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Pre-Service Science Teachers' Mental Images of Science Teaching

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ABSTRACT

The purpose of this study is to investigate pre-service science teachers' mental images of science teaching. This study also aimed to ascertain if there is any significant difference in pre-service science teachers' mental images of science teaching based on gender and levels of schooling. This study was both quantitative and qualitative in its design. In this study, the 'Draw-A-Science-Teacher-Test-Checklist' (DASTT-C) was used as the primary data collection instrument. Pre-service science teachers were instructed to draw pictures of themselves as science teachers at work and write a brief explanation describing their drawings. They were also asked to specifically answer two questions namely, "What is the teacher doing?" and "What are the students doing?" regarding their drawings. This study revealed that pre-service science teachers had three different teaching styles which were categorized as, i) 'neither student-centred nor teacher-centred (no decision)', ii) 'teacher-centred' and iii), 'student-centred'. Independent sample *t*-test results showed that there was no significant difference in pre-service science teachers' mental images of science teaching based on gender. However, there was a significant difference in pre-service science teachers' mental images of science teaching based on levels of schooling

Keywords: Pre-Service science teachers, mental images of science teaching, DASTT-C

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INTRODUCTION

One of the fundamental goals of the National Science Education Standards (National Research Council, 1996) is to instill science learning as an active, inquiry-based activity that students do rather than something that is done for them. Following the explicit goal of the standards to establish scientific literacy for all, students are expected to participate in hands-on and minds-on learning experiences that reflect the intellectual traditions of the contemporary science. In relation to this, standards-based lessons involve children in inquiry-oriented investigations, help them to establish connections, encourage questions, promote problem solving, and support group discussions. In the words of the Standards, "Emphasizing active science learning means shifting away from teachers presenting information and covering science topics. The perceived needs to include all the topics, vocabulary, and information in the textbooks are in direct conflict with the central goal of having students learn scientific knowledge with understanding" (National Research Council, 1996, p.20).

In accordance with the National Science Education Philosophy, science curriculum in Malaysia gives clear and conscious emphasis on the acquisition of scientific skills and thinking skills, the fostering of scientific attitudes and noble values besides the acquisition of scientific and technological knowledge and its application to the natural phenomena and students' day-to-day experiences (Curriculum Development Centre, 2001). Teaching and learning strategies recommended in the science curriculum emphasise thoughtful learning, a process that helps students acquire knowledge and master the skills that will help them develop their minds to the optimum level. In relation to this, thoughtful learning can occur through various learning approaches such as inquiry, constructivism, contextual learning, and mastery learning (Curriculum Development Centre, 2001).

Many studies showed that using inquiry and constructivist perspective is the most effective way to teach science as students experience the learning of science as a process of doing something or looking at something, and then learning what it means by processing their observations with their classmates. In constructivist perspective, students are encouraged to ask their own questions, carry out their own experiments, make their own analogies, and come to their own conclusions by themselves (Caprio, 1994; Staver, 1998; Yilmaz & Huyuguzel Cavas, 2006). These research findings indicate that "students are likely to begin to understand the natural world, if they work directly with natural phenomena, using their senses to observe, and using instruments to extend the power of their senses (National Science Board, 1991, p.27), while these approaches generally improve students' attitudes toward science in a positive way (Glasson, 1989). It is of no surprise that contemporary philosophers and educators suggest that it is time to replant student-centred instruction in the field of science learning (Taylor *et al.*, 1995; Turkmen, 2006; Turkmen & Pedersen, 2005; Yilmaz & Huyuguzel Cavas, 2006).

PROBLEM STATEMENT

Today's pre-service science teachers experience yesterday's science learning in the form of text-based, didactic lessons presenting science as an inert body of knowledge (Tobin *et al.*, 1990). Pre-service science teachers usually experience traditional science learning at primary and secondary levels where teachers are considered as the main source of knowledge that should be transmitted to students. Such learning experiences will undoubtedly have a powerful impact on the way in which pre-service science teachers understand the nature of science and the way in which science should be taught. Consequently, pre-service science teachers' mental models about science teaching are usually incompatible with science teaching as a hands-on and minds-on activity (Thomas *et al.*, 2001). As highlighted by Goodman (1988), pre-service teachers are guided by past events that create intuitive screens through which new information is filtered and transformed, and that their beliefs predict, to a certain extent, their teaching behaviour, and are much more influential than knowledge in determining their future teaching practices and approaches. Hence, this study is crucial due to the inadequate understanding of pre-service science teachers' mental images of themselves as science teachers at work especially in the state of Sabah, Malaysia.

PURPOSE OF THE STUDY

The purpose of this study is to investigate pre-service science teachers' mental images and teaching styles of science teaching and to ascertain the significant difference in pre-service science teachers' mental images of science teaching based on gender and levels of schooling.

RESEARCH QUESTIONS

Four research questions have been formulated in this study, namely,

1. What mental images do pre-service science teachers have of themselves as science teachers at work?
2. What teaching styles do pre-service science teachers have of themselves as science teachers at work?
3. Is there a significant difference in pre-service science teachers' mental images of science teaching based on gender?
4. Is there a significant difference in pre-service science teachers' mental images of science teaching based on levels of schooling?

RESEARCH DESIGN

This study was both quantitative and qualitative in its design. The 'Draw-A-Science-Teacher-Test-Checklist' (DASTT-C) (Thomas & Pedersen, 1998a, 1998b; Thomas *et al.*, 2001) was used to investigate pre-service science teachers' mental images of themselves as science teachers at work. The DASTT-C was selected as it lends itself to this type of data collection and can assist in evaluating how pre-service science teachers perceived their self-image as science teachers. The DASTT-C is one of the essential instruments that can be used to develop techniques and procedures for promoting reflection and analysis of pre-service science teachers' thinking.

RESEARCH SAMPLES AND SAMPLING METHODS

The sample consisted of primary and secondary schools pre-service science teachers who were selected by using cluster random sampling technique. The teachers were chosen from the Teacher Education Institute - Kent Campus and School of Education and Social Development, Universiti Malaysia Sabah, respectively. The selected sample limits the generalisability of the research findings. The distribution of pre-service science teachers according to gender and levels of schooling (primary or secondary school) is illustrated in Table 1.

INSTRUMENTATION

Pre-service science teachers' mental images of science teaching were measured by DASTT-C, an essential instrument that is used to develop techniques and procedures for promoting reflection and analysis of pre-service science teachers' thinking.

The 'Draw-A-Science-Teacher-Test-Checklist' (DASTT-C)

In this study, the 'Draw-A-Science-Teacher-Test-Checklist' (DASTT-C) was used as the primary data collection instrument.

Teachers were provided with writing material where on the first page, pre-service science teachers were instructed to "draw a picture of themselves as a science teacher at work". On the second page, pre-service science teachers were required to write a brief explanation describing their drawings and specifically answer the questions, "What is the teacher doing?" and "What are the students doing?" regarding their drawings. The short narrative helps to define the meanings of the more illustrative images as well as the more abstract images. In the case of the illustrative images, the narrative helps to confirm the meaning of the images. With more abstract images, the narrative gives meaning to the symbols or metaphors indicated in the drawings. The DASTT-C consists of three sections: (a) Teacher, including two subsections: teacher's activity (demonstrating, lecturing, using visual aids, etc.) and teacher's position (location with respect to students, such as at the head of the classroom; and posture); (b) Students, including two subsections: student's activity (passively receiving information, responding to the teacher, etc.) and student's positions (seated within the classroom); and (c) environment, including

TABLE 1
Distribution of Pre-Service Science Teachers according to Gender and Levels of Schooling

		n	%
Gender	Male	26	33.3
	Female	52	66.7
	Total	78	100
Level	Primary school	30	38.5
	Secondary school	48	61.5
	Total	78	100

5 sub-sections: desks arranged in rows, teacher desk, lab organization, symbols of teaching (e.g. chalkboards), and symbols of science knowledge (e.g. science equipment). The teachers took about 15-20 minutes to complete the DASTT-C task.

Reliability and Validation of the DASTT-C Instrument

To determine the internal consistency of the original DASTT-C instrument, a pilot checklist was developed. The checklist indicators were derived from the DASTT-C as well as from a review of the traditional and reform emphases as suggested in the new science teaching standards (National Research Council, 1996). Five raters checked 10 samples according to 11 criteria. A Phi coefficient rating measured the association of scores between raters. Items receiving a rating of .70 or higher remain unchanged. Items rated below .70 were either eliminated or modified by clarifying the descriptors. The final form includes 10 criteria and three modified criteria. This form of the DASTT-C was then tested for internal consistency and for inter-rater reliability. Five raters scored the same set of pictures independently using the new form of the DASTT-C. In each case, individuals were asked to follow the scoring directions and score the complete set of pictures. An analysis of variance (ANOVA) was completed on the set of five scores examining the differences in the scores of each picture between the five individuals. No significant difference was found in any of the sub scores or total scores of the DASTT-C. As well, the set of scores was used to determine a coefficient of internal consistency. A coefficient alpha was calculated for the data set since the DASTT-C produces dichotomous data. For dichotomous data, the coefficient alpha is equivalent to the Kuder-Richardson-20 (KR-20) which uses the method of rational equivalence in determining internal consistency. The coefficient alpha for the DASTT-C is .82 indicating a high degree of internal consistency in the instrument. As well, all five individuals were asked to determine the face validity of the instrument. In each case, the five individual scorers indicated that the instrument appears to be relevant in terms of content. Although Thomas, Pedersen, and Finson (2001) reported the instrument's reliability to be KR-20 = .82, the Cronbach's alpha reliability coefficient was found to be KR-20 = .70 in the context of this study. On the other hand, the validity of the DASTT-C instrument was determined via review of drawings.

DATA COLLECTION PROCEDURES

Before administering the DASTT-C instrument, formal permission from the related authorities was sought and obtained. The DASTT-C instrument was personally-administered by the researchers. Pre-service science teachers were gathered in the lecture rooms and the instrument was administered to them concurrently. They were informed about purpose of the instrument.

DATA ANALYSIS PROCEDURES

Each subsection in the DASTT-C was scored in a dichotomous fashion with an indication of "Present" (1) or "Not present" (0) in the picture. The data was analyzed by tabulating the number of responses for each of the categories and their attributes using the DASTT-C instrument. Each element of the DASTT-C is considered to depict stereotypical elements of teacher-centred teaching and classroom images. If a stereotypical element appears in a student's drawings, the corresponding element is marked on the checklist. Marks can later be added to derive both sub-scores for each section as well as an overall checklist score. Total checklist scores can range from 0 to 13. The higher the score, the more teacher-centred is the teaching style. Scores are grouped into three ranges on a continuum, with scores of 0 - 4 representative of student-centred teaching style, 10 - 13 representative of teacher-centred teaching style, and 5 - 9 representative of neither student-centred nor teacher-centred (no decision) teaching style.

In relation to this, Thomas *et al.* (2001) defined their use of the terms 'Student-Centred' as representing exploratory or inquiry / constructivist teaching, in which students are actively engaged and the teacher is guiding or facilitating the learning and in which the students are selecting and pursuing those investigations of interest and importance to them; 'Teacher-Centred' represented as explicit / didactic teaching in which the teacher is the central image and one who is predominantly a transmitter of information, while students are relatively passive and often in desks arranged in rows; middle scores are represented by conceptual teaching showing students at the center, but likely to include more teacher images within the central aspects of the images and have them leading the formation of concepts or providing information leading directly to concept formation and usually show students engaged in exploration and investigation with materials (Finson, 2001; Thomas & Pedersen, 2001; Thomas, *et al.*, 2001). In addition, , the DASTT-C Teaching Styles Continuum (derived from Simmons *et al.*, 1999) serves as the report form for the pre-service science teachers. It is intended that pre-service science teachers might first locate themselves on the continuum (according to the descriptions) and then consider the position determined by their DASTT-C score.

On the other hand, as an effort to ensure all the quantitative data were drawn from a normally distributed population, graphical measures such as histogram, stem-and-leaf plot, normal Q-Q plot, and detrended normal Q-Q plot were plotted for each of the variables studied. Furthermore, numerical measures such as skewness and kurtosis were used to identify deviations from normal distributions (Hair *et al.*, 1998; Miles & Shevlin, 2001). After the assumptions of using parametric techniques in analyzing quantitative data were met, independent sample *t*-test was used to test the stated null hypotheses at a predetermined significance level, alpha = .05. Independent sample *t*-test was used to determine whether there is a significant difference in pre-service science teachers' mental images of themselves as science teachers at work based on gender and levels of schooling.

RESEARCH FINDINGS AND DISCUSSION

Pre-Service Science Teachers' Mental Images of Science Teaching

As mentioned earlier, the total checklist scores of the DASTT-C instrument can range from 0 to 13. The higher the score, the more teacher-centred is the teaching style. In relation to this, scores were grouped into three ranges on a continuum, with scores of '0 – 4' representative of 'student-centred' teaching style, '10 – 13' representative of 'teacher-centred' teaching style, and '5 – 9' representative of 'neither student-centred nor teacher-centred (no decision)' teaching style. As illustrated in Table 2, 51.3% of pre-service science teachers were categorized as 'neither student-centred nor teacher-centred (no decision)' teaching style. This is followed by 28.2% of pre-service science teachers were categorized as 'teacher-centred' teaching style whereas 20.5% were categorized as 'student-centred' teaching style. Table 3 shows the mean and standard deviation of pre-service science teachers' mental images of themselves as science teachers at work according to the DASTT-C subsections.

On the other hand, the DASTT-C Teaching Styles Continuum (derived from Simmons *et al*., 1999) serves as a report form for the pre-service science teachers to locate themselves on the continuum according to the given descriptions. As shown in Table 4, we observe that 56.4% of pre-service science teachers were categorized as

TABLE 2
Distribution of Pre-service Science Teachers according to Different Types of Mental Images of Science Teaching

Type of Mental Images of Science Teaching	*n*	%
Student-Centred (0-4)	16	20.5
No-Decision (5-9)	40	51.3
Teacher-Centred (10-13)	22	28.2
Total	78	100

TABLE 3
Mean and Standard Deviation of Pre-Service Science Teachers' Mental Images of Themselves as Science Teachers at Work according to the DASTT-C Subsections

DASTT-C Subsections	*n*	*M*	Average Item Mean[a]	*SD*	Average Item Std. Dev.
Teacher's Activity and Teacher's Position	78	3.41	.682	1.012	.202
Students' Activity and Students' Position	78	1.74	.580	.973	.324
Environment	78	2.60	.520	1.332	266
Overall	78	7.76	.60	2.693	.207

[a]Average item mean = Scale mean divided by the number of items in a scale

'conceptual teaching', 11.5% 'exploratory teaching', and only 5.1% were categorized as 'explicit teaching'. It should be noted that 26.9% of pre-service science teachers were uncertain about their teaching style. Table 5 shows the mean and standard deviation of pre-service science teachers' teaching styles.

As defined by Thomas *et al.* (2001), the term 'Student-Centred' was used as representing exploratory or inquiry/constructivist teaching; 'Teacher-Centred' as representing explicit or didactic teaching whereas 'No-Decision' as representing conceptual teaching. Table 6 shows the distribution of pre-service science teachers according to different types of mental images of science teaching and teaching styles. 34.6% of pre-service science teachers were categorized as 'No-Decision and Conceptual' teaching style, 6.41% 'Student-Centred and Exploratory' teaching style, and only 2.56% were categorized as 'Teacher-Centred and Explicit' teaching style. Surprisingly, 56.4% of pre-service science teachers were shown to have a 'mismatch' between their mental images of science teaching and teaching style.

TABLE 4
Distribution of Pre-service Science Teachers according to Different Types of Teaching Styles

Type of Teaching Styles	*n*	%
Exploratory(0-4)	9	11.5
Conceptual (5-9)	44	56.4
Explicit (10-13)	4	5.1
'Uncertain'	21	26.9
Total	78	100

TABLE 5
Mean and Standard Deviation of Pre-Service Science Teachers' Teaching Styles

Types of Teaching Styles	*n*	*M*	*SD*
Exploratory	78	1.36	1.032
Conceptual	78	2.71	1.058
Explicit	78	.94	.858

TABLE 6
Distribution of Pre-service Science Teachers according to Different Types of Mental Images of Science Teaching and Teaching Styles

Type of Mental Images and Teaching Styles	*n*	%
Student Centred & Exploratory	5	6.41
No-Decision & Conceptual	27	34.6
Teacher Centred & Explicit	2	2.56
'Mismatch'	44	56.4
Total	78	100

'Teacher-Centred' Teaching Style

In the teacher-centred teaching style, teachers were lead or directed learning activities, established order, presented the rules, and lectured. They appeared to have absolute authority, transmitted information, and did not provide assistance to students. The teacher was often teaching in front of a chalk board or a chart that supports the lesson presentation such as introducing the parts of an animal cell or a plant. Teacher-centred illustrations usually placed the teacher in front of the class and include the backs of student heads (if students are referenced at all). The students were sitting in straight rows listening and taking notes on their slates. They often appeared to be passive receivers of information. Classroom organization frequently indicated the traditional rows placement of desks or chairs, but even when the students were grouped they were working in a different area of the classroom. These images fit with teacher-centred thinking about subject matter knowledge being central of the learning process led by a teacher who organizes and delivers learning. Fig.1 and Fig.2 show examples of teacher-centred teaching style.

'No-Decision' Teaching Style

In the 'No-Decision' teaching style, it can be seen that students were doing some experiments with the same materials, being led by teachers, or the teacher was encouraging students to ask questions, participate learning process. Students were raising their hands to answer questions and actively doing an experiment assisted by teacher. For those drawings that were in the middle range of scores (5-9), the teacher-centred techniques involved in the

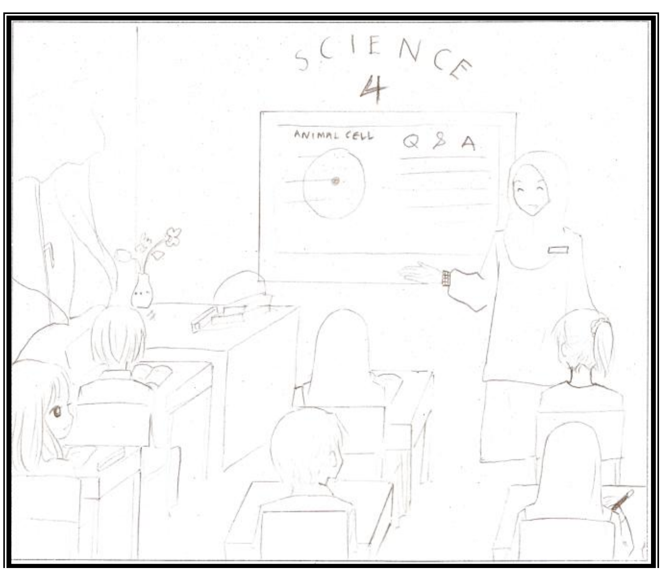

Fig.1: 'Teacher-Centred' Teaching Style (Example 1)

transfer of knowledge can be seen (e.g., lecturing, taking notes, writing, videos), as well as student-centred techniques (e.g., discussing, drawing, conducting experiments, conducting research, analyzing, planning, collaborating, etc). Generally, students carried out 'hands-on activities' in small groups, raised their hands to answer questions, and actively didexperiments assisted by the teacher. Typically, the teacher observed groups and may be seen intervening briefly in group's work to extend students' thinking. The classroom was usually represented with many routine duties delegated to students (Whyte & Ellis, 2004). Fig.3 and Fig.4 show examples of 'No-Decision' teaching style.

'Student-Centred' Teaching Style

In student-centred illustrations, the focus was clearly on the learners rather than the teacher. It is sometimes difficult to find the teacher who was often labeled with an arrow or series of arrows to indicate movement. The drawings reflected a constructivist perspective where the students were constructing rather than receiving information. For example, students were represented in the drawings indicated that they were directly involved in inquiry learning through experiences with concepts rather than sitting in a passive manner. Student-centred images indicated a constructivist learning environment where students were participating at different tables and/or the teacher was standing with one group of students while other groups of students were doing experiment at a different table. Students in these drawings were working together in groups of three or four with limited teaching guidance, developing lab procedures for the investigation of specific science concepts. The teacher's role in these settings was reflected as a learning

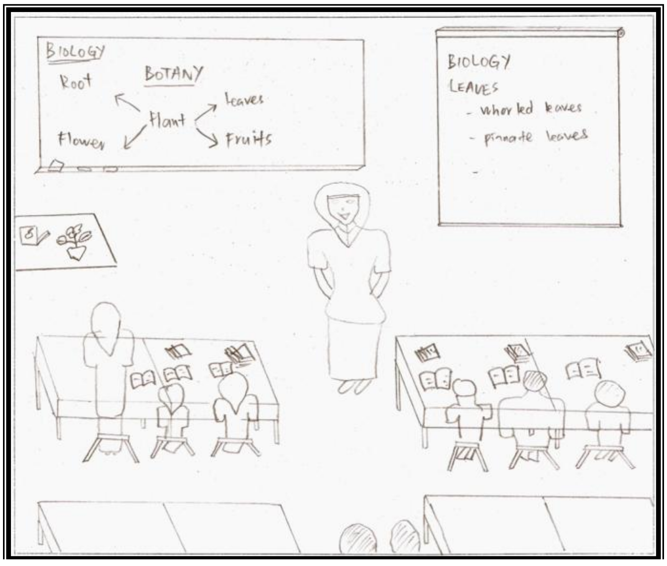

Fig.2: 'Teacher-Centred' Teaching Style (Example 2)

facilitator, where students were provided with rich and exciting opportunites for the development of knowledge as a process rather than a product. In most of these drawings, teachers were shown to engage students in recalling what they already knew about the subject. Students were also depicted being involved in an activity that would take them beyond what they already knew. The teacher appeared to actively engage the student in the learning process by focusing the students on doing. Overall the

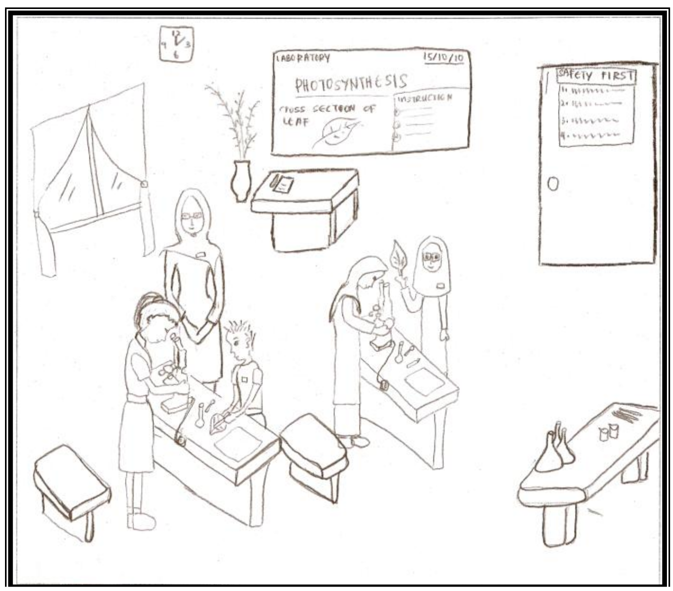

Fig.3: 'No-Decision' Teaching Style (Example 1)

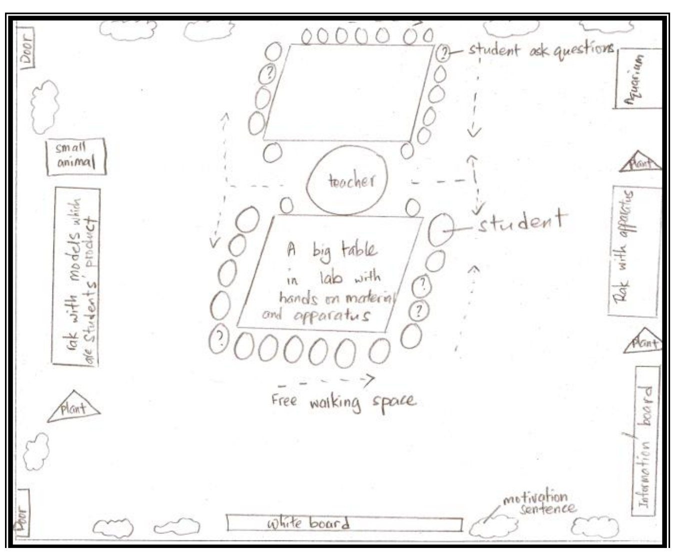

Fig.4: 'No-Decision' Teaching Style (Example 2)

student-centredness was reflected in these drawings, indicating students to be dynamic and working cooperatively on various assignments. Each student who were seating were drawn in unique ways that adapted to discussions or group work (O'Hara, & O'Hara, 1998). Though many of these illustrations indicate an outdoor learning environment, the classroom organization usually included more than the usual desks

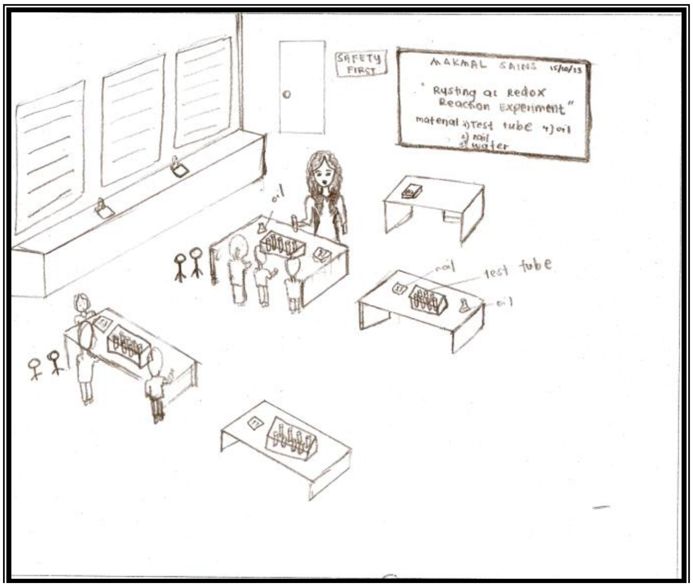

Fig.5: 'Student-Centred' Teaching Style (Example 1)

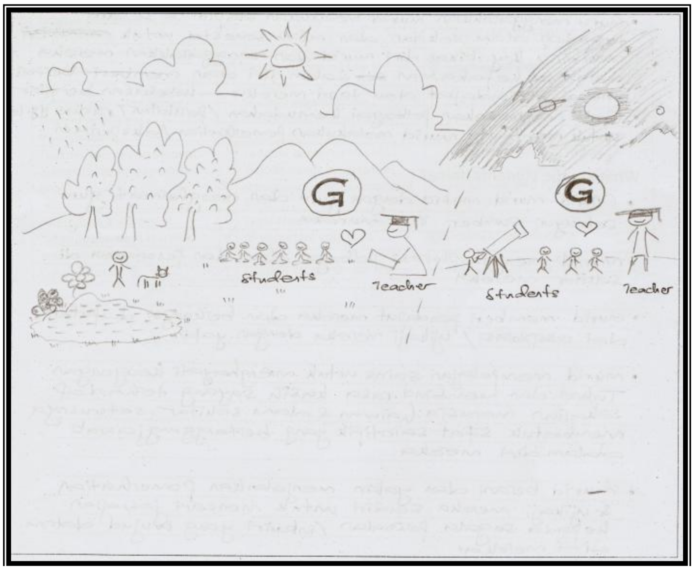

Fig.6: 'Student-Centred' Teaching Style (Example 2)

and chairs. These classrooms also included extra worktables or cabinets around the room for reference books, science equipment, and animals. These images fit more closely with standards-oriented or student-centred teaching following an exploratory approach to learning that encourages inquiry and questions facilitated by the teacher. Fig.5 and Fig.6 show examples of student-centred teaching style.

Mean Differences in Pre-Service Science Teachers' Mental Images of Science Teaching based on Gender

The first null hypothesis was tested by using the independent sample *t*-test at a specified significance level, alpha = .05. As shown in Table 7 and Fig.7, independent sample *t*-test results showed that there was no significant difference in pre-service science teachers' mental images of science teaching based on gender (t = -.681, df = 76, p = .498). Hence, this finding has failed to reject the

TABLE 7
Mean Differences in Pre-service Science Teachers' Mental Images of Science Teaching based on Gender

Subsection	Gender	*n*	*M*	*SD*	Mean Difference	Effect Size	*t*	*df*	*p*
Teacher's Activity and Teacher's Position	Male	26	3.35	1.056	.096	.036	-.393	76	.695
	Female	52	3.44	.998					
Students' Activity and Students' Position	Male	26	1.73	1.002	.019	.007	-.082	76	.935
	Female	52	1.75	.968					
Environment	Male	26	2.38	1.388	.327	.121	-1.022	76	.310
	Female	52	2.71	1.304					
Overall Mental Images of Science Teaching	Male	26	7.46	2.832	.442	.164	-.681	76	.498
	Female	52	7.90	2.637					

* $p < .05$; The effect size is the mean difference divided by the pooled standard deviation.

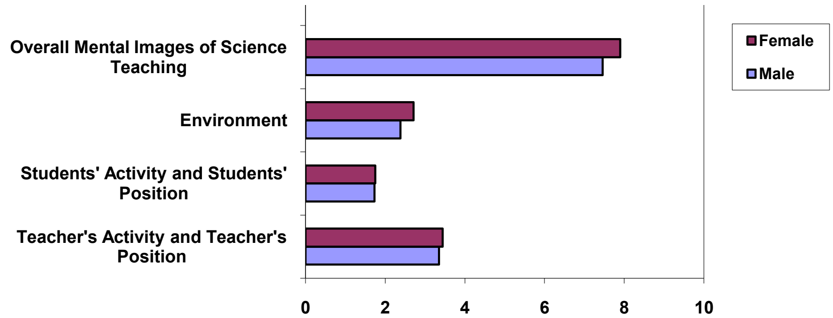

Fig.7: Mean differences in Pre-Service Science Teachers' Mental Images of Science Teaching based on Gender

first null hypothesis. Generally, male pre-service science teachers' mental images of science teaching are more 'student-centred' as compared to their female counterparts. However, the difference was not statistically significant.

Mean Differences in Pre-Service Science Teachers' Mental Images of Science Teaching based on Levels of Schooling

The second null hypothesis was tested by using the independent sample *t*-test at a specified significance level, alpha = .05. As shown in Table 8 and Fig.8, independent sample *t*-test results showed that there was a significant difference in pre-service science teachers' mental images of science teaching

TABLE 8
Mean Differences in Pre-Service Science Teachers' Mental Images of Science Teaching based on Levels of Schooling

Subsection	Levels of Schooling	*n*	*M*	*SD*	Mean Difference	Effect Size	*t*	*df*	*p*
Teacher's Activity and Teacher's Position	Primary	30	3.20	1.243	.342	.127	1.334	45.027	.189
	Secondary	48	3.54	.824					
Students' Activity and Students' Position	Primary	30	1.40	.855	.558	.207	2.553	76	.013*
	Secondary	48	1.96	.988					
Environment	Primary	30	2.23	1.331	.600	.223	1.971	76	.052
	Secondary	48	2.83	1.294					
Overall Mental Images of Science Teaching	Primary	30	6.83	2.692	1.500	.557	2.471	76	.016*
	Secondary	48	8.33	2.554					

* $p < .05$; The effect size is the mean difference divided by the pooled standard deviation.

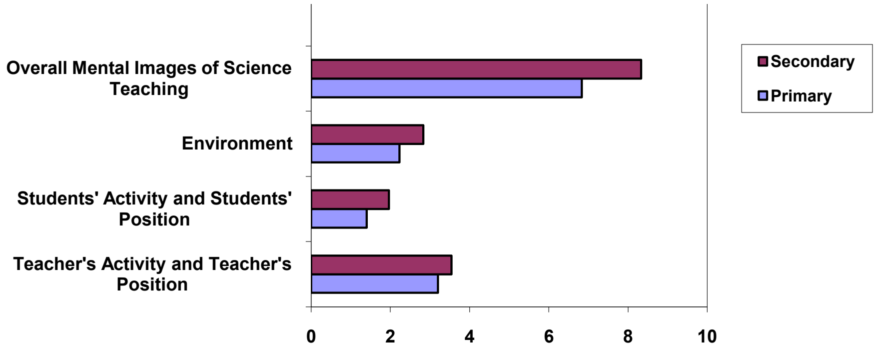

Fig.8: Mean differences in Pre-Service Science Teachers' Mental Images of Science Teaching based on Levels of Schooling

based on levels of schooling ($t = 2.471$, $df = 76$, $p = .016$). Hence, this finding has rejected the second null hypothesis successfully. There was also a significant difference in the 'Students' Activity and Students' Position' subsection between primary and secondary school pre-service science teachers. It seems that primary school pre-service science teachers' mental images of science teaching are more 'student-centred' as compared to their secondary teacher counterparts.

CONCLUSION

The DASTT-C is one of the essential instruments that can be used to help to develop techniques and procedures for promoting reflection and analysis of pre-service science teachers' thinking. Exploration of pre-service science teachers' mental images of science teaching plays a vital role in their acquisition and interpretation of knowledge and subsequent teaching behaviour. It directs science educators to devote efforts for changing pre-service science teachers' mental images to more insightful learning experiences in the teacher preparation programmes (Finson *et al.*, 1999; Simmons *et al.,* 1999; Thomas & Pedersen, 1998a, 1998b; Thomas *et al.*, 2001).

Certainly, there is no one best way to teach science all the time (Roseberry *et al.*, 1992). According to Louca, Rigas, and Valanides (2002, p. 247), "good teaching requires a blend of teacher-centred and student-centred skills and deep understanding of when to do what kind of teaching". Given that the National Science Education Standards recommended both process skills and content knowledge by grade levels, good teaching will no doubt require a blend of teacher-centred and student-centred teaching skills- with standards-guided teachers knowing when to do what kind of teaching.

The findings of this study are derived from a group of primary and secondary schools pre-service science teachers who were selected by using cluster random sampling technique from the Teacher Education Institute - Kent Campus and School of Education and Social Development, Universiti Malaysia Sabah respectively. As such, further studies investigating pre-service science teachers' mental images of science teaching as measured by DASTT-C using a more nationally representative samples are recommended in order to examine the validity of such generalization. Equally, it would be beneficial to determine the progression in pre-service science teachers' mental images of science teaching by examining if they continue to have the intended mental images of science teaching in successive years of teacher education programmes.

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