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Perception, Conceptual Knowledge and Competency Level of Integrated Science Process Skill Towards Planning a Professional Enhancement Programme

(Persepsi, Pengeta huan Konsepsual dan Tahap Penguasaan Kemahiran Proses Sains Bersepadu ke Arah Perancangan Program Pembangunan Profesional)

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ABSTRACT

Science curriculum that emphasizes science process skills (SPS) will be able to help students acquire and understand information, as well as improve skills in critical thinking and decision making. Consequently, the SPS should be systematically taught to the students from as early as at primary school. To produce students who acquire the science process skills, the teacher should be competent in SPS; theoretically and practically. Thus, the aim of this study was to identify the teachers' perception on their understanding of integrated SPS, conceptual knowledge and the competence level of integrated SPS of primary school teachers in Kuala Lumpur. A questionnaire was administered to 329 science teachers from 52 primary schools that have been selected randomly. The reliability of the instrument is 0.80. The data were analyzed using descriptive and inferential analysis (t-test and ANOVA). The findings showed that majority of teachers (74.1% to 83.6%) perceived that they have a high level of understanding on each of the sub-component of an integrated SPS. However teachers' perception on their level of understanding of the integrated SPS was found to be inconsistent with the actual level of understanding (conceptual knowledge). Teachers had a low level of conceptual understanding of the integrated SPS. The findings also revealed that science teachers did not have sufficient conceptual knowledge of integrated SPS to teach their students to understand it in a meaningful way. However, the competency level of the integrated SPS among teachers is high with a mean of 20.86. As a conclusion, the study showed that teachers competency in the integrated SPS is good at the practical stage but not theoretically. Therefore, emphasis should be given to integrated SPS both conceptual and operational knowledge in pre and in-service training to ensure that the teachers understand, acquire and are able to implement the skills meaningfully.

Keywords: Primary school science teacher; teacher's perception

ABSTRAK

Kurikulum sains yang menekankan kemahiran proses sains (KPS) akan berupaya membantu pelajar untuk memperoleh dan memahami maklumat, disamping meningkatkan keupayaan pemikiran kritikal dan kemahiran dalam membuat keputusan. Sehubungan itu, KPS perlu diajarkan kepada pelajar dengan sistematik daripada peringkat seawal sekolah rendah. Bagi melahirkan pelajar yang menguasai KPS, maka guru perlulah terlebih dahulu menguasai KPS secara teori dan praktikal. Maka kajian ini bertujuan untuk mengenalpasti persepsi guru terhadap tahap kefahaman KPS bersepadu, pengetahuan konseptual dan tahap penguasaan KPS bersepadu dalam kalangan guru-guru sains sekolah rendah di Wilayah Persekutuan Kuala Lumpur. Kajian melibatkan 329 guru sains dari 52 buah sekolah rendah yang dipilih melalui pensampelan secara rawak mudah. Darjah kebolehpercayaan (Cronbach alpha) instrumen adalah 0.80. Data dianalisa secara deskriptif dan inferensi (Ujian-t dan ANOVA). Dapatan menunjukkan majoriti guru (74.1% hingga 83.6%) berpersepsi bahawa mereka mempunyai tahap kefahaman yang tinggi terhadap setiap sub komponen KPS bersepadu. Namun demikian, persepsi guru terhadap tahap kefahaman KPS bersepadu ini tidak selari dengan tahap kefahaman sebenar (pengetahuan konseptual). Guru mempunyai tahap pengetahuan konseptual KPS bersepadu yang rendah. Dapatan juga mununjukkan guru tidak mempunyai pengetahuan konseptual yang mencukupi untuk mengajar murid memamahi KPS Bersepadu secara bermakna. Walau bagaimanapun, guru mempunyai tahap penguasaan (praktikal) KPS bersepadu pada tahap baik secara keseluruhan dengan nilai min 20.86. Kesimpulannya, kajian menunjukkan guru sains menguasai KPS bersepadu secara praktikal tetapi tidak secara teoritikal. Maka penekanan perlu diberikan terhadap pengetahuan KPS bersepadu secara konseptual dan operational dalam latihan pra dan latihan dalam perkhidmatan agar guru berupaya untuk memahami, menguasai dan melaksanakannya secara bermakna.

Kata kunci: Guru sains sekolah rendah; persepsi guru

Introduction

The scenario of the world in the 21st century saw rapid progress in science and technology. Knowledge is increasing rapidly as the effects of testing new ideas in the world either by research institutions or others. But it is impossible for students to obtain all the information in any of these disciplines (Karsli et al. 2009). Hence, it is necessary to teach them how to acquire this knowledge and not just teach all the knowledge. In the science education system, science process skills are competencies that enable students to acquire knowledge (Harlen 1999; Karsli et al. 2010) as well as understand the knowledge obtained (Bati et al. 2010). In addition, acquisition of SPS also has a great influence in developing mental processes such as higher order critical thinking and decision making (Koray 2007; Lee et al. 2002). Individuals who can develop the mental processes of high order will also be able to think creatively and can transfer this capability to the other disciplines (Meador 2003). Therefore, SPS should be systematically taught to students from the earliest stages of primary school up to the highest level in their formal education.

The teaching of SPS has become an important component in the science curriculum at all levels in many countries and has become one of the new approaches in teaching science more effective and meaningful. In Malaysia, explicit teaching of SPS was emphasized during the review of the science curriculum in 2002 for both primary and secondary level. The objective of acquiring SPS and experimental skills or investigation is stated in the primary and secondary school science syllabuses. The science processes specifically required at primary school level are observing, classifying, measuring, communicating, inferring, predicting, formulating hypothesis, experimenting, interpreting data, and controlling variables (Ministry of Education Malaysia 2003). The science curriculum also stated that the teaching and learning strategies should enable scientific concepts to be mastered by applying SPS and inquiry skills through investigation and practical work. Therefore the science syllabuses of primary school education in Malaysia require that teachers use learner-centred methods to teach and provide the students with these investigation and experimental skills.

Science Teaching and Inquiry

Science curricula around the world emphasize inquiry in the science teaching. In the context of science, "inquiry" refers to the scientific inquiry that scientist do (Schwab 1960 in Settlage & Southerland 2007). In this view, students were considered as junior scientist with less sophisticated knowledge. In other words, "it refers to the abilities students should develop to be able to design and conduct scientific investigations and to the understanding they should gain about the nature of scientific inquiry" (NRC 2000). In the context of instruction, inquiry refers to "the teaching and learning strategies that enable scientific concepts to be mastered through investigation and practical work" (NRC 2000).

In science classroom, the investigations or practical work normally takes place in science laboratory. There is a general acceptance on the view that SPS have to be acquired in the laboratory (though laboratory may not be narrowly construed) (Solomon 1980). According to Kim (2007), inquiry–based teaching that engages students in various hands-on activities in the science laboratory is believed to enhance children's SPS and create positive attitude towards science. Inquiry based lab activities also have a potential to facilitate students' conceptual development (Hofstein & Lunetta 2004). In the Malaysian primary school science curriculum, it is emphasised that teaching and learning should enable scientific concepts to be acquired through investigation. Science classroom should therefore involve students in a wide range of inquiry activities. In the context of Malaysia, The Curriculum Development Centre, Ministry of Education has proposed inquiry process or SPS to include; observing, measuring, predicting, inferring, using numbers, using space and time relationships, defining operationally, formulating hypotheses, interpreting data, controlling variables, experimenting, and communicating. Pupils at the end of their primary education should acquire all these 12 process skills.

This scientific approach to inquiry is a domain of knowledge (Campbell et al. 2005) which has a conceptual and a procedural or operational component. The procedural part is the "doing" of practical work or investigation, while the conceptual part is the underlying meaning of the processes. Lunetta (1998) over the years had argued that there are two frameworks used as organisers of school science. First, it was the framework of "telling the story of science" in which the goal of laboratory activities was to verify the story; that is, to verify the scientific laws presented in the theory lessons. Second, it was the hands-on framework that emphasised on science process skills. He further argued that it was not enough to verify science laws and principles by simply following the procedures, but it was also important to understand the scientific concepts themselves, whether they were theoretical or practical.

Evidence is increasing to support this view that learning of science process and product are intertwined (Metz 1995). Within this view is the concern for what Brown et al. (1989) refer to as authentic activity. Thus authentic school science requires that learners experience and acquire both the procedural and conceptual knowledge of the content of science. However, in reality, the investigation and practical work of science in schools in Malaysia is conducted by students by following instructions. Most of the investigations carried out involving manipulating the apparatus and follow the instructions given either by teachers or stated in the practical work books (Ong et al. 2006). Scanlon et al. (2002) categorically state that many of the skills associated with experimental investigation are seldom explicitly taught. They assumed that students are expected to pick them up through osmosis, simply through the experience of working in a laboratory environment.

Teachers are considered as an important factor in many studies on effective schools. Thus, before any intervention is carried out as part of collaborative action research by training providers, namely Faculty of Education as well as Institutes of Teacher Education, it is necessary to determine the level of competencies of primary school teachers themselves in science process skills. This study aims to identify and investigate the teacher's perception of understanding, conceptions and competence of the integrated SPS, both the theory and practical components, among primary teachers in the Federal Territory of Kuala Lumpur, Malaysia. Perception of understanding refers to what the teacher perceived of their understanding of each sub component of integrated SPS. Demonstrated conceptual knowledge refers to the ability to provide the underlying meaning of each component of the integrated SPS. While competence refers to the ability of the teachers to use the skills practically (was determined by the ability of the teachers to answer 25 multiple-choice exam questions developed specifically for the content of science in the Malaysian science curriculum at primary level). This study also investigates whether there is a difference in conception and competence of integrated SPS according to teaching experiences, options and gender.

DATA COLLECTION AND ANALYSIS

The sample of this study consisted of 329 science primary teachers who were randomly selected from 52 primary schools in Kuala Lumpur. The survey research instrument consists of four sections in which Part I seeks to obtain demographic data and Part II requires the respondents to state their perception on their level of understanding of the integrated SPS. Part III requires the respondents to state the conceptual definition or meaning of each component of integrated SPS. Conceptual definition and meaning of each integrated SPS used in this study are as described by the Curriculum Development Centre, Ministry of Education Malaysia (2003). These conceptual definitions were examined in order to provide underlying meanings or definitions of the integrated SPS. Standard definition for each component of the integrated SPS was approved by joint evaluation of expert teachers and lecturers in science education. The "correct" and "partially correct" definitions were indication of the acquisition of conceptual knowledge of integrated SPS (theoretical) and vice versa. Part IV examines the acquisition level of the integrated SPS (operational) of the respondents. The instrument had five constructs: 1) Making Hypothesis, 2) Controlling Variables, 3) Defining Operationally, 4) Interpreting Data and 5) Experimenting. The construct reliability values range from 0.34 to 0.53. 25 items (5 items for each sub construct of integrated SPS) in the test for acquisition level of integrated SPS was developed specifically for the content of science in the Malaysian science curriculum at primary level. According to Harlen (1999), it is not valid to assess mastery of SPS in the item that requires understanding of the concepts that are not learned by someone . Thus the objective of this test is to assess the integrated SPS associated with the content of Malaysian primary school science curriculum. Data were using descriptive and inferential statistics (t test and ANOVA).

RESULTS

RESPONDENTS' BACKGROUND

A total of 329 primary science teachers responded to the questionnaire. Four of the respondents (1.2%) has a degree in Master of Education, 147 (44.7%) graduated with a degree in various fields, 114 (34.7%) hold a Malaysian Higher School Certificate (STPM) and 64 (19.5%) hold a Malaysian Certificate of Education (SPM). All of the respondents also have a Diploma of Education where 222 (67.5%) of the respondents are science options while 107 (32.5%) are non science options. This indicates that teaching of primary science is usually conducted by those trained in the science option. Teaching experience of the respondents was between 1 to 25 years where 30 (20.7%) of them have teaching experience between 1 to 5 years, 63 (43.4%) between 6 to 10 years and 52 (35.9%) between 11 to 25 years. In terms of gender, 210 (63.8%) of the respondents were female which is a reflection of the teaching force at the primary school, in which most primary teachers are female.

RESPONDENT PERCEPTION OF THEIR UNDERSTANDING OF INTEGRATED SPS.

Table 1 presents the percentages of teachers based on perception of their understanding of the integrated SPS.

TABLE 1. Percentages of teacher perceptions of understanding of integrated SPS according to sub-constructs

Integrated Science Process Skill	Understand completely	Understand	Not Sure	Do not Understand	Do not Understand completely
Controlling Variables	31.9	47.4	11.2	0	0.3
Making Hypothesis	33.4	49.8	7.3	0.3	0
Defining Operationally	18.8	55.3	15.8	0	0.3
Interpreting Data	25.2	58.4	7.0	0.3	0
Experimenting	30.1	51.4	9.1	0	0

As indicated in Table 1, majority of the science teachers (74.1% to 83.6%) claimed that they “understand completely” or “understand” each component of integrated SPS. Yet the percentage indicating “understand completely” is in the range of 18.8 to 33.4 percent. This reflects that the majority of teachers are still not confident about their understanding on the concept of integrated SPS. Percentage of teachers who say “understand completely” and “understand” is the lowest for the skill related to defining operationally and the highest for the skills of making hypothesis. The findings also showed that there are still teachers who perceived that they do not understand what is meant for each component of these integrated SPS, as indicated from their responses of “not sure”, “not understand” and “do not understand completely”.

RESPONDENTS’ CONCEPTION OF THE INTEGRATED SPS

Table 2 shows the percentage of teachers according to the ability to give the correct meaning of each component of the integrated SPS.

Although the teachers’ perception shows that they are confident with their understanding of integrated SPS (Table 1), but in terms of actual ability, more than 65% of teachers gave the wrong answer to the definition of integrated SPS except for making hypothesis skills (49.0% - Table 2). Percentages of teachers providing the acceptable conceptual definition for the process of defining operationally is the lowest (13.1%) while the highest is for making hypothesis (51.0%).

One sample t-test was then carried out on the science teachers’ definition scores by using a test value of 2 (the midpoint of the scale). Correct definition is given three points on the scale, partially correct definition is given two points and incorrect definition is given a score of one point. T-test analysis in Table 3 indicated that there were significant differences at 0.05 level of confidence from the test value in the teachers’ scores. Mean scores for all integrated SPS was less than 2. So, the finding shows that the science teachers did not have sufficient conceptual knowledge of integrated SPS to help their students to understand the SPS in a meaningful way.

TABLE 2. Percentage of teachers providing definition of integrated SPS

Integrated SPS	*N*	Conceptual Knowledge			
		Demonstrated		Not demonstrated	
		n	%	*n*	%
Controlling Variables	145	50	34.5	95	65.5
Making Hypothesis	145	74	51.0	71	49.0
Defining Operationally	144	19	13.1	125	86.2
Interpreting Data	145	33	22.7	112	77.2
Experimenting	145	37	25.5	108	74.5

TABLE 3 T-test for score mean of definition of integrated SPS

Subject	Group	M	SD	Std. Error Mean	*t*	Sig. (2-tailed)
Conceptual	Controlling Variables	1.38	0.55	0.046	-13.50	0.00*
knowledge	Making Hypothesis	1.64	0.70	0.058	-6.13	0.00*
	Defining Operationally	1.17	0.43	0.049	-14.34	0.00*
	Interpreting Data	1.30	0.59	0.036	-23.15	0.00*
	Experimenting	1.27	0.48	0.039	-18.53	0.00*

Based on teaching experience, Table 4 shows that teachers with teaching experience between six years and above have better conceptual knowledge except for the skills of defining operationally and interpreting data. However results of the ANOVA analysis test in Table 5 showed that there were no significant differences for the conceptual knowledge level of integrated SPS owned by the science teachers.

TABLE 4. Teachers conceptual knowledge of integrated SPS based on teaching experiences

Integrated SPS	Teaching Experience	*N*	Competent n(%)	Incompetent *n*(%)
Controlling Variables	1-5	30	10(33.3)	20(66.7)
	6-10	63	23(36.5)	40(63.5)
	≥11	52	17(32.7)	35(73.5)
Making Hypothesis	1-5	30	14(47.0)	16(53.3)
	6-10	63	34(54.0)	29(46.0)
	≥11	52	26(50.0)	26(44.1)
Defining Operationally	1-5	30	5(16.6)	25(83.3)
	6-10	63	9(14.3)	54(85.7)
	≥11	52	5(9.6)	47(91.2)
Interpreting Data	1-5	30	10(33.4)	20(66.6)
	6-10	63	10(15.9)	53(84.1)
	≥11	52	13(25.0)	39(76.5)
Experimenting	1-5	30	7(23.3)	23(76.7)
	6-10	63	16(25.4)	47(74.6)
	≥11	52	14(26.9)	38(73.6)

TABLE 5. Level of conceptual knowledge of integrated SPS based on teaching experiences

Subject		Sum of Squares	*df*	Mean Square	*F*	Sig.
Controlling Variables	Between Group	0.300	2	0.150	0.487	0.616
	Within Group Total	43.838 44.138	142 144	0.309		
Making Hypothesis	Between Group	0.215	2	0.108	0.215	0.807
	Within Group Total	71.137 71.352	142 144	0.501		
Interpreting Data	Between Group	1.758	2	0.879	2.574	0.080
	Within Group Total	48.491 50.248	142 144	0.341		
Defining Operationally	Between Group	0.186	2	0.093	0.498	0.609
	Within Group Total	26.504 26.690	142 144	0.187		
Experimenting	Between Group	0.058	2	0.029	0.127	0.881
	Within Group Total	32.452 32.510	142 144	0.229		

$^{*}p < 0.05$

Based on teachers' options, t-test analysis results in Table 6 shows that there are significant differences (p<0.05) for the conceptual knowledge on controlling variables, making hypothesis and experimenting.

T-test analysis results in Table 7 shows that there are no significant differences (p<0.05) for conceptual knowledge of integrated SPS among science teachers based on gender (t= -1.325, p=0.187).

RESPONDENTS' COMPETENCE OF THE INTEGRATED SPS

Table 8 shows the level of teacher's competency of integrated SPS. The overall mean score out of 25 total possible points on the instrument was 20.86, or 83% correct (s.d. = 3.83), with a range from 7 to 25 correct responses.

The findings show teachers' competency for the skills of interpreting data (m=4.77), controlling variables (m=4.18) and experimenting (m=4.11) is at a good level. While the skills of making hypothesis and defining operationally is at a moderate level.

Based on the gender factor, t-test analysis results in Table 9 shows that there is no significant differences (p<0.05) for the competency level of for most of the sub-constructs of integrated SPS based on gender; except for the skill of defining operationally,

TABLE 6. The level of conceptual knowledge of integrated SPS based on teachers' option

Subject	Group	M	SD	Std. Error Mean	t	Sig. (2-tailed)
Acquisition of	option	1.44	0.593	0.060	2.103	0.037*
Controlling Variables	non-option	1.24	0.431	0.064		
Acquisition of	option	1.76	0.730	0.073	2.996	0.003*
Making Hypothesis	non-option	1.39	0.577	0.085		
Acquisition of	option	1.21	0.480	0.048	1.639	0.103
Defining operationally	non-option	1.09	0.285	0.042		
Acquisition of	option	1.32	0.636	0.064	0.797	0.427
Interpreting Data	non-option	1.24	0.480	0.071		
Acquisition of	option	1.32	0.512	0.051	2.040	0.043*
Experimenting	non-option	1.15	0.363	0.054		

*$p < 0.05$

TABLE 7. The level of conceptual knowledge of integrated SPS based on gender

Subject	Group	M	SD	Std. Error Mean	t	Sig. (2-tailed)
Acquisition of	Male	1.27	0.451	0.068	-1.537	0.126
Controlling Variables	Female	1.43	0.589	0.059		
Acquisition of	Male	1.50	0.550	0.083	-1.605	0.111
Making Hypothesis	Female	1.70	0.756	0.075		
Acquisition of	Male	1.18	0.446	0.067	0.173	0.863
Defining Operationally	Female	1.17	0.426	0.042		
Acquisition of	Male	1.27	0.449	0.075	-0.320	0.750
Interpreting Data	Female	1.31	0.628	0.063		
Acquisition of	Male	1.20	0.408	0.062	-1.078	0.283
Experimenting	Female	1.30	0.501	0.050		

*$p < 0.05$

TABLE 8. Level of teachers' competency of integrated SPS

Integrated SPS	Total question	Minimum marks	Maximum marks	Mean	Standard Deviation
Controlling Variables	5	0	5	4.18	1.16
Making Hypothesis	5	0	5	3.67	1.47
Defining Operationally	5	1	5	3.81	1.01
Interpreting Data	5	1	5	4.77	0.73
Experimenting	5	0	5	4.11	1.52
Total	25	7	25	20.86	3.83

TABLE 9. Teachers' competency level of integrated SPS tests based on gender

Subject	Group	M	SD	Std. Error Mean	t	Sig. (2-tailed)
Acquisition of	Male	4.17	1.084	0.099	-0.096	0.923
Controlling Variables	Female	4.18	1.208	0.083		
Acquisition of	Male	3.73	1.382	0.127	0.580	0.562
Making Hypothesis	Female	3.63	1.517	0.105		
Acquisition of	Male	3.50	1.134	0.104	-4.388	0.000*
Defining Operationally	Female	3.99	0.886	0.061		
Acquisition of	Male	4.82	0.61	0.056	1.021	0.308
Interpreting Data	Female	4.74	0.79	0.055		
Acquisition of	Male	4.03	1.729	0.159	-0.731	0.465
Experimenting	Female	4.15	1.382	0.095		

*$p < 0.05$

which showed that females perform better than the males (t=-4.388).

While based on teaching experience, the ANOVA test analysis in Tables 10 and 11 showed that there was no significant difference for all the sub constructs of integrated SPS based on teaching experience possessed by science teachers.

Based on teachers' options, t-test analysis results in Table 12 showed that there was no significant differences for most the sub constructs except for the skills of interpreting data; in which teachers of science option significantly acquire the skills compared to those who are non science options($t = 2.329$, $p = 0.020$).

DISCUSSION

The findings show that teachers' perceptions on their level of understanding of integrated SPS is high (within 74.1% to 83.6%), but the actual level of understanding (conceptual knowledge) of the integrated SPS is low (in the range 13.1% to 51.0%). This shows that there is a discrepancy between teachers' perception on their level of understanding of integrated SPS and their actual level of understanding (conceptual knowledge). Teachers feel that they have understood what is meant by the skills but the fact is that their understanding of the skills is inaccurate or incorrect. This incongruity between the perceptions and the actual level of understanding (conceptual knowledge) may be

TABLE 10. Teachers' competence level of integrated SPS according to teaching experiences

Integrated SPS	Teaching experiences	Minimum marks	Maximum marks	Mean	Standard Deviation
Controlling Variables	1-5	1	5	4.24	1.20
	6-10	1	5	4.18	1.17
	≥11	0	5	4.15	1.20
Making Hypothesis	1-5	0	5	3.58	1.58
	6-10	0	5	3.69	1.46
	≥11	1	5	3.76	1.38
Defining Operationally	1-5	1	5	3.71	1.14
	6-10	1	5	3.90	0.87
	≥11	1	5	3.76	1.06
Interpreting Data	1-5	1	5	4.69	0.86
	6-10	1	5	4.81	0.70
	≥11	2	5	4.79	0.60
Experimenting	1-5	0	5	3.99	1.53
	6-10	0	5	4.13	1.46
	≥11	0	5	4.06	1.64

TABLE 11. ANOVA analysis of differences between the competence level of integrated SPS based on teaching experiences

Subject		Sum of Squares	df	Mean Square	F	Sig.
	Total	4812.286	328			
Controlling Variables	Between group	0.829	3	0.276	0.517	0.671
	Within Group	173.615	325	0.534		
	Total	174.444	328			
Making Hypothesis	Between group	2.260	3	0.753	0.737	0.530
	Within Group	332.056	325	1.022		
	Total	334.316	328			
Defining Operationally	Between group	1.651	3	0.550	0.254	0.859
	Within Group	705.236	325	2.170		
	Total	706.888	328			
Interpreting Data	Between group	0.922	3	0.307	0.226	0.879
	Within Group	442.853	325	1.363		
	Total	443.775		328		
Experimenting	Between group	3.731	3	1.244	0.539	0.656
	Within Group	749.546	325	2.306		
		Total	753.277	328		

*$p < 0.05$

TABLE 12. The competence level of sub-components integrated SPS according to teachers' option

Subject	Group	M	SD	Std. Error Mean	t	Sig. (2-tailed)
Acquisition of	Option	4.81	0.648	0.043	1.338	0.182
Controlling Variables	Non Option	4.69	0.873	0.084		
Acquisition of	Option	4.19	1.165	0.078	1.147	0.252
Making Hypothesis	Non Option	4.03	1.169	0.113		
Acquisition of	Option	4.28	1.182	0.079	2.329	0.020*
Interpreting Data	Non Option	3.96	1.098	0.106		
Acquisition of	Option	3.75	1.449	0.097	1.409	0.160
Defining Operationally	Non Option	3.50	1.501	0.145		
Acquisition of	Option	4.08	1.586	0.106	-0.513	0.608
Experimenting	Non Option	4.17	1.363	0.132		

*$p < 0.05$

due to several factors. One possible reason is that most of the terms or words used to describe the SPS are also used in everyday words (Farsakoglu et al. 2008)

Even though, the level of understanding (conceptual knowledge) is low, however the findings also show that the competence level of integrated SPS among teachers is good as a whole. The findings of this study support the study conducted by Hezekiah (2008) that most science teachers are not able to describe the skills (SPS) even though they are able to implement them practically. In addition, the evaluation system in primary schools in Malaysia does not test the conceptual knowledge of integrated SPS among students in the public examination. Assessment of Science subject in this examination only tests for students' competency in performing the practical component of SPS. Therefore, science teachers did not feel the need to teach the conceptual knowledge of SPS. Thus the issue of having sufficient conceptual knowledge of the SPS is not important to the science teachers. This may then explains why the findings in this study indicate that the level of acquisition (practical) on integrated SPS among teachers is high but the level of conceptual knowledge (theoretical) is low.

The low level of teachers' conceptual knowledge of integrated SPS could also be attributed to the practice in the Malaysian education system that emphasize a "following instruction" approach in conducting investigation. This approach promotes students capability of performing SPS operationally (practical) but not the understanding of what is meant by each of these skills. This might explain why the science teachers in this study displayed a good level of mastery of these skills operationally (practical), but not conceptually because they went through the education system from primary level to teacher training institutions that emphasize on this approach.

Thus, the overall findings of this study indicate that science teachers in primary schools in Kuala Lumpur do not have sufficient conceptual knowledge of integrated SPS (theoretical) to help their students to understand these skills in a meaningful way. As a result, students may also have a low level of understanding of the integrated SPS. This is because the implementation of these skills (application) depends on the ability of the teachers (Karsli et al. 2009). Findings by Aiello-Nicosia et al., (1984) show that there is a correlation between the level of understanding and mastery of SPS teachers with the level of students' understanding and mastery of SPS.

The findings in this study also showed the competence level according to each sub components of integrated SPS, parallels with the findings of the study by Ong et al. (2006) and Tan (1996) stating that the level of teachers the skill of interpreting data is the highest compared to other sub component of integrated SPS. This finding is also consistent with the findings of previous studies showing that the level of hypothesis making skills (Mohamed Isa Khalid 2001; Ong et al. 2006; Tan & Chin 2001) and defining operationally (Aziz et al. 2008) are moderate compared to the other skills.

The findings of this study also showed that there is no significant difference of the conceptual knowledge (theoretical) and competence level (operational) of integrated SPS based on gender. Although the findings of previous studies showing that male teachers have a better level of mastery in the field of science than women teachers (Nevin & Mustafa 2010), but these findings indicate otherwise. However, this finding is consistent with findings by Brian et al. (2004) also showed that there was no difference significant on the level of integrated SPS based on gender.

Based on the factors of teaching experience, overall, the findings showed that teachers with longer teaching experience (15 years or more) have a higher perception of their level of understanding of integrated SPS than teachers with less teaching experience (1 to 15 years). So this implies that teachers with longer teaching experience have high level of confidence in the level of understanding of integrated SPS than teachers with less teaching experience. However this finding is not parallel to the actual level of understanding (conceptual knowledge) of integrated SPS. The analysis of ANOVA indicates that there is no significant difference on the level of teachers' conceptual knowledge of integrated SPS based on teaching experience. This may be due because of the teachers already have less accurate of understanding on these skill since the early years of teaching and it is remain unchanged despite their increased teaching experience. This may be caused by teacher training undergo by the teacher does not provide them with sufficient knowledge of these skills theoretically. Similarly, in-service training attended by teachers also not emphasize this SPS theoretically but mostly focus on improving teachers' practical mastery of SPS alone. This may explain why experienced teachers did not show different levels of conceptual knowledge of integrated SPS then the teachers with less teaching experience.

Analysis of ANOVA tests showed that there was no significant difference to the competence level of integrated SPS (practical) based on teaching experiences possessed by teachers. The findings of this study are in line with findings by Brian et al. (2004) show that there is no difference in the competence level of integrated SPS based on teaching experience. Based on the factor of teaching options, the findings show that the overall percentage of teachers who say "understand completely" is higher for teachers of science option than the non-option teachers for all components of integrated SPS. Although science option teachers are more confident on their level of understanding than the non science option teachers, however, the percentage of science option teachers that claimed "understand completely" and "understand" is in the range of 20 to 40%. This indicates that although teachers undergo science options during the teacher training course, they still have a low level of confidence in the understanding of the integrated SPS as a whole. Similarly, the conceptual knowledge level of integrated SPS among science option teachers also found to be higher than the non-option teachers. The findings also show that there are significant differences on the conceptual knowledge level of integrated SPS among teachers based on teacher option. This is probably because the science option teachers have more in-depth exposure to the SPS through science education programs at universities or teacher training college compared with non-science option teachers.

Although science option teachers have the SPS conceptual knowledge level better than non-science option teachers, but the findings indicate that the level of conceptual knowledge of science teachers with the option is still low because only in the range of 17% to 59% only. This indicates that science option teachers still have the low level of conceptual knowledge even though they have undergone relevant training at the universities of teacher training institutes. Thus, the training or exposure to the implementation of the SPS at these training institutes is insufficient to improve teachers' conceptual mastery of integrated SPS. This is further supported by findings by Shaharom and Hanizah (2008) show that practical education courses in teacher education institutions is less helpful in increasing the level of students' understanding of the SPS. Similarly, a study by Karsli et al. (2009) states that SPS is not emphasized in teacher training colleges. Ebru & Deniz (2010) in their study also showed that teacher training does not provide science teachers with sufficient skills in designing lesson plans that integrate the SPS. His study also showed that science teachers are not exposed to enough of the latest models of teaching as inquiry. Therefore, the pre-service training should focus on improving skills to design and implement inquiry-based teaching of SPS. Prospective teachers should be involved in planning activities that integrating SPS so that their conceptual knowledge can be improved and then will be able to teach this SPS meaningfully to their future students.

CONCLUSION

The findings showed that majority of teachers perceived that they have a high level of understanding on each of the sub-component of an integrated SPS. However teachers' perception on their level of understanding of the integrated SPS was found to be inconsistent with the actual level of understanding (conceptual knowledge). Teachers did not have sufficient conceptual knowledge of integrated SPS to teach their students to understand it in a meaningful way. Primary teachers' competency in the integrated SPS is good at the practical stage but not theoretically. Therefore, emphasis should be given to integrated SPS both conceptual and operational knowledge in pre and in-service training to ensure that the teachers understand, acquire and are able implement the skills meaningfully.

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