches was to evaluate these through their experiences...Along the way, I guided them to see the real value of these approaches...The approaches will only be able to reach their potential when the teachers themselves believe in these approaches...when they really get interested...Accumulating knowledge is not enough...they must really see the value of the knowledge they get from the course. Once they see the value, the power, or the potential of the knowledge they got, I think that's when this knowledge will have its effect.

Implications to Teacher Education, Teacher Training Programme Reform, and Research

Teaching places much demands on teacher. Embedded in the science and mathematics education community's reform efforts is a belief that rigorous standard backed by quality curricula ad effective teaching—often identified as inquiry approach and student-centered-will translate into robust learning and high levels of achievement for all students. Thus, the more the teacher can cultivate an attitude of seeing himself as responsible for the outcomes of his actions, the greater is the chance of achieving his goals in teaching.

What we want of teachers is for them to be reflective of their teaching practices. An important characteristic of reflective teachers is that they consider why they do what they do (McKay, 2002, p. 1)

In their everyday teaching, teachers are constantly making decisions: how the topic should be introduced, whether or not to change the order of the activities already in the lesson plan, whether or not to change the activities that had planned, and a lot more. Often these decisions are influenced by their reflections on what happened in previous classes they have taught.

By being reflective, it frees teachers from routine behaviour (McKay, 2002, p. 5). Teachers are no longer teaching the lesson in a way what the textbook says. Rather teachers are presenting the lesson in a particular way for a specific reason. In deciding the way to teach the lesson, the teacher often considers several factors such as background and interest of the students, the goals of the curriculum, and the teaching time available. Considering these factors when teaching often results to effective teaching practice.

As researchers, the study created an opportunity for us to think more critically about our own teaching and research. Results of the study provided us a way to critique our experiences in the conduct of the teacher training programme at the Centre. This has led us to pose several questions in our ongoing research and development efforts, including: What can be done to encourage teacher participants to be more reflective of their teaching practices? What sort of activities and relationship are needed to develop teachers who are critical learners? How might the research culture at the Centre be influenced in the struggle to produce reflective teachers?

The challenge that lies before us is creating ways to practice science and mathematics teacher training reforms that are generated and critiqued through reflective teacher-learning communities. For it is said, "a teacher affects eternity; he can never tell where his influence stops." (Adams, cited in Freeman, 1998).

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