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Eurasia Journal of Mathematics, Science and Technology Education

Volume 2, Number 2, July 2006

WHAT MALAYSIAN SCIENCE TEACHERS NEED TO IMPROVE THEIR SCIENCE INSTRUCTION: A COMPARISON ACROSS GENDER, SCHOOL LOCATION AND AREA OF SPECIALIZATION

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ABSTRACT. This research looks specifically at the perceived needs of secondary school science teachers in Malaysia so that subsequent effective in-service programmes can be planned and implemented. The prime aim of this cross-sectional survey study is to ascertain the perceived needs of 1,690 practicing secondary school science teachers, characterized by gender, school location, and area of specialization. The main instrument used is a questionnaire. The validity and reliability of the instrument were systematically established through relevant test procedures. The questionnaire seeks feedback on the eight dimensions of science teachers' needs: generic pedagogical knowledge and skills, knowledge and skills in Science subjects, managing and delivering science instruction, diagnosing and evaluating students, planning science instruction, administering science instructional facilities and equipment, integration of multimedia technology and the use of English language in science instruction. Data were descriptively analyzed, followed by a series of chi square analysis. Results of the descriptive analysis demonstrate that the most prevalent needs of the Malaysian secondary school science teachers are the integration of multimedia and the use of English in science instruction. When measures of association were gauged between the science teachers' needs and the independent variables, it was found that significant associations exist. The associations were apparent between most of the dimensions of science teachers' needs and school location.

KEYWORDS. Malaysian, Science Teachers' Needs, Gender, School Location, Area of Specialƨzation.

INTRODUCTION: CONTEXT OF THE PROBLEM

Analysis of the historical panorama of Science education in Malaysia leads to the conclusion that science curriculum innovation is continuously in the state of flux. To date, continuous modification has been planned and hence implemented to suit the current national as well as global needs (Kamisah, 1999). Lee (1992) argues that such innovation is triggered by the interface between internal affairs and external global factors, which leads to the production of a

ISSN: 1305-8223

local made science curriculum. This curriculum is not only recognized in Malaysia, but is also accepted in the international arena. Compared to the other subjects in the curriculum, changes in the science curriculum occurred at a much faster pace. This is due to significant impact created by science and technology advancement of human civilization. As a result, to keep abreast with the changes, science teachers must be well-equipped with the necessary knowledge and skills so that what is outlined in the curriculum is being realized in the classroom. In other words, science teachers must deliver their lesson effectively as envisaged in the curriculum.

As a transmitter of knowledge, skills and values to the mass population, teachers in Malaysia or in any other parts of the world, are always considered as the nation's greatest asset. As such, teachers must be able to play their roles and fulfill their responsibilities to their utmost capabilities. To be able to do so, teachers must be well prepared for the profession and at the same time maintain and improve their skills through lifelong career learning. Support for their well being and professional development should therefore be an integral and essential part of the efforts made to raise the standard of teaching and learning, and students' achievement. At the same time, teachers must also inculcate in their students dispositions towards lifelong learning and skills required in facing the upcoming national and global challenges. As a role model, teachers must first exhibit their commitment and enthusiasm towards lifelong learning.

Currently, the situation in Malaysia does not only call for the need to equip teachers with the necessary knowledge and skills per se, but includes tackling issues pertaining to the quality of teaching and learning Science. Arguably, Malaysia, like many other countries in the world (e.g. Pakistan, Australia, New Zealand, United States of America and Britain) is confronted with the problem of inadequate trained science teachers especially in the teaching of Physics, Chemistry and Mathematics. As such, teachers of various educational backgrounds teaching science subjects were common in most schools. As a result, teachers with various subject majors' background are often required to teach science subjects which they are not trained for. Though these teachers might have used various kinds of coping strategies in their teaching, they are in dire need for in-service training courses in order to teach science meaningfully and effectively whilst filling the gaps of content knowledge and pedagogical content knowledge in the subject that they are required to teach (Subahan, Lilia, Khalijah and Ruhizan, 2001). Arguably, as documented in the literature, this situation is also overwhelming in many developed countries such as in the United States of America and United Kingdom since the mid 1980s (Millar, 1987).

It has been argued elsewhere that effective in-service training programmes should include program development and orientation geared towards meeting the stated needs of the teachers' concern (Amir Salleh, 1993). Nevertheless, to date, there is only one comprehensive study conducted by Kamariah (1984) on the perceived needs of Malaysian secondary school science teachers. Based on a total of 1,330 samples, it was concluded that the most prevalent need of science teachers then was providing for students' safety in the science laboratory. It could therefore be argued that science teachers' perceived needs, as identified by this study, is in contrast to the current accepted view of priority needs which lead to effective science teaching; viz. developing students' understanding and creating meaningful learning (Harlen, 1996). Thus, it is timely that another comprehensive assessment of the perception of the professional needs of secondary school science teacher's be conducted. Craft (1996), Day (1999) and Parkinson (2004) concur by negotiating that the first step in designing a curriculum for continuous professional development is revelation and assessment of teachers' needs. In a similar vein, Baird and Rowsey (1989), based on their survey of secondary school science teachers needs conclude that without accurate data on teachers' needs, planning is not only difficult, but results generated are likely to be disappointing to both teachers and those who offer in-service courses.

Baird and Rowsey (1989) also highlight teachers' complaints that much time spent during in-service programmes and activities had been wasted where such programmes were not applicable in meeting their respective classroom needs.

Another significant point is that those who teach science at secondary school level are from diverse groups and thus require different needs. High quality in-service programmes designed to meet the perceived needs of science teachers are necessary if teachers are to respond and benefit from staff development programmes.

NEEDS ASSESSMENT MODEL: A RETROSPECTIVE

Analytical scrutiny of needs assessment model used in educational research indicates the availability of a variety of models such as Discrepancy Model (Sweigert and Kase (1971), System Model and Organizational Needs Model (Kaufman (1972), and Marketing Model (Kotler (1982). Based on his conception of training needs as "…a discrepancy between an educational goal and trainees performance in relation to this goal", Borich (1980; p.40) proposes another needs assessment model known as the Borich Needs Assessment Model. This model primarily focuses on (i) underlining the competencies, (ii) surveying the in-service teachers, (iii) ranking competencies, and (iv) comparing high priority competencies with training programme content. Although Borich's (1980) model is widely used in determining the science teachers' needs, Witkins (1984) contends that there is no "best" or single universally accepted model of needs assessment in the educational field since its choices, procedures as well as instrument used to gauge the needs will depend on the purpose and context of the assessment study.

Reviews on empirical studies on science teachers' needs and the development of procedures for identifying and categorizing science teachers' needs have been a major educational agenda since the 1970s. The evolution of science teachers' needs instrument inaugurated with the development of Moore Assessment Profile (MAP) was further refined by Blakenship and Moore (1977) and Rubba (1981). Eleven years later, Kamariah, Rubba, Tomera and Zurub (1988) established the Science Teacher Inventory of Needs (STIN) which classify the science teachers' needs into seven categories. The STIN was widely used primarily in Jordan and in Malaysia. STIN was further used and contextually refined by Baird and Rowsey (1989) by comprehensively administering the instrument to 1,870 science teachers across Alabama. In 1993, once again STIN was used by Zurub and Rubba in identifying the needs of 1,507 rural science teachers in Arkansas, Illinois, Oklahoma, Kansas, Tennessee and Texas. Until recently, the needs of the science teachers is still a major national agenda as evidenced in Dillon, Osborne, Fairbrother and Kurina (2000) and State of Delaware study (2002).

It could be synthesized that from all the needs assessment study highlighted, its major outcome is the identification of contextualized, science teachers' needs. In Malaysia, a needs analysis study was initiated in an effort to establish empirical evidence of the science teachers' needs in meeting the challenges of science education. In 1984, Kamariah first undertook a national needs assessment study to ascertain the needs of Malaysian science teachers five years after the implementation of the New Integrated Science Curriculum for Secondary Schools. At the primary level, currently there is only one comprehensive study conducted by Mohamad (2002). These studies therefore served as a point of departure for this paper, which specifically focuses on the identification of the secondary school science teachers' needs in Malaysia.

AIMS OF THE STUDY

The main aim of this study is to identify the most prevalent needs of Malaysian secondary school science teachers in keeping themselves abreast with the current demands in teaching and learning science. This is essential so as relative measures can be undertaken to prepare teachers in meeting with these local challenges as well as confronting issues of globalization. This study also seeks to identify existing associations if any, in the science teachers' needs across gender (male, female), geographic regions change to school location (rural, urban) and area of specialization (physics, chemistry, biology).

RESEARCH METHODOLOGY

Research Design

The research design employed in this study is a cross-sectional survey using a questionnaire as the prime instrument. The survey design is chosen so that generalizations can be made from the samples representing the population (Creswell, 2005; Kerlinger and Lee, 2002). Neuman (2000) argues that such an approach can be justified in terms of the nature of information gathered. This study garnered information on the Malaysian science teachers' needs based on gender, school location and area of specialization. The nature of such data justifies the suitability of the survey design employed.

The Samples

The population of this study comprised practicing science teachers in all secondary schools in Malaysia. Using the research questions developed as points of reference, a stratified random sampling of respondents was made, taking these factors into consideration; gender of the respondents (male vs. female), geographical location of the schools involved (rural vs. urban) and the respondents' area of specialization (physics, chemistry, biology, science and mathematics). As a result, 1,690 science teachers were randomly selected as respondents for this survey. Table 1 summarizes the demographic data of the science teachers who participated in this study.

Table 1: School Location by Gender and Area of Specialization

School Location		**Area of Specialization**					
		Physics	Chemistry	Maths	Biology	Science	Others
Urban	Male	31	35	32	33	25	30
	Female	63	132	83	186	57	81
Rural	Male	38	39	39	29	43	57
	Female	58	97	99	165	76	111

As displayed succinctly in Table 1, almost 85.9% of the teachers in the urban areas are science majors compared to only 80.2% in the rural areas. For both locations, most of the teachers are majoring in biology (urban = 219; rural = 194) and the least number of teachers are majoring in physics (urban, n = 94; rural, n = 96). Nonetheless, there are about an equal percentage of teachers majoring in chemistry and mathematics both in the rural and urban areas. The percentages of teachers who are not majoring in science in urban and rural areas are 14% and 19.7% respectively.

Analysis across gender shows that most of the male respondents are physics (n = 69), chemistry (n = 74), mathematics (n = 71) or biology (n = 62) teachers. This is evidenced by the almost equal number of male science teachers majoring in all those four subjects. On the other hand, most female respondents are biology teachers (n = 351), followed by chemistry (n = 229), mathematics (n = 182), and physics (n = 121). On examination, it was also found that almost 20.0% of male respondents and 15.8% of female respondents are not majoring in Science. When the distribution of science teachers is examined across school location, it was found that the ratio of male to female teachers in both rural and urban schools is about 1 to 3.5. From the ratio, it could be inferred that for both urban and rural areas, there are more female compared to male teachers. It was also found that only 14.0% of science teachers in the urban schools are not Science majors. In contrast, the percentage is slightly higher in rural areas with almost 20.0% of science teachers who taught in rural schools were not majoring in Science.

THE INSTRUMENT

Primarily, the term science teachers' needs used in this study is defined as "…a conscious drive, or desire on the part of the science teacher, which is necessary for the improvement of science teaching" (Moore, 1977; p. 145). The needs analysis instrument used in this study is developed by using the Science Teacher Inventory of Needs (STIN) developed by Zurub and Rubba (1983) as its main reference. Items were carefully and collectively crafted, which reflect the current needs of the secondary school science teachers in Malaysia. The overall process of item development involved five main stages. Firstly, the existing perceived needs sub-scales were consecutively reviewed. Secondly, a thorough review and analysis of the needs literature were conducted. Thirdly, in order to identify the needs of science teachers, structured interviews were conducted which involved eight experienced science teachers across the country. The interview data were used as background information in constructing the needs items. Fourthly, a panel of experts in the area of science teaching representative of biology, chemistry and physics were engaged to add, edit, or eliminate irrelevant items from the initial pool of items.

At the final stage of items construction, the instrument was validated by having teachers and lecturers review the items with respect to its readability, clarity and ease of response. Instructions or items that were equivocally stated were identified and improvements were made. The final version of the instrument consists of two sections. Section one seeks information on the demographic characteristics of the respondents, while section two consists of 72 items pertaining to in-service needs of the science teachers. These needs can be categorized into eight distinct dimensions: (i) management of science lessons, (ii) diagnosing and evaluating students, (iii) generic pedagogical knowledge and skills, (iv) knowledge and skills in Science subjects, (v) managing science facilities and utilities, (vi) planning science instruction, (vii) integrating multimedia technology in science instruction and (viii) using English language in science instruction. Each item constitutes a statement, which is followed by a three-point Likert scale ranging from (1) not needed to (3) greatly needed. Table 2 summarizes the distribution of items according to the dimensions identified.

Table 2: The Distribution of Items for Each Dimension of Science Teachers' Needs

Dimension	No of Items	Item Distribution
Management of science instruction	16	B11, C16, C19, C22, C23, C24, C27, C29 C31, C32, D33, D34, D35, D37, A38, A39
Diagnosing and evaluating students	11	A1, A2, A3, A4, A5, A6, A7, A8, B9, B10, C28
Generic pedagogical knowledge and skills	14	F57, F58, F59, F60, F61, F62, F63, F64, F65, F67, F68, F69, F70, F71
Knowledge and skills in science subjects	7	F50, F51, F52, F53, F54, F55, F56
Administering science instructional facilities and equipment	10	D36, E40, E41, E42, E43, E44, E45, E46, E47, E49
Planning activities in science instruction	8	B12, B13, C14, C15, B17, C21, C25, C26
Integration of multimedia technology in science teaching	4	C18, C20, E48, F72
Use of English language in science teaching	2	C30, F66

Reliability and Validity of Instrument

Reliability of the needs instrument was established by employing the internal consistency (Cronbach Alpha) approach. Based on Table 3, the alpha values range from .674 to .953. In discussing item reliability, score variability, item homogeneity and test length are three main issues commonly associated with it (Anastasi, 1982; Youngman, 1979). It was found that, the number of items for each dimension did not have any significant impact on the reliability index. For instance, the alpha value generated from planning activities in science instruction dimension (n = 8) is not much different from the alpha value generated from diagnosing and evaluating students dimension (n = 11). Based on the alpha values generated and the heterogeneous nature of the samples who participated in the study, it could be argued that the heterogeneity of scores is obtained. To summarize, a higher value of reliability index is demonstrated due to score heterogeneity caused by a balanced distribution of science teachers with respect to independent variables that characterized them (see also Table 1).

Table 3: The Reliability Coefficients of the Science Teachers' Needs Assessment Instrument

Dimension	No of Items	Alpha Coefficient
Management of science instruction	16	0.953
Diagnosing and evaluating students	11	0.909
Generic pedagogical knowledge and skills	14	0.861
Knowledge and skills in science subjects	7	0.900
Administering science instructional facilities and equipment	10	0.878
Planning activities in science instruction	8	0.902
Integration of multimedia technology in science instruction	4	0.830
Use of English language in science instruction	2	0.674

It is almost axiomatic that the choice of validation mechanism will primarily depend on the purpose of the test scores (Anastasi, 1982). The same test, when employed for different purposes should be validated in rather different ways. Considering the main function of the instrument developed in this study, it was reckoned that the most suitable approach for establishing the validity is construct validity. By definition, construct validity of a measure is directly concerned with the theoretical relationship of a variable with other variables. It refers to the extent in which a measure "behaves" the way the construct purports to measure with regard to established measures of other constructs. The construct validity of the needs instrument was established by employing the confirmatory factor analysis. As suggested by De Vaus (2001; p. 257), "… this inductive approach to scaling clusters item that go together" and extracting items based on the samples respond consistently in harmonious ways. In the confirmatory factor analysis, the first step involved extraction of factors via principal component analysis. By doing so, certain eigen values, represented by certain percentage of variance will be generated. The eigen value represents a measure that attaches to the factors and indicates the amount of variance in the pool of original variables that the factors explain. Each construct (factor) will be retained if its eigen value is more than 1. The second step involved additional procedure called factor rotation. Varimax rotation method is used due to its advantage in producing factors (constructs) that are free and independent of one another. By doing so, the subsequent factor interpretation is relatively easy (Blakenship and Moore, 1977; Bryman and Cramer, 1998).

By systematically and meticulously conducting all the procedures mentioned, nine factors were successfully extracted, which as a whole contribute 66.7% of the overall variance. Nevertheless, based on the corresponding Scree plot analysis, eight factors were then identified which as a whole represent 64.5% of the overall variance. Close examination of each factor generated reveals that each factor is mainly represented by at least three items. The application of all those procedures finally generated eight factors (dimensions) of Malaysian science teachers' needs. Table 4 depicts factors that were successfully extracted as well as the labels that are given to them.

Table 4: Factors Extracted by Factor Analysis Procedures

Factor	Dimension	No of Items	Percentage of Variance
I	Management of science instruction	16	0.953
II	Diagnosing and evaluating students	11	0.909
III	Generic pedagogical knowledge and skills	14	0.861
IV	Knowledge and skills in Science subjects	7	0.900
V	Administering science facilities and equipment	10	0.878
VI	Planning activities in science instruction	8	0.902
VII	Integration of multimedia technology in science instruction	4	0.830
VIII	Use of English language in science instruction	2	0.674

RESEARCH FINDINGS

To reiterate, the definition of perceived science teachers' need as measured in this study is referred to as an area for in-service help; a situation in which science teachers indicate more than a moderate need. Hence, it was then decided that science teachers' need will be categorized as a priority when the percentage of respondents indicating a great need is 40 percent or more. This is in line with Moore and Blakenship (1978) suggestion whereby a priority science teachers' need is defined as "…an area for in-service help when science teachers indicate more than a moderate need" (page 514). Similarly, the 40 percent cut-off point was also used in previous studies (Baird and Rowsey, 1989).

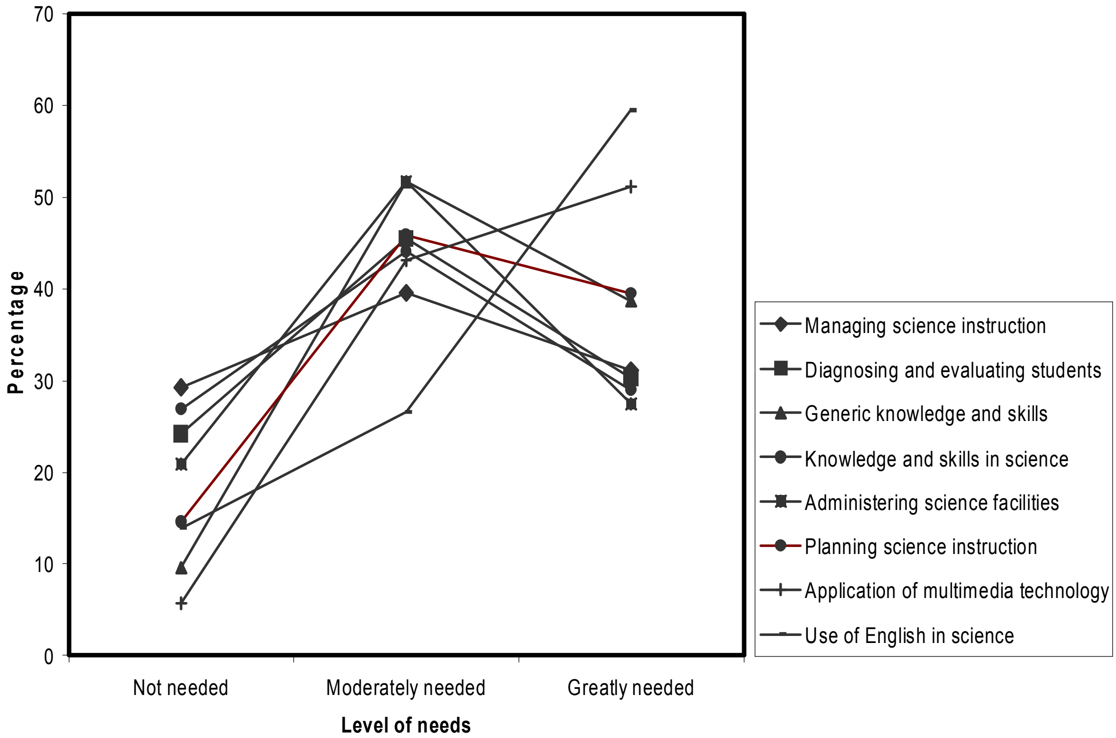
Table 5 summarizes the level of needs for each of the eight dimensions as perceived by the 1,690 Malaysian secondary school science teachers who participated in this study. Overall, it could be inferred that Malaysian secondary school science teachers have demonstrated their need to improve knowledge and skills in all eight dimensions of science teachers' needs. More than 60.0% of the science teachers echoed 'moderately and greatly needed' in all the eight dimensions.

Table 5: Level of Needs for Each Dimension

Dimension	**Level of Needs N (%)**					
	Not needed		Moderately Needed		Greatly Needed	
1. Managing and delivering science instruction	496	(29.3)	669	(39.6)	525	(31.1)
2. Diagnosing and evaluating students for science instruction	409	(24.2)	769	**(45.5)**	512	(30.3)
3. Generic pedagogical knowledge and skills	162	(9.6)	874	**(51.7)**	654	(38.7)
4. Knowledge and skills in Science subjects	454	(26.9)	745	**(44.1)**	489	(29.0)
5. Administering science instructional facilities and equipment	353	(20.9)	873	**(51.7)**	464	(27.5)
6. Planning of science instruction	247	(14.6)	775	**(45.9)**	668	(39.5)
7. Integration of multimedia technology	96	(5.7)	729	(43.1)	865	**(51.2)**
8. Use of English language in science teaching and learning	235	(13.9)	450	(26.6)	1005	**(59.5)**

With reference to Table 5, the highest percentage of the greatly needed scale is demonstrated in the use of English in science teaching and learning dimension (59.5%). This is followed by the integration of multimedia technology dimension (51.2%). The third highest percentage of moderately and greatly needed scale selected is related to planning of science instruction dimension (39.5%), which is then followed by the need for generic pedagogical knowledge and skills dimension (38.7%). It seems that the moderately needed skill is in managing and delivering science instruction (31.1%). In terms of diagnosing and evaluating students, only 30.3% of the science teachers expressed their great need for the skill while 45.5% of them expressed a moderate need. Table 5 also reveals that most of the science teachers who participated in this study perceived that their knowledge and skills in science subjects is adequate to ensure effective and meaningful science instruction. This is evidenced when only 29.0% of the respondents perceived that they greatly needed assistance in that particular skill, and about 44.0% displayed a moderate need for such skill. Finally, the least needed skill is in administering science instructional facilities and equipment, whereby only 27.5% of the science teachers felt that they should upgrade their knowledge and skills in that aspect. Figure 1 illustrates a comparative illustration of science teachers' needs based on the percentage of the likert scale (degree of needs) used. (See also Table 5).

Figure 1: Comparative Illustration of the Malaysian Science Teachers' Needs



THE CATEGORIZATION OF SCIENCE TEACHERS' NEEDS

Further analysis of the science teachers' needs with respect to independent variables that characterized them would enhance the conclusion that will be generated from the analysis. Consequently, the proposed in-service programmes could be tailored according to the science teachers' characteristics. The following is a detailed analysis of perceived science teachers' needs of each dimension according to gender, school location and area of specialization. Based on the aims and objectives of the study and the consideration of the type of data generated from it, the analyses used are mainly cross tab procedures followed by subsequent Chi Square measure of association (Kerlinger and Lee, 2002).

Table 6:

Dimension	Variables		Not Needed	Moderately Needed	Greatly Needed	x^2	p
Administering science instructional facilities and equipment	Gender	Male	102 (22.8)	236 (52.8)	109 (24.4)	3.325	.190
		Female	251 (20.2)	637 (51.2)	355 (28.6)		
	School	Rural	147 (16.8)	461 (52.7)	266 (30.4)	**20.611**	**.000***
		Urban	206 (25.2)	412 (50.5)	198 (24.3)		
	Area of specialization	Physics	48 (25.3)	100 (52.6)	42 (22.1)	**29.208**	**.001***
		Chemistry	75 (24.8)	165 (54.5)	63 (20.8)		
		Mathematics	60 (23.7)	120 (47.4)	73 (28.9)		
		Biology	86 (20.8)	198 (47.9)	129 (31.2)		
		Science	29 (14.4)	117 (58.2)	55 (27.4)		
		Others	42 (15.1)	147 (52.7)	90 (32.3)		
Knowledge and skills in science subjects	Gender	Male	130 (29.1)	194 (43.5)	122 (27.4)	**1.745**	**.000***
		Female	324 (26.1)	551 (44.4)	367 (29.5)		
	School	Rural	204 (23.4)	383 (43.9)	286 (32.8)	17.368	.418
		Urban	250 (30.7)	362 (44.4)	203 (24.9)		
	Area of specialisation	Physics	60 (31.6)	82 (43.2)	48 (25.3)	13.710	.187
		Chemistry	89 (29.4)	138 (45.5)	76 (25.1)		
		Mathematics	75 (29.6)	102 (40.3)	76 (30.0)		
		Biology	101 (24.5)	197 (47.7)	115 (27.8)		
		Science	45 (22.4)	89 (44.3)	67 (33.3)		
		Others	70 (25.3)	116 (41.9)	91 (32.9)		
Diagnosing and evaluating students for science instruction	Gender	Male	106 (23.7)	222 (49.7)	119 (26.6)	5.080	.079
		Female	303 (24.4)	547 (44.0)	393 (31.6)		
	School	Rural	171 (19.6)	416 (47.6)	287 (32.8)	**21.680**	**.000***
		Urban	238 (29.2)	353 (43.3)	225 (27.6)		
	Area of specialization	Physics	50 (26.3)	89 (46.8)	51 (26.8)	**22.616**	**.012***
		Chemistry	87 (28.7)	141 (46.5)	75 (24.8)		
		Mathematics	63 (24.9)	109 (43.1)	81 (32.0)		
		Biology	106 (25.7)	175 (42.4)	132 (32.0)		
		Science	40 (19.9)	94 (46.8)	67 (33.3)		
		Others	44 (15.8)	146 (52.3)	89 (31.9)		
Managing and delivering science instruction	Gender	Male	135 (30.2)	189 (42.3)	123 (27.5)	3.730	.155
		Female	361(29.0)	480 (38.6)	402 (32.3)		
	School	Rural	216 (24.7)	360 (41.2)	298 (34.1)	**19.781**	**.000***
		Urban	280 (34.3)	309 (37.9)	227 (27.8)		
	Area of specialization	Physics	68 (35.8)	68 (35.8)	54 (28.4)	14.800	.140
		Chemistry	100 (33.0)	119 (39.3)	84 (27.7)		
		Mathematics	73 (28.9)	97 (38.3)	83 (32.8)		
		Biology	114 (27.6)	169 (40.9)	130 (31.5)		
		Science	59 (29.4)	80 (39.8)	62 (30.8)		
		Others	61 (21.9)	122 (43.7)	96 (34.4)		

* significant at .05

Table 6:

Dimension	Variables		Not Needed	Moderately Needed	Greatly Needed	x^2	p
Generic pedagogical knowledge and skills	Gender	Male	62 (13.9)	231 (51.7)	154 (34.5)	**14.470**	**.001***
		Female	100 (8.0)	643 (51.7)	500 (40.2)		
	School	Rural	60 (6.9)	449 (51.4)	365 (41.8)	**18.411**	**.000***
		Urban	102 (12.5)	425 (52.1)	289 (35.4)		
	Area of specialization	Physics	31 (16.3)	90 (47.4)	69 (36.3)	**28.727**	**.001***
		Chemistry	32 (10.6)	176 (58.1)	95 (31.4)		
		Mathematics	26 (10.3)	130 (51.4)	97 (38.3)		
		Biology	33 (8.0)	217 (52.5)	163 (39.5)		
		Science	14 (7.0)	106 (52.7)	81 (40.3)		
		Others	19 (6.8)	129 (46.2)	131 (47.0)		
Planning science instruction	Gender	Male	92 (20.6)	208 (46.5)	147 (32.9)	**21.643**	**.000***
		Female	155 (12.5)	567 (45.6)	521 (41.9)		
	School	Rural	98 (11.2)	402 (46.0)	374 (42.8)	**19.228**	**.000***
		Urban	149 (18.3)	373 (45.7)	294 (36.0)		
	Area of specialization	Physics	38 (20.0)	78 (41.1)	74 (38.9)	**20.832**	**.022***
		Chemistry	43 (14.2)	155 (51.2)	105 (34.7)		
		Mathematics	41 (16.2)	115 (45.5)	97 (38.3)		
		Biology	60 (14.5)	180 (43.6)	173 (41.9)		
		Science	28 (13.9)	98 (48.8)	75 (37.3)		
		Others	23 (8.2)	130 (46.6)	126 (45.2)		
Integration of multimedia technology in science teaching	Gender	Male	37 (8.3)	199 (44.5)	211 (47.2)	**9.366**	**.009***
		Female	59 (4.7)	530 (42.6)	654 (52.6)		
	School	Rural	36 (41)	363 (41.5)	475 (54.3)	**12.389**	**.002***
		Urban	60 (7.4)	366 (44.9)	390 (47.8)		
	Area of specialization	Physics	11 (5.8)	85 (44.7)	94 (49.5)	10.083	.433
		Chemistry	21 (6.9)	140 (46.2)	142 (46.9)		
		Mathematics	19 (7.5)	105 (41.5)	129 (51.0)		
		Biology	16 (3.9)	180 (43.6)	217 (52.5)		
		Science	(8 (4.0)	86 (42.8)	107 (53.2)		
		Others	15 (5.4)	110 (39.4)	154 (55.2)		
Use of English language in science teaching and learning	Gender	Male	74 (16.6)	134 (30.0)	239 (53.5)	**9.309**	**.010***
		Female	161 (13.0)	316 (25.4)	766 (61.6)		
	School	Rural	64 (7.3)	230 (26.3)	580 (66.4)	**70.940**	**.000***
		Urban	171 (21.0)	220 (27.0)	425 (52.1)		
	Area of specialization	Physics	36 (18.9)	53 (27.9)	101 (53.2)	**26.890**	**.003***
		Chemistry	54 (17.8)	71 (23.4)	178 (58.7)		
		Mathematics	36 (14.2)	68 (26.9)	149 (58.9)		
		Biology	52 (12.6)	126 (30.5)	235 (56.9)		
		Science	21 10.4)	56 (27.9)	124 (61.7)		
		Others	23 (8.2)	64 (22.9)	192 (68.8)		

* significant at .05

With reference to the administering science instructional facilities and equipment dimension, there is no significant association between gender and science teachers' perceived needs (χ^2 = 3.325; p>.005). This is evidenced when results show that the perceived needs of female teachers are similar to the perceived needs of their male counterparts. However, the school location and area of specialization factors established significant association with the science teachers' needs. A comparison in school location reveals that 30.4% of teachers in the rural areas expressed a great need for the skill as opposed to 24.3% of teachers in the urban areas. More teachers from the rural areas felt that they moderately need such assistance in this aspect (rural = 52.7%; urban = 50.5%). In contrast, 25.2% of teachers in urban areas felt that they had already acquired such skills. With respect to the teachers' area of specialization, it was found that the highest percentage of respondents opting for the 'greatly needed' scale is shown by non-Science option teachers (32.3%). More than half of the science option teachers (52.7%) felt that they moderately need refresher courses in this aspect, whereas 25.0% perceived that they had already acquired the necessary skills in administering science instructional facilities and equipment.

The results displayed in Table 6 show that overall, science teachers portrayed that they moderately need support in upgrading their mastery of knowledge and skills in science subjects. Further Chi Square analysis reveals that significant association only exist between gender (χ^2 = 1.745; p<.005). Specifically, female teachers demonstrated a higher percentage (29.5%) compared to their male colleagues (27.4%) in expressing their great need for such support. Concomitantly, a higher percentage is displayed by male teachers (29.1%) who perceived that such support is not needed. Female teachers on the other hand demonstrated a lower percentage of 26.1%.

Discussion on teaching and learning processes is not confined to teaching and learning per se, but should ideally include measurement issues. In general, there are significant associations between school location (χ^2 = 21.68; p<.005) with perceived science teachers' needs with reference to diagnosing and evaluating students. As shown in Table 6, most teachers felt that they moderately need assistance in this aspect. Detailed analysis of the association between school location and perceived science teachers' needs shows that 47.6% of science teachers in the rural areas moderately need assistance in assessing their students. Nonetheless, 32.8% of the teachers in rural areas expressed a great need for skills in the said dimension.

The managing and delivering science instruction dimension reveals a significant association between teachers' perceived needs and school location (χ^2 = 19.781; p< .005). Generally, most science teachers in the rural areas require assistance in terms of managing and delivering science instruction. This is evident where 34.1% of the science teachers from this geographical region expressed their great need in this dimension as opposed to only 27.8% of science teachers from urban areas. However, there is no association between gender and perceived science teachers' needs (χ^2 = 3.730; p>.005). For both genders, most of them perceived a moderate need for assistance in this dimension. In contrast, 32.3% of female teachers compared to 27.5% of their male counterparts expressed a great need. When the perceived science teachers' need in this dimension is associated with their area of specialization, there is no significant association detected (χ^2 = 14.8; p>.005). The science teachers, regardless of their specific area of specialization, felt that they moderately need assistance in managing and delivering Science lessons. Interestingly, it was also found that the highest percentage identified is in the 'greatly needed' scale which was expressed by 34.4% of non-Science option teachers; viz. the percentage of greatly needed as expressed by this cohort of science teachers. On the average, respondents majoring in physics, chemistry and mathematics, only moderately need assistance in this dimension.

There is no significant association identified in managing and delivering science instruction dimension and the independent variables, except for gender and the teachers' perceived needs. However, in the acquisition of generic pedagogical knowledge and skills dimension, associations exist in all the three teacher variables. It seems that most of the teachers felt the urgency to upgrade their generic pedagogical knowledge and skills. A comparison between male and female respondents shows that female teachers (40.2%) demonstrated a great need. Nevertheless, for both genders, the percentage of responses received on a 'moderate need' is similar (51.7%). Data on school location reveals that teachers in the rural areas (41.8%) require great assistance in this aspect as opposed to teachers in urban areas (35.4%). In the case of area of specialization variable, 47.0% of non-Science option teachers greatly need the respective knowledge and skills. The science option teachers (physics, chemistry, biology and mathematics) on the other hand, only moderately need such generic pedagogical knowledge and skills.

In the planning science instruction dimension, association exists between all three independent variables. The strongest association is established between gender and science teachers' needs (χ^2 = 21.643; p<.005). It was found that 41.9% of female teachers compared to 32.9% of male teachers, greatly need assistance with regard to planning science instruction. Interestingly, 46.5% of male teachers moderately need such assistance. Further analysis of the findings reveals that only 12.5% of female teachers felt that such competencies is not needed as opposed to male teachers who displayed a significantly higher percentage of 20.6%. It was also found that school location is significantly associated with the perceived needs expressed by science teachers (χ^2 = 19.228; p<.005). Forty-two point eight percent (42.8%) of teachers in rural areas perceived that they greatly need and 46.0% of them moderately need such skills. Teachers in the urban areas expressed similar views with 45.7% of them moderately need such skills and 36.0% of them felt that such skills are crucially important. The teachers' area of specialization also seems to be associated with their perceived needs (χ^2 = 20.83; p<.005). The highest percentage of a great need for planning science instruction competencies is demonstrated by non-science option teachers (45.2%), followed by teachers majoring in biology (41.9%), and those majoring in physics (38.9%).

In the integrating multimedia in science instruction dimension, a significant association exists between gender (χ^2 = 9.366; p<.005) and school location (χ^2 = 12.39; p<.005) with perceived science teachers' needs. For gender, both male and female teachers felt that they either greatly need or moderately need such skills. For both genders, only a low percentage felt that such skill is irrelevant and hence unimportant. For school location, mostly teachers from least advantaged areas expressed their concern for this skill. More than 50.0% of them felt that such skill is greatly needed. For urban teachers, the percentage of those who expressed a great need for such skills (47.8%) and the percentage of those who demonstrated a moderate need (44.9%) show little difference. However, no significant association is found between respondents' area of specialization and perceived needs of the science teachers. Therefore it could be inferred that science teachers, regardless of their options, have similar needs in terms of integrating ICT in their science instruction.

With the implementation of teaching science in English language, naturally teachers must be competent in imparting their lessons using the prescribed medium of instruction. As expected, when association is gauged between this dimension of science teachers' need and teacher variables, significant associations exist. More than 50.0% of the respondents indicated that they greatly needed assistance in all three dimensions of teacher variables: gender, school location, and area of specialization. Sixty-six percent (66.0%) of those teaching in rural schools indicate a great need for help in mastering the English language compared to those in urban schools (52.1%). At the same time, 61.6% of female teachers echoed similar cries compared to 53.5% of male teachers. Similarly, non-science option teachers (68.8%) also indicated a great need.

Table 7: Summary of Association between Teachers' Needs Dimensions and Demographic Variables

Dimension	**Teachers' Variable**		
	Gender	School Location	Area of Specialization
Administering science instruction facilities and equipment	3.325	20.611**	29.208**
Knowledge and skills in science subjects	1.745**	17.368	13.710
Diagnosing and evaluating students for science instruction	5.080	21.680**	22.616**
Managing and delivering science instruction	3.730	19.781**	14.800
Generic pedagogical knowledge and skills	14.470**	18.411**	28.727**
Planning science instruction	21.643**	19.228**	20.832**
Integration of multimedia technology in science teaching	9.366**	12.389**	10.083
Use of English language in science teaching and learning	9.309**	70.940**	26.890**

** Association is significant at ? .05

Based on data interpreted from Table 6, it could be synthesized that school location seems to be a detrimental factor in determining Malaysian secondary school science teachers' needs. As shown in Table 7, significant associations exist between school location and science teachers' needs in all dimensions except one: knowledge and skills in Science subjects. Most rural teachers demonstrated a great need for all the other seven dimensions highlighted. Nonetheless, the existence of significant association between science teachers' needs and gender is similar as in respondents' area of specialization.

Analysis of data also reveals that teachers' gender seems to be associated with their perception towards upgrading their knowledge and skills in science subjects, as well as generic pedagogical knowledge and skills required for effective science instruction. Such needs affect the respondents' perception of the importance of planning effective science instruction. As a consequence, they also need assistance in command of the English language so as to be able to deliver effectively. The integration of ICT in science instruction also appears to be a skill which needs to be developed greatly. Analysis across gender reveals that female teachers require more attention in equipping themselves with the skills in all the dimensions identified. Meanwhile teachers' area of specialization seems to be associated with teachers' perceptions of the importance of specific skills pertaining to science teaching and learning such as administering science instructional facilities and equipment, diagnosing and evaluating students, generic pedagogical knowledge and skills, planning science instruction and the use of English language in science teaching. It was also detected that for almost all dimensions, non-option science teachers appear to be those who require more attention in all the dimensions of science teachers' needs as measured in this study. When all the analysis is integrated together, it could be synthesized that specifically, the cohort of science teachers who require more training in all dimensions of science teachers' needs are non-science option female teachers in rural areas.

DISCUSSION

It should be reiterated that in this study, a particular need is considered a priority science teachers' need when the percentage of greatly needed scale selection is more than 40 percent. Based on Table 5, it could be inferred that the topmost priority needs which entail are the use of English language as the medium of instruction and the integration of multimedia technology in science teaching and learning. Additionally, science teachers also need support in planning and designing their science instruction as well as equipping themselves with generic pedagogical knowledge and skills. On the other hand, teachers only require a moderate need of assistance in managing their science instruction and in measuring students' performance. It is also apparent from the findings that science teachers do not have problems with updating their content knowledge as well as technical skills in administering science instructional facilities and equipment. When such classification of science teachers' need is compared with previous local studies conducted by Kamariah (1984), Kamariah, Rubba, Tomera and Zurub (1988), and Mohamad (2002), it could be argued that science teachers' needs evolve with time as well as social and political scenarios that navigate the policy implementation of the country. Twenty years ago, during the wake of the New Integrated Malaysian Science Curriculum implementation, the prominent needs of the Malaysian science teachers then, mainly involved delivering and managing science instruction, and administering science instructional facilities and equipment, which as a whole contributed towards improving one's self competence as a science teacher in meeting new challenges in science teaching.

Currently, in Malaysia, we are witnessing the use of English language as the medium of instruction for teaching Science. In addition a great emphasis is put on integrating ICT in science lessons. Undoubtedly, the implementation of such new approaches, generate anxiety on the part of teachers, especially in imparting scientific knowledge using English language as the medium of instruction. It must be pointed out that education in Malaysia, can be argued to be justifiably intertwined with political interest as it is increasingly the case in the west, particularly in the United Kingdom. Thus, in furnishing science teachers with the necessary knowledge and skills required as a result of new policy implementation, many short courses have been inaugurated. Nevertheless, most of the programmes were implemented in an *ad hoc* or "bolt on" fashion, and hence failed to equip science teachers with the necessary knowledge and skills. The need for integrating ICT in science instruction as publicized in the media (written as well as electronic), has successfully instilled in the teachers cognizance of the importance of ICT in every niche of human activities. In this context, the teachers' main concern is how they could upgrade their knowledge of integrating ICT towards a more interesting yet meaningful science lesson. Literature evinces that the teachers' concern on how to fully utilize ICT facilities effectively in science lessons, is also a major problem in the United States and United Kingdom (Banilower, 2000; Dillion, Osborne, Fairbrothre and Kurina, 2000; Smith, 2000). Although many support systems were granted by the government, such as providing every science teacher with a laptop computer and an LCD, a wide dissemination of stand alone science teaching software, and organizing short courses on integrating ICT in their lessons, nonetheless, many science teachers still felt incompetent and hence need much support in this aspect.

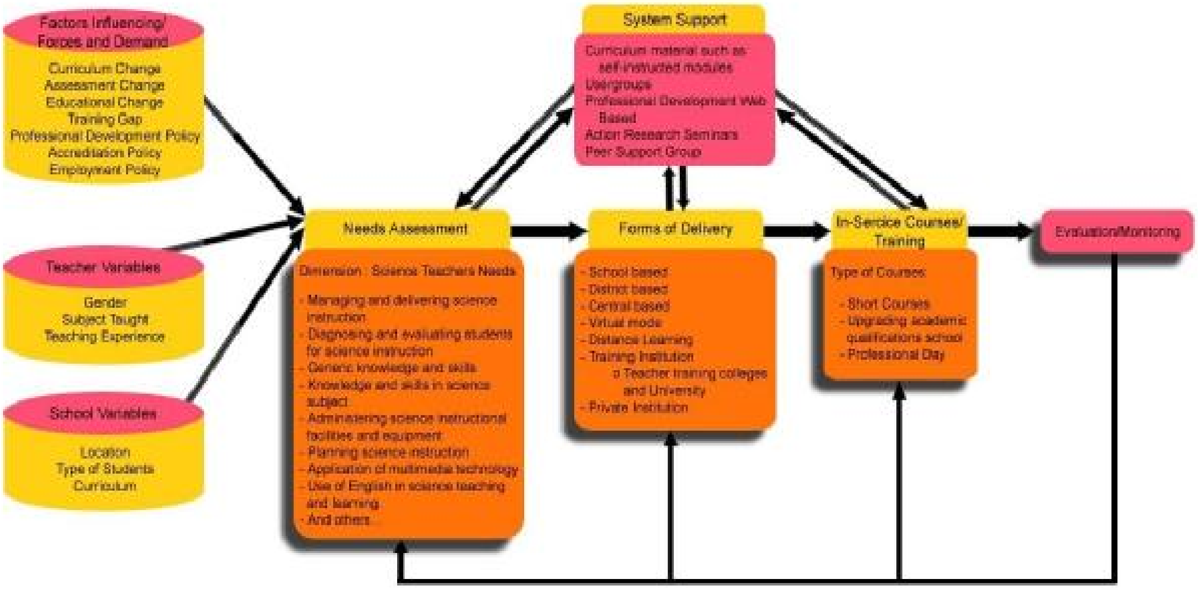
The third main concern of the Malaysian secondary school science teachers is proper planning of science instruction. The main concern about planning is entrenched in the teachers' inclination to motivate their students to learn science. Such situation is triggered due to the current practice of teaching science in English, beginning in Year One of primary education. The existence of a wide spectrum of children's abilities thus creates a need for teachers to make their lessons interesting and attractive especially for children with low ability levels. The science teachers' awareness of the importance of varying their pedagogical approaches and how to constructively maneuver their lessons with the support of ICT and other teaching aids also contribute to such pattern of feedback. Another plausible reason for the concern in planning instruction is associated with the government policy of achieving a 60 to 40 ratio of science to art students. This is a new phenomenon which science teachers are currently facing, especially in dealing with students who do not really want to take up science subjects but were forced to do so. The students' lack of interest and the lack of motivation mould their attitudes towards the science subject, which ultimately shape their negative behaviors during science lessons.

Several interesting issues emerged when association is gauged between gender, school location, areas of specialization and science teachers' needs. As earlier mentioned, the cohort of science teachers who require more training in all dimensions of science teachers' needs as measured in this study are non-science option female teachers teaching in rural schools. Arguably, schools in urban areas offer a more conducive environment for the teaching of science particularly in the usage of English language as well as the integration of ICT in teaching and learning Science. This is not surprising as many support systems and infrastructure are made available in urban areas. In addition, these schools are located near Teacher Activity Centres as well as the District Education Office, which provide avenues for exchange of ideas as well as keeping them well informed of the latest policy implementation in science teaching and learning. The needs of non-science option teachers on the other hand, revolve around updating knowledge and skills for effective science instruction. Consequently, the issue of using English language as the medium of instruction also takes priority in their self improvement agenda.

Based on the findings, several suggestions can be forwarded to meet the current needs of science teachers. Undoubtedly, in-service courses which offer continuous development of science teachers appear to be the best platform in upgrading science teachers' needs as identified in this study (Craft, 1996; Parkinson, 2004). Figure 2 displays in graphical manner a proposed framework for the Malaysian secondary school science teachers' in-service training (INSET) model. As shown in Figure 2, the INSET established can take many forms; school-based, central-based, institutionalized training either via public or private institutions, conducted by means of a virtual or a distance learning mode. Compatriot institutions such as the District Education Department and Teacher Education Division can offer support in ensuring effective implementation of the programmes. Figure 2 also highlights three main modus operandi which can be undertaken: short courses, professional day, or long term courses such as pursuing a masters or doctoral degree programme.

It is recommended that multimedia technology is used as the main teaching tool, in addition to face to face interaction. Loucks-Horsley, et al. (1998) argues that the key feature of technology is not only as a tool for presenting ample opportunities for diverse learning experiences, but it can become the best support for professional learning. To ensure that the programmes implemented meet its objectives, continuous monitoring and evaluation by governing bodies should be systematically planned and followed. Appleton and Kindt (1999) suggest that the most helpful support is through mentoring programmes. The roles of mentors, however, should not merely be confined to tackling problems about science content and generating innovative ideas about pedagogical issues, but more importantly, mentors should provide continuous support especially for the teachers involved (Anderson and Mitchener, 1994). Besides coaching and mentoring, there are many other strategies such as provision of curriculum materials, self-instructed modules, action research network, peer and study group support, and establishing a partnership with scientists (see also Brown and Smith, 1977; Loucks-Housley, et.al. 1998).

Figure 2: A Framework of In-service Training Model for Malaysian Science Teachers



CONCLUSION

Being descriptive in nature, this study provides meaningful empirical evidences of effective in-service programmes in the process of upgrading science teachers' professionalism in Malaysia. Data garnered in this study provide vital information especially for those involved in designing and implementing INSET, so that all the programmes implemented will be tailored specifically to the immediate needs of the science teachers. From this study, the science teachers' needs identified revolve around upgrading oneself in meeting the current challenges of teaching and learning Science, which as indicated, is determined mostly by socio-political scenario of the country. Another important feature which emerged from this study is the teachers' personal concern and awareness of the importance of self improvement, especially in making their lessons meaningful and attractive, which would subsequently lead to improvement in the students' achievement. In conclusion, it is thus apt to mention that Malaysian secondary school science teachers, as empirically indicated in this study, indulge in keeping the best interest of their students and they maintain that lifelong learning is at the heart of teacher development.

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