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Perceived Needs of Urban and Rural Mathematics Majors Teaching Science in Malaysian Secondary Schools

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Abstract

This study seeks to identify the needs of urban and rural science educators majoring in mathematics. In Malaysian secondary schools, due to a lack of qualified science teachers, the phenomenon of mathematics majors teaching science is common. Analysis of data revealed that the perceived needs with the highest overall rating were related to ICT (Internet, Communication and Technology), followed by the need for short professional development courses and the need for critical thinking skills. The lowest rated perceived needs were related to implementation of PEKA (Science Practical Work Assessment), the updating of content knowledge in the field of biology, and supervising laboratory assistants in preparing apparatus. The multivariate analysis of variance (MANOVA) found that there are differences among teachers' perceived needs related to science teaching and learning based on a school's location. All tests were conducted at the 0.05 level of significance.

Keywords: Perceived needs, Mathematics majors, Teaching science

1. Introduction

Mathematics majors teaching science in Malaysian secondary schools is a common occurrence due to a lack of qualified teachers in the field of science (Kamisah, Lilia & Subahan, 2006). The shortage of science teachers reached a high of 1395 vacancies in the year 2000 (Ministry of Education, Malaysia, 2000). As a result, teachers with various subject backgrounds are often required to teach science despite their lack of training in teaching science subject (Kamisah, Lilia & Subahan, 2006). This is problematic because these educators have limited knowledge of science content. Subahan et al. (2001) found that 60% to 68% of non-option physics teachers believed they needed to increase their understanding of physics content. A study by Berenson et al. (1991) found that 58% of the teachers felt unqualified to teach science and only 8% would elect to teach science. Additionally, 37% of these teachers requested more in-service courses dealing with science content. According to Kofi (2007), a teacher who is competent and knowledgeable in his or her subject can teach it well and is more likely to establish a good rapport with students, create a democratic classroom climate, maintain an orderly and learning-focused environment, motivate learners, and provide co-operative interaction that can maximize learning. He further states that, to be competent and knowledgeable, the teacher must undergo comprehensive training and continue to learn throughout his or her teaching career.

A needs assessment study by Baird and Rowsey (1989) found that science teachers are most interested in student motivation, obtaining instructional materials, learning to use computers, and in updating their own personal knowledge in science content areas. Performing clerical tasks, writing lesson plans, assigning student grades, communicating with parents, or administering tests are the least pressing needs for science teachers. According to Baird and Rowsey (1989), the duties of science teachers include specifying learning objectives in content areas, skills in planning, managing and delivering science instruction, administering laboratory facilities and materials, ordering and maintaining supplies, testing and evaluation, and utilizing technologies. Kamariah and Rohani (1995) reported that the three most important items are creativity in teaching science, update knowledge in application of science, and technology and innovation in science teaching. They also report that teachers who lack experience need help in professional development. A recent study by Kofi (2007) found that teachers in South Africa needed professional development in the areas of teaching methods, classroom management, alternative ways to assess students, and preparation of lessons for effective teaching.

Most of the teachers relied on in-service programs to enhance their skills. However, many teachers expressed dissatisfaction with the development program and questioned its usefulness for the staff. In-service programs must be high quality in order for teachers to benefit from them (Baird & Rowsey, 1989). Effective professional development programs should be designed to help teachers build new understandings of teaching and learning through direct experiences that introduce new strategies, which help students learn in new ways (Lee, 2001). The development of in-service programs should be directed toward meeting the stated needs of teachers. According to Kofi (2007), staff development program are too general. In many cases, they may not take into consideration the local contexts and the needs of individual schools and educators. The needs of rural science teachers are not being met as those of their urban colleagues (Lyons, 2008). Those who teach science at the secondary school level are diverse and thus have very different needs (Kamisah, Lilia & Subahan, 2006). Lee (2004) further stated that the lack of motivation for staff development might be due to the fact that in-service programs are typically designed to cater to the masses in the district rather than appealing to the specific needs of teachers. Therefore, accurate data should be gathered and used in planning a successful program. A needs assessment is one means of determining areas in which teachers desire help (Rossett, 1997). Identification of these perceived needs could have implications for in-service programs provided for teachers. There is a limited literature concerning the perceived needs of mathematics majors who are teaching science. For this reason, the study discussed in this paper identified the perceived needs of science teachers whose primary subject area is mathematics.

2. Purpose of the study

The main purpose of this study was to determine the perceived needs of science teachers majoring in mathematics. Also, this study will try to determine if there is a significant difference in these perceived needs based on a school's location as the variable. Therefore, this study was an attempt to collect data to provide answers to the following specific questions:

a) What are the most pressing needs of science teachers as perceived by secondary science teachers majoring in mathematics?

b) What are the least pressing needs of science teachers as perceived by secondary science teachers majoring in mathematics?

c) Is there a significant difference between the professional needs of science teachers who teach in urban schools and those who teach in rural schools?

3. Methodology

3.1 Population and Sample

The population of this study is educators teaching science at the secondary level. 198 mathematics majors who are teaching science subjects were randomly selected as respondents for this survey. Of these 198 teachers, 92 were from urban areas while 106 teachers came from rural areas. Additionally, 57 of the teachers were male and 141 were female.

3.2 Instrumentation

Zurub and Rubba (1983) developed the original *Science Teacher Inventory of Needs* (STIN) instrument from which this survey was formed. The STIN contains 76 items organized into 7 categories of science teachers' professional needs. These categories are: (a) specifying objectives for science instruction, (b) diagnosing and evaluating learners, (c) planning science instruction (d) delivering science instruction, (e) managing science instruction (f) administering science instructional facilities and equipment, (g) improving personal competence as a science teacher.

Modifications to the STIN were made for this study; items were added that reflected the needs of science teachers in secondary schools in Malaysia. Item development took place in six steps. First, an existing perceived needs subscale was reviewed. Second, a thorough review and analysis of the needs literature was conducted. Third, in order to identify the needs of science teachers, a structured interview was conducted. Eight teachers were interviewed. The interview data were used to update and modify the instrument. Fourth, a panel of experts in the area of science teaching representing biology, chemistry and physics was asked to edit, combine, suggest, and eliminate items from initial pool of items. Fifth, comments and suggestions from the fourth stage were reviewed.

Finally, the items were field tested by having teachers and lecturers review the survey with respect to its readability, clarity, and ease of response. Instructions or items that were unclear were identified and suggestions for changes were incorporated. The final versions of the scale sent to participants contained 72 items. Each item is followed by a scale of selection: (1) Not needed, (2) Moderately needed, and (3) Greatly needed. The instrument for this study consists of two sections. Section I asks for demographic data about each respondent. The following demographic data was collected: race, gender, school location, teaching experience, academic qualification, subjects major/minor, professional qualification, subjects taught, years of teaching science, and in-service courses attended. Section II includes 72 items regarding the in-service needs of science teachers.

To establish validity, a construct was considered through factor analysis with principal component analysis as an extraction method and varimax as a rotation method. Through factor analysis, 8 factors were identified. These categories are: (a) managing and delivering science instruction (16 items), (b) diagnosing and evaluating students for science instruction (11 items), (c) knowledge and generic skills (14 items), (d) generic pedagogical knowledge and skills (7 items), (e) administering science instructional facilities and equipment (10 items), (f) planning science instruction (8 items), (g) integration of multimedia technology in science teaching (4 items), and (h) use of the English language in science teaching and learning (2 items). In order to determine reliability, Cronbach's alpha was calculated for each of the surveys. The managing and delivering science instruction scale had a reliability of 0.96; diagnosing and evaluating students for science instruction scale, 0.93; knowledge and generic skills scale, 0.95; generic pedagogical knowledge and skills scale, 0.95; administering science instructional facilities and equipment scale, 0.93; planning science instruction scale, 0.91; integration of multimedia technology in science teaching, 0.81; and use of English in teaching and learning science scale, 0.75. Ranking of means was used to determine the most pressing perceived needs of science teachers. Multivariate analysis of variance (MANOVA) was used to determine differences in perceived needs based on school location.

4. Results

Table 1 contains a demographic summary of teachers who responded. Of a total of 198 participants, 71.2% were female teachers and 28.8% were male teachers. Additionally, 40% were between the ages of 31 and 40 and only 1% were above the age of 50. In terms of ethnicity, Malays were the highest respondents with 70.7%. In terms of school location, 46.5% were from urban schools and 53.5% were from rural schools. In terms of subject-specific experience, 24% of respondents had experience teaching physics, and 39% had experience teaching science at the lower secondary school level. However, only 7% had experience teaching biology. In terms of total years of experience, 19% had 0 to 3 years of teaching experience in science, and 53% had more than 12 years of experience in teaching science. Finally, 55% of the participants have undergraduate degrees in education.

To determine needs items, a mean score for each need was computed from all responses. Table 2 provided an analysis of the perceived needs of science teachers, as ranked on the basis of the mean. The top 10 perceived needs included: upgrading knowledge of ICT (2.55); enhancing professionalism through short courses (2.45); critical thinking skills (2.41); creativity in teaching science (2.40); English communication skills (2.39); various activities in science teaching (2.33); information on innovation in science instruction (2.32); motivation in learning science (2.29); selecting appropriate teaching strategies (2.27); and preparing various teaching materials (2.26). The most pressing needs were found in the knowledge and generic skills scale (items 61, 62, 63, and 71); planning science instruction scale (items 12, 14, and 21); integration of multimedia technology in science teaching (item 72), diagnosing and evaluating students for science instruction (item 9), and use of English in teaching and learning science scale (item 66).

In comparison to the 10 most preferred perceived needs for science teachers (Table 2), the 10 least preferred included (Table 3): planning science instruction outside of the class (1.96); doing a demonstration to understand a science concept (1.96); living organism in science teaching (1.95); updating the scientific skills in chemistry (1.95); updating the content knowledge of chemistry (1.95); updating the scientific skills in biology (1.90); management of budget for science teaching (1.89); updating the content knowledge of biology (1.89); implementation of PEKA (1.87), and supervising laboratory assistants in preparing apparatus (1.83). The least pressing needs were found primarily in management and science instruction (item 29); administering science instructional facilities and equipment (items 36, 40, 49); diagnosing and evaluating students for science instruction (item 28); knowledge and skills in science subject (items 51, 53, 54, 56); and planning science instruction (item 17) scales.

Table 4 presents the mean and standard deviation of perceived needs by school location. Rural teachers had a higher mean score than urban teachers. A one way multivariate analysis (MANOVA) was conducted to determine the differences, if any, between the means of the two groups (urban and rural) with respect to the eight dependent variables listed above. The results of MANOVA are presented below (Table 5). Significant differences were found between the rural and urban groups on the dependent variables, Wilks' lambda = 0.917, $F(8,189)= 2.14$, $p< 0.05$. These results signify that there is a difference between rural and urban groups on any dependent variables.

Box's test equality of covariance matrices and Levene's test of equality of error variances were also conducted. These tests were used to determine whether the assumptions of the MANOVA were met. Box's M statistics is used to test the assumption of homogeneity of the variance-covariance matrices. If the F test for Box's test is significant, the homogeneity hypothesis is rejected, and it is concluded that there are differences in the matrices. Box's test of the equality of covariance matrices showed that Box's $M=35.588$, $F(36,124045.2)=0.946$, $p>0.05$ and was, therefore, not significant. This indicates that the covariance matrices of the dependent variables were not different across group, i.e., the scatter of the scores in the different tests did not differ significantly. Levene's test revealed that the variability for the variables 3, 6, and 8 (see Table 4) differed from the other variables because of the existence of more extreme scores. Gardner (2001) recommends the use of Pillai's trace because it is the most robust overall measure and is unaffected by violations of assumptions.

Table 6 presents a multivariate analysis of variance for location effect. The data show a significant main effect for the following: (a) managing and delivering science instruction, $F(1, 196)=10.402$, $p<0.05$; (b) diagnosing and evaluating students for science instruction, $F(1,196)=12.296$, $p<0.05$; (c) knowledge and generic skills, $F(1,196)=10.472$, $p<0.05$; (d) generic pedagogical knowledge and skills, $F(1,196)=6.180$, $p<0.05$; (e) administering science facilities and equipment, $F(1,196)=4.853$, $p<0.05$; (f) planning science instruction, $F(1,196)=10.562$, $p<0.05$; (g) use of the English language in teaching and learning, $F(1,196)=7.857$, $p<0.05$. There was no significant effect for integration of multimedia technology in science teaching, $F(1,196)=1.978$, $p<0.05$.

5. Discussion

Based upon the responses of these secondary school science teachers, the greatest need was for ICT. The high rankings of the technology-related needs provide evidence for the desirability of in-service programs in the area of technology. The need for integration of multimedia technology in science teaching is almost the same for rural and urban teachers. The high rankings of the integration of ICT in teaching and learning were expected since many teachers had not been formally trained to integrate technology into classroom instruction. According to McKenzie (1999), only 20% of teachers were well prepared to integrate technology into the classroom. A continued program of in-service training can provide teachers with the support they may need in technology usage (Wright, Rice & Hildreth, 2001). The ten highest-ranked needs, each to various degrees, point to the teachers' desire to improve their knowledge, professionalism, thinking skills, creativity, and communication skills. This result is supported by a study done by Kamariah and Rohani (1995). The low ranking of planning science instruction outside the class, doing a demonstration, updating content knowledge and scientific skills in chemistry and biology were expected since most of the teachers were experienced teachers. Evidence indicates differences between the needs of urban teachers and rural teachers for each dimension except the integration of multimedia technology in science teaching. Rural teachers' needs are greater than their urban counterparts. This may be due to their lack of exposure and experience and may also indicate that these educators are not acquiring relevant information and knowledge in their current in-service program.

6. Conclusion

The results of this study demonstrate the perceived needs of science teachers in Malaysian secondary schools whose primary subject area is mathematics. This assessment indicates an interest regarding the use of technology. In-service programs should focus on technology integration, professionalism through short courses, critical thinking, and creativity in teaching science, as well as communication skills in English. The findings from this study might have implications for science teachers majoring in mathematics. When planning in-service courses or programs, consideration should be given to areas of most pressing need. We should be sensitive to the different needs of the teachers as rural and urban teachers showed different needs. Providing the same program for teachers regardless of the school location may not meet the needs of all teachers. The findings of this study also provide direction for further research related to the perceived needs of science teachers, to the extent that current in-service courses are adequate to meet the needs of the teachers. Further research should also look into other teacher variables such as experience, gender and level of education.

References

Baird, W.E & Rowsey, R.E. (1989). A survey of secondary science teachers' needs. *School Science and Mathematics*, *89*(4), 272-284.

Berenson, S., Hodgin, K., Ward, C., Andrews,D. & Thomas, R. (1991) Needs Assessment of Elementary Teachers in Mathematics and Science: A Crucial Step Toward Planning a Statewide Inservice program. *Journal of Science Teacher Education*, 16-21.

Gardner, R. C. (2000). *Psychological statistics using SPSS for windows*. Upper Saddle River New Jersey: Prentice Hall, Inc.

Kamariah A.B. & Rohani, A.T. (1995). Teacher preparation concerns: Professional needs of Malaysia Secondary School Science Teachers. ERIC Document ED 390632.

Kamisah, O., Lilia, H & Subahan, M.M. (2006). What malaysian science teachers need to improve their science instruction: a comparison across gender, school location and area of specialization. *Eurasia Journal of Mathematics, Science and Technology Education*, 2 (2),58-81.

Kofi Poku Quan-Baffour. (2007). Continuous Professional Development: A Strategy to Enhance Quality of Teaching at the School level University of South Africa, South Africa. *The International Journal of Learning, 14*(1), 183-189

Lee, Hea-Jin. (2001). Enriching the Professional Development of Mathematics Teachers. ERIC Digest. EDO-SE-01-01.

Lee, Hea-Jin. (2004). Developing a Professional Development Programme. *Model Based on Teachers' Needs. Profesional Educator,* 27(1-2), 39-49.

Lyons, T. (2008). More equal than others? Meeting the professional development needs of rural primary and secondary science teachers. *Teaching Science*, http:// www.articlearchives.com/education-training/education-systems-institutions/1894440-1.html.

McKenzie. (1999). Technology growth in an elementary magnet school. A longitudinal study. *Journal of Computing in Teacher Education, 18*(1),19-24.

Ministry of Education, Malaysia. (2000). Pembangunan Pendidikan 2001-2010 (Education Development 2001-2010). Ministry of Education, Malaysia.

Rossett, A. (1997). *Training Needs Assessment*. Englewood Cliffs, NJ: Educational Technology Publication.

Subahan M. Meerah , Lilia Halim, Khalijah Mohd Salleh & Ruhizan Mohd. Yassin. (2001). To improve physics content and pedagogical skills of non physics option teachers, IRPA (07-02-02-0046), UKM.

Wright, V.H, Rice,M.L. & Hildreth, D. (2001). Technology growth in an Elementary Magnet School. *Journal of Computing in Teacher Education, 18* (1).

Zurub, A. R. & Rubba, P.A. (1983). Development and validation of an inventory to assess science teacher needs in developing countries. *Journal of Research in Science Teaching*, *20*(9), 867-873.

Table 1. Demographic Characteristics of Science Teachers

Variable	Category	N	Percent
Gender	Male	57	28.8
	Female	141	71.2
Age	21-30	52	26.3
	31-40	80	40.4
	41-50	64	32.3
	>50	2	1.0
Ethnicity	Malay	140	70.7
	Chinese	52	26.3
	Indian	5	2.5
	Others	1	0.5
Locations of Schools	Urban	92	46.5
	Rural	106	53.5
Highest academic qualification	SPM*	1	0.5
	STPM**	8	4.0
	Diploma	10	5.1
	Undergraduate Degree	59	29.8
	Undergraduate Degree in Education	109	55.1
	Masters Degree	4	2.0
	Masters Degree in Education	5	2.5
	Others	2	1.0
Science Subject Taught in school***	Physics	47	23.7
	Chemistry	21	10.6
	Biology	13	6.6
	Science (Lower)	77	38.9
	Science (Upper)	47	23.7
Teaching Experience in Science	0-3 years	38	19.2
	4-6 years	21	10.6
	7-9 years	22	11.1
	10-12 years	13	6.6
	>12 years	104	52.5

N=198, unless indicated otherwise, *equivalent to O level, **equivalent to A level, ***more than one subject taught

Table 2. Top 10 Ranking of Perceived Needs

Ranking	Item	Mean	S.D.
1	(72) upgrading knowledge of ICT	2.55	0.64
2	(71) enhancing professionalism through short courses	2.45	0.65
3	(63) critical thinking skills	2.41	0.68
4	(62) creativity in teaching science	2.40	0.68
5	(66) English communication skills	2.39	0.78
6	(21) various activities in science teaching	2.33	0.77
7	(61) information on innovation in science instruction	2.32	0.68
8	(14) motivation in learning science	2.29	0.81
9	(9) selecting appropriate teaching strategies	2.27	0.82
10	(12) preparing various teaching materials	2.26	0.79

Table 3. Bottom 10 Ranking of Perceived Needs

Ranking	Item	Mean	S.D.
63	(17) planning science instruction outside of the class	1.96	0.75
64	(29) doing a demonstration to understand a science concept	1.96	0.80
65	(49) living organism in science teaching	1.95	0.82
66	(54) updating the scientific skills in Chemistry	1.95	0.91
67	(51) updating the content knowledge of Chemistry	1.95	0.92
68	(56) updating the scientific skills in Biology	1.90	0.95
69	(36) management of budget for science teaching	1.89	0.86
70	(53) updating the content knowledge of Biology	1.89	0.94
71	(28) implementation of PEKA (Science Practical Work Assessment)	1.87	0.87
72	(40) supervising laboratory assistants in preparing apparatus	1.83	0.86

Table 4. Mean and Std Deviation of Perceived Needs by Location

Dimension	Location	Mean	Std Deviation
1) Managing and delivering science instruction	Urban	30.7391	11.08396
	Rural	35.5472	9.89192
2) Diagnosing and evaluating students for science instruction	Urban	21.2609	7.16504
	Rural	24.6321	6.36258
3) Knowledge and generic skills	Urban	29.6087	8.69250
	Rural	33.2075	6.94429
4) Generic pedagogical knowledge and skills	Urban	12.7391	5.47496
	Rural	14.6981	5.57745
5) Administering science instructional facilities and equipment	Urban	19.1848	6.42100
	Rural	21.1887	6.35177
6) Planning science instruction	Urban	16.3043	5.23038
	Rural	18.5094	4.31442
7) Integration of multimedia technology in science teaching	Urban	8.9891	2.51367
	Rural	9.4528	2.12528
8)Use of English language in science teaching and learning	Urban	4.2391	1.49262
	Rural	4.7925	1.28521

Table 5. Results of MANOVA

Effects		Value	F	Hypothesis df	Error df	Sig
Location	Pillai's Trace	.083	2.135	8.000	189.000	.034
	Wilks' Lambda	.917	2.135	8.000	189.000	.034
	Hotelling's Trace	.090	2.135	8.000	189.000	.034
	Roy's Largest Root	.090	2.135	8.000	189.000	.034

Table 6. MANOVA of Perceived Needs by School Location

Dependent Variable	SS	df	MS	F	p
Managing and delivering science Instruction	1138.583	1	1138.583	10.402	.001
Diagnosing and evaluating students for science instruction	559.756	1	559.756	12.296	.001
Knowledge and generic skills	637.906	1	637.906	10.472	.001
Generic pedagogical knowledge and skills	189.012	1	189.012	6.180	.014
Administering science instructional facilities and equipment	197.779	1	197.779	4.853	.029
Planning science instruction	239.486	1	239.486	10.562	.001
Integration of multimedia technology in science teaching	10.590	1	10.590	1.978	.161
Use of English language in science teaching and learning	15.079	1	15.079	7.857	.006