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Pre-Service Teachers' Attitudes Towards Studying Chemistry

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Abstract

This research aims at investigating the pre-service teachers' attitudes towards chemistry. A researcher used "Chemistry Attitudes and Experiences Questionnaire" (CAEQ) to measure students' experiences and attitude towards chemistry, it has good indices for validity and reliability. This questionnaire has three subcategories, (1) attitudes towards lecturer classes in chemistry, (2) attitudes towards tutorial classes in chemistry and (3) attitudes towards laboratory classes in chemistry. The participants are 70 students (85.7% female and 14.3% male) from the first year students in faculty of science and mathematics (FSM) - UPSI. The findings showed that, the students have moderate attitudes towards lecture class in chemistry, tutorials classes in chemistry and laboratory classes in chemistry. Although there is no significant differences found related to the students' gender or race (except for attitudes and tutoring) but there is an interaction between gender and race concerning the pre-service teachers ' attitude toward chemistry.

Keywords: Pre-service teachers, science education,Chemistry, university, attitudes, laboratory, tutorial.

Introduction

Students' attitudes is an important factor that affect their performance in school. Students' attitudes may, for examine, influence their motivation to pursue study in a specific subject or persist in their effects to attain subject matter mastery (Soediono, 1989).Investigating students' attitudes towards studying science has been a substantive feature of the science education research in last four decades (Osborne, Simon, & Collins, 2003; Can & BOZ, 2012). Promoting of students attitudes is vital in

education and promoting positive attitudes has been an important goal for educators (Sundre, Barry, Gynnild, & Ostgard, 2012). Therefore, science education should pay a lot of attention for improving students' interest in and attitudes toward science (van Aalderen-Smeets, Walma van der Molen Juliette, & Asma Lieke, 2012).

Attitudes, one of the constructs of the affective domain. The term "attitude" is sometimes mentioned in course design descriptions along with learning objectives associated with "knowledge" and "skills." (Sundre et al., 2012). Although, many studies provide uncertain definitions of attitude because attitude is a multi-faceted construct, or do not distinguish between attitudes toward science and other related concepts (e.g., opinions or motivation) (van Aalderen-Smeets et al., 2012). In other words, the term "attitude" is often confused with other terms such as value, belief, interest and opinion (Sundre et al., 2012). Different researchers define attitude differently (Anwer, Iqbal, & Harrison, 2012). Attitude could be a way of looking at things (Khan & Ali, 2012; Mokoro, Wambiya, & Aloka, 2014), it is also an individual mental processes which determine both the actual and potential responses of each person in the social world (Akbulut & Karakus, 2011). Attitude characterized by: (Cheung, 2011) (van Aalderen-Smeets et al., 2012)

- It is a hypothetical construct used by social psychologists to understand and predict the behaviors of humans,
- It indicates an individual like and dislike towards an item.
- It may positive, negative or neutral.
- Attitudes are quite stable (once formed they are hard to change).
- They are highly dependent upon context.
- It is a construct consisting of multiple dimensions and subcomponents.

As Pajares (1992) describes, "When clusters of beliefs are organized around an object or situation and predisposed to action, this holistic organization becomes an attitude". Like attitude, the definition of attitude towards science has also been an issue among the researchers. According to some of them, attitude consists of different sub-constructs that ultimately give rise to a person's attitude towards science. Researchers made a distinction between attitude towards science and scientific attitude. According to them, attitude towards science is linked with the views and images that the individual develops about science as a result of interaction with different situations, while the term scientific attitude is linked to the ways of thinking or scientific method, which covers the skills and is related to the undertaking of practical work (Anwer et al., 2012).

Research clearly shows that feelings of enjoyment and interest in science combined with success in junior science courses are likely to lead to a positive commitment toward science that is enduring (Osborne et al., 2003). Many studies pointed out the

importance of attitudes towards performance. Some of them found that students attitude towards chemistry have significant direct effect on students' achievement in the subject (Adesoji, 2008); others mentioned that attitude is one of the factors that determines achievement and enrolment of students in science subjects (Afolabi, 2009). Adesoji (2008) indicated that:

- Students' attitude and interests could play substantial role among pupils studying science.
- Students' positive attitudes to science correlate highly with their science achievement.
- Using integrated science environmental activities improved high school students' attitudes towards and awareness about the environment.

However, students' affect toward science becomes increasingly less positive, as science attitudes scores have been observed to decline as students advance through the grade levels (Soediono, 1989). The reviewed studies showed the absence of consensus between the psychologists about the casual relationship between achievement and attitude. Some of them clarify that there is a strong relationship between attitude and achievement; and that it is possible to predict achievement from attitude scores (Adesoji, 2008).

Walma, Molen, & Aalderen-smeets (2013) mentioned that (pre-service) primary teachers' attitudes towards science are mostly negative, and that "primary teachers share a number of characteristics that impede the stimulation of science learning and of positive attitudes towards science among their pupils". For example, a meta-analysis of research concluded that the correlation between attitude toward science and achievement is 0.50 for boys and 0.55 for girls, indicating that attitude can account for 25–30% of the variance in achievement. However, not all previous studies documented that girls had a more positive attitude toward the study of chemistry than boys (Cheung, 2009). Others mentioned that there is some disagreement about the nature of the causal link and whether it is attitude or achievement that is the dependent variable. The essential premise permeating much of the research is that attitude precedes behaviour (Osborne et al., 2003).

Many factors could contribute to student's attitude towards studying science, such factors include teaching methods, teacher attitude, influence of parents, gender, age, cognitive style of pupils, career interest, and social implication of chemistry and achievement (Adesoji, 2008). The attitude literature includes various studies that investigated gender differences in students' attitudes toward chemistry courses. Some of the studies reported that female students' attitudes toward chemistry lessons are higher than male students. Some of the studies, on the other hand, found the opposite situation in their cases; that is, boys have more positive attitudes to chemistry lessons than girls (Ilgaz & Aricak, 2008). In her study, (Cheung, 2009) found that male students in secondary 4 and 5 liked chemistry theory lessons more than

their female counterparts. However, male students' liking for chemistry laboratory work declined when they progressed from Secondary 4 to Secondary 7; no such a significant decline in attitude toward chemistry laboratory work was found in females. Overall, both males and females were just marginally positive about chemistry lessons during the years of secondary schooling.

Research suggests that the main factor determining attitudes towards school science is the quality of the educational experience provided by the teacher. Part of the explanation for student attitudes toward school science may be a shortage of well-qualified science teachers capable of providing a positive experience (Osborne et al., 2003). Teachers as basic tool in curriculum implementation remain a very crucial factor that influence students' experience and achievement, and continuing educational development. On the other hand, teachers' personality and attitude towards their teaching subjects as factors contributing to poor performance in science subjects Afolabi (2009).

According to van Aalderen-Smeets et al.(2012) many studies have shown generally negative attitudes toward science among preservice and in-service primary school teachers. The negative attitudes come from the teachers' negative experiences that they had during their own primary and secondary education, and these attitudes persist during their training. Primary schools teachers play a crucial role in enhancing the positive attitudes of students towards science (Walma et al., 2013). Moreover, there is a clear evidence from the previous studies that the primary science teachers with less positive attitudes share a number of characteristics, such that:(van Aalderen-Smeets et al., 2012)

- They have lower confidence and self-efficacy beliefs about teaching science.
- They spend less time discussing and teaching these topics in their classrooms.
- They rely more on standardized methods and top–down instruction.
- They are less able to stimulate the attitudes of their students.

Obviously, the development of students' positive attitudes regarding chemistry as a school subject is one of the major responsibilities of every chemistry teacher (Cheung, 2011), however a major problem remains that school teachers are not adequately trained to teach science (van Aalderen-Smeets et al., 2012). Professional development should therefore pay explicit attention for improving the attitude of pre-service science teachers towards science (Walma et al., 2013). The content courses and pedagogical content courses have a significant role to develop positive attitudes towards teaching profession. If pre-service teachers develop a positive attitude towards their profession, they will develop creative thinking, motivate their students more easily, and adapt their verbal and non-verbal messages to their students (Akbulut & Karakus, 2011).

Therefor, improving science teachers' attitudes towards science is one of the major challenges in today's science education (Walma et al., 2013) and teacher education have a major role to form the pre-service teachers' thinking towards teaching profession. This research investigates the attitudes of pre-services teachers towards chemistry that are; pre-services teachers' attitudes towards lecturer class in chemistry, pre-services teachers' attitudes towards tutorial classes in chemistry and pre-services teachers' attitudes towards laboratory classes in chemistry. These finding to evaluate learning experiences of chemistry, along with their attitude-towards-chemistry in first year in lecturer classes, tutorial classes and laboratory classes.

Research Questions

This study addressed the following questions:

1. What are the pre-services teachers' attitudes towards studying Chemistry?
    - What are the pre-services teachers' attitudes towards lecturer classes in Chemistry?
    - What are the pre-services teachers' attitudes towards tutorial classes in Chemistry?
    - What are the pre-services teachers' attitudes towards laboratory classes in Chemistry?
2. Are there any differences in pre-services teachers' attitudes in Chemistry according to their gender and race?

Aims

This study aims to study the (1) pre-services teachers' attitudes towards lecturer classes in chemistry, (2) pre-services teachers' attitudes towards tutorial classes in chemistry (3) pre-services teacher teachers' towards laboratory classes in chemistry and (4) to test the differences in pre-services teachers' attitudes in Chemistry according to their gender and race.

Research Methodology

Research Sample

The sample in this study was randomly selected from first year chemistry students in FSM-UPSI, those students studying to be science teachers in the future. Table 1 below shows the sample for this research. The participants' sample consisted of 70 pre-service teachers. There are 10 male and 60 females. On the other hand, there are 34 Malay, 23 Chinese and 13 Indian. In other words, the majority of the sample are female 85.7% (51.7% of them are Malay, 33% Chinese and 15% are Indian) while Male students formed 14.3% with equal percent within race variable.

Table 1: The sample

	Female		Male		Total	
	Count	% within	Count	% within	Count	% within
Malay	31	51.7%	3	30.0%	34	48.6%
Chinese	20	33.3%	3	30.0%	23	32.9%
Indian	9	15.0%	4	40.0%	13	18.6%
Total	60	85.7%	10	14.3%	70	100.0%

The Instrument

The survey is aimed to collect data about: (1) pre-services teacher attitudes towards lectures classes in chemistry, (2) pre-services teacher attitudes towards tutorial classes in chemistry and (3) pre-services teacher attitudes towards laboratory classes in chemistry. The survey instrument used in this study was developed based on literature review. It is not a test instrument but it is a descriptive one. To measure what influence students learning experiences might have upon their attitude towards chemistry, Dalgety, Coll, & Jones (2003) developed the Chemistry Attitudes and Experiences Questionnaire (CAEQ). The final version of the CAEQ consists of three categories scales; experiences during first year chemistry class about class lecture, class tutorial and class laboratory. The attitude-toward-chemistry scale contains a total of 35 questions, across three subscales: 10 questions of experiences in lecturer classes, 10 questions in tutorial classes and 15 questions about experiences in laboratory classes. This scale have 5 point Likert with response options: (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree.

The Validity

One concept of validity is how faithfully the set of items in an instrument correspond to that attribute in which the researchers are interested. To enhance clarity and conciseness, the English teachers made suggestions about the terminologies of some items and modified them into Malay language according to the sample characteristics. Then, a Malay Language teacher from each school retranslates the statements into English. Both the translated and original piece is examined. Both the translated and original instrument are the same.

The Reliability

The Cronbach's alpha, and split –half procedures were used to obtain the reliability estimate of the instrument, the results were summarized in Table 2. George and Mallery (2003) proposed that Cronbach's alpha of 0.7–0.8 is acceptable; 0.8–0.9 is good; and ≥0.9 is excellent. . The results in Table 4 indicate that an alpha coefficient and split–half reliability test values are more than 0.8 for all the instrument's subcategories, they are higher than the values suggested by George and Mallery (2003). Therefore, the reliability of the instrument were considered to be acceptable. It was clear that the instrument is reliable and could be used to measure the pre-

services teachers attitudes in chemistry about the teachers' experiences in first year in chemistry.

Table 2: Results of Reliability Tests

The coefficient	Cronbach's alpha	split –half
Total Lectures Class	.841	.835
Total Tutorial Class	.823	.821
Total Laboratory Class	.867	.866

Results

What is the pre-services teachers' attitudes towards studying Chemistry?

Basic descriptive statistics about the data collected for this research are summarized in Table 3. From the descriptive data in the Table 3, the pre service teachers have positive attitudes toward chemistry (*M=153.9, SD=13.07*). The other results showed that the student teachers' have a positive attitudes of learning experience in lecture class in chemistry (*M=37.829, SD=4.745*), a positive attitudes of learning experience in tutorials classes in chemistry (*M=38.014, SD=4.67*) and of learning experience in laboratory classes in chemistry (*M=57.129, SD=5.71*). The percent of the means range from 73 to 76%.

Table 3: Descriptive Statistic for Pre-Services Teachers Attitudes towards Chemistry

	Mean	%	Std. Deviation
LECTURES	37.829	75.7%	4.74562
TUTORIAL	38.014	76.0%	4.67337
LABORATORY	57.129	76.2%	5.71020
CLASS IN CHEMISTRY	132.971	76.0%	13.07722

What is the pre-services teachers' attitudes towards lecturer classes in Chemistry?

Results in table 4 showed that the first two items are respectively (The lecture material is relevant to the course objectives, and Lecturer explain the problem clearly to me), all of those get a percent of mean more than 80%. On the other hand the last three items are respectively (Notes is interesting lecture, Chemistry lecturer has made me feel that I have the ability to continue learning in science, and It is easy to find lecturers to discuss issues).

Table 4: Descriptive Statistic for Pre-Services Teacher Attitudes towards lecturer

	Mean		Std. Deviation
The lecture material is relevant to the course objectives	4.157	83.1%	.500
Lecturer I took out about my progress in chemistry	3.929	78.6%	.598
The concepts introduced in the lecture materials which have been explained clearly	3.629	72.6%	.641
Lecturer me encouraged me to take up chemistry courses	3.729	74.6%	.962
Notes is interesting lecture	3.443	68.9%	1.002
Chemistry lecturer has made me feel that I have the ability to continue learning in science	3.543	70.9%	.716
Notes lecture presented clearly	3.757	75.1%	.806
It is easy to find lecturers to discuss issues	3.643	72.9%	.799
Teaching was presented in an interesting way	3.814	76.3%	.597
Lecturer explain the problem clearly to me	4.186	83.7%	.952

What is the pre-services teachers' attitudes towards tutorial classes in Chemistry?

Results in table 5 showed that the first three items are respectively (The material presented in the tutorial is useful, Problem tutorial covers all parts of the course, and the material in this tutorial was presented in an interesting way), all of those get a percent of mean more than 85%. On the other hand the last three items are respectively (My tutor interested to know in my progress, my tutor encouraged me to take up chemistry papers, and it is easy to find a tutor to discuss issues) that gain a percent around 70%.

Table 5: Descriptive Statistic for Pre-Services Teacher Attitudes towards tutorial

	Mean		Std. Deviati
Problem tutorial covers all parts of the course	4.000	80.0%	.511
My tutor interested to know in my progress in chemistry	3.529	70.6%	.737
Problems in the tutorial sheet relevant to the course	3.686	73.7%	.894
My Tutor encouraged me to take up chemistry papers	3.486	69.7%	.864
Materials tutorial helped me understand college courses	3.986	79.7%	.732

Tutor chemistry has made me think has the ability to continue learning in science	3.857	77.1%	.856
The material presented in the tutorial is useful	4.100	82.0%	.617
The material in this tutorial was presented in an interesting way	4.000	80.0%	.417
It is easy to find a tutor to discuss issues	3.471	69.4%	.696
Tutor explain the problem clearly to me	3.900	78.0%	.640

What is the pre-services teachers' attitudes towards laboratory classes in Chemistry?

Results in table 6 showed that the best item is (the experiment is interesting) with 83.4%, and the last item is (When writing in a book of practical experiments) that gain a percent around 67%. The other items are between 83-67%.

Table 6: Descriptive Statistic for Pre-Services Teacher Attitudes towards laboratory

	Mean		Std. Deviation
Manual instructions contained in the laboratory is easy to follow	3.914	78.3%	.608
When writing in a book of practical experiments, relationship between the data and the results are clear	3.371	67.4%	.663
Demostrator interested in my progress in chemistry	3.686	73.7%	.956
Practical experiments related to college	3.971	79.4%	.481
What is required in practical writing is clear	3.514	70.3%	.989
Laboratory assistant encouraged me to take up chemistry papers	3.929	78.6%	.573
The theory behind the experiment clearly presented	3.657	73.1%	.883
The purpose of the calculations required to write a practical book is clear	3.771	75.4%	.745
Chemical Laboratory Assistant has made me feel that I have the ability to continue learning in science	3.886	77.7%	.498
Laboratory manual, experimental techniques and practical writing are interrelated	3.886	77.7%	.526
What is required in practical questions while writing the book is clear	3.971	79.4%	.416

It is easy to find a lab assistant to discuss the issue with me	3.743	74.9%	.716
The experiment is interesting	4.171	83.4%	.701
The amount of work required when writing a practical book is appropriate for the number of votes	3.986	79.7%	.551
Laboratory assistant explained the problem clearly to me	3.671	73.4%	.557

Are there any differences in pre-services teachers' attitudes in Chemistry according to their gender and race?

Students' attitudes towards chemistry were subjected to a two-way analysis of variance having two levels of gender (male/female) and three levels of race (Malay/Chinese/Indian). Table 7 shows the main ANOVA summary results. The main effect of gender was not significant, $F(1, 64) = 0.514$, $p = .476$. While, the main effect of race was significant, $F(2, 64) = 4.204$, $p = .019$. However, the interaction effect was significant, $F(2, 64) = 14.111$, $p = 0.001$. The plot of the mean "attitudes towards chemistry" score for each combination of groups of "Gender" and "Race" is plotted in a line graph, as shown in figure 1, and the results of the Multiple Comparisons (Scheffe test) for Race presented in table 8.

Table 7: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4455.896[a]	5	891.179	7.766	.000
Intercept	582200.110	1	582200.110	5073.607	.000
GENDER	59.036	1	59.036	.514	.476
RACE	964.759	2	482.379	4.204	.019
GENDER * RACE	3238.470	2	1619.235	14.111	.000
Error	7344.047	64	114.751		
Total	1249498.000	70			
Corrected Total	11799.943	69			

a. R Squared = .378 (Adjusted R Squared = .329)

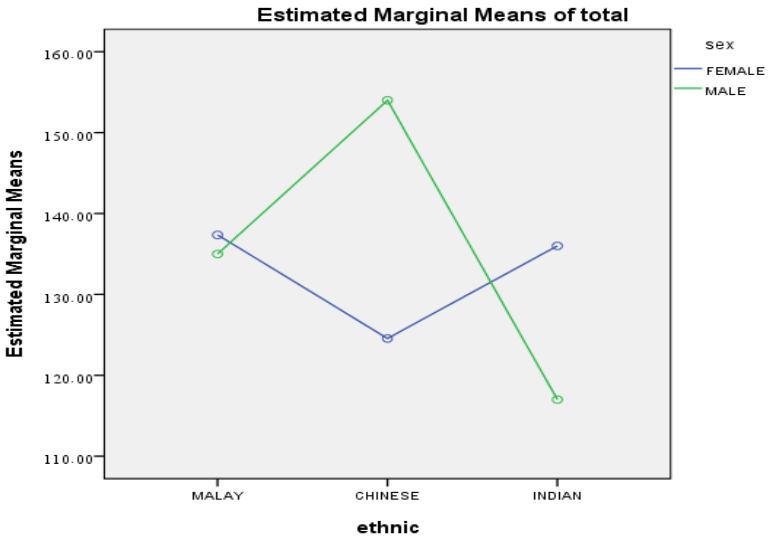

Figure 1. Effects of gender and race on attitudes towards chemistry

Figure 1 shows that gender type effects the Chinese and Indian students' attitudes towards chemistry. The Chinese males have more positive attitudes than the females Chinese students. On the opposite, the Indian female students have more positive attitudes than the Indian male students have. The results of the Multiple Comparisons (Scheffe test) presented in table 8 showed that there is a significant differences between the Malay and Chinese students, the Malay students have more positive attitudes towards studying chemistry than the Chinese students have.

Table 8: Multiple Comparisons (Scheffe test)

(I) ethnic	(J) ethnic	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Malay	Chinese	8.7558*	2.89209	.014	1.5077	16.0038
	INDIAN	6.9932	3.49314	.143	-1.7612	15.7476
Chinese	Malay	-8.7558*	2.89209	.014	-16.0038	-1.5077
	INDIAN	-1.7625	3.71701	.894	-11.0780	7.5529
Indian	Malay	-6.9932	3.49314	.143	-15.7476	1.7612
	CHINESE	1.7625	3.71701	.894	-7.5529	11.0780

1. Lectures Class in Chemistry

Table 9 shows the main ANOVA summary results.

Table 9: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	488.502[a]	5	97.700	5.869	.000
Intercept	45189.921	1	45189.921	2714.514	.000
GENDER	10.846	1	10.846	.651	.423
RACE	69.200	2	34.600	2.078	.133
GENDER * RACE	324.110	2	162.055	9.734	.000
Error	1065.441	64	16.648		
Total	101724.000	70			
Corrected Total	1553.943	69			
a. R Squared = .314 (Adjusted R Squared = .261)					

The main effect of gender was not significant, $F(1, 64) = 0.651$, p = .423 and the main effect of race was not significant also, $F(2, 64) = 2.078$, p = .133. However, the interaction effect was significant, $F(2, 64) = 9.734$, $p = 0.001$. The plot of the mean "attitudes towards lectures class in chemistry" score for each combination of groups of "Gender" and "Race" is plotted in a line graph, as shown in figure 2.

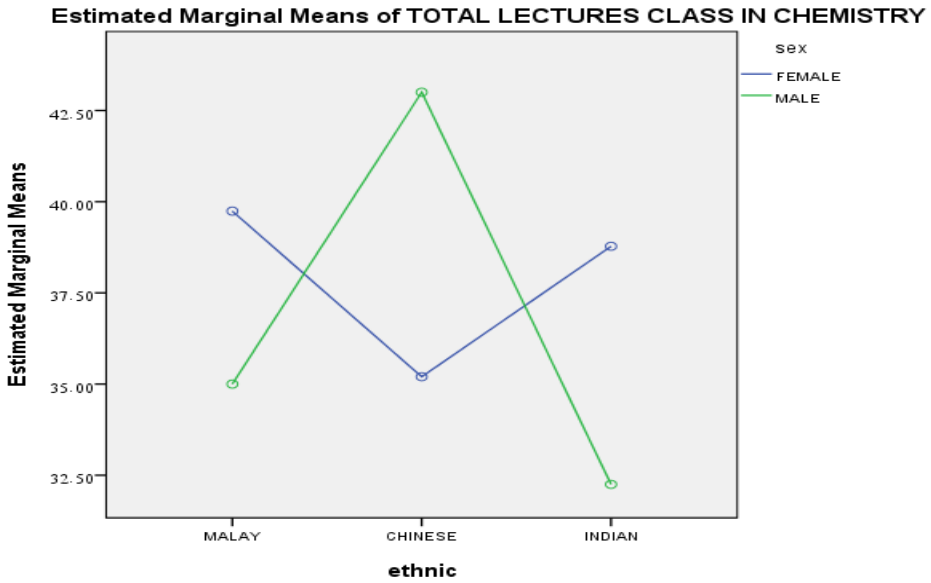

Figure 2. Effects of gender and race on attitudes towards

From figure 2 it is clear that gender type effects Malay, Chinese and Indian students' attitudes towards lectures class in chemistry. The Malay and Indian females have more positive attitudes than the males. On the opposite, the Chinese male students have more positive attitudes than the Chinese female have.

2. Tutorial Class in Chemistry

Table 10 shows the main ANOVA summary results. The main effect of gender was not significant, $F(1, 64) = 1.337$, $p = .252$. While, the main effect of race was significant, $F(2, 64) = 4.304$, $p = .018$. However, the interaction effect was significant, $F(2, 64) = 8.603$, $p = 0.001$. The plot of the mean "attitudes towards tutorial class in chemistry" score for each combination of groups of "Gender" and "Race" is plotted in a line graph, as shown in figure 3, and the results of the Multiple Comparisons (Scheffe test) for Race presented in table 11. Figure 3 shows that gender type effects the Chinese and Indian students' attitudes towards tutorial class in chemistry. The Chinese males have more positive attitudes than the females have. On the opposite, the Indian female students have more positive attitudes than the Indian male students have.

Table 10: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	436.050[a]	5	87.210	5.212	.000
Intercept	48078.059	1	48078.059	2873.185	.000
GENDER	22.378	1	22.378	1.337	.252
RACE	144.033	2	72.016	4.304	.018
GENDER * RACE	287.908	2	143.954	8.603	.000
Error	1070.936	64	16.733		
Total	102663.000	70			
Corrected Total	1506.986	69			

a. R Squared = .289 (Adjusted R Squared = .234)

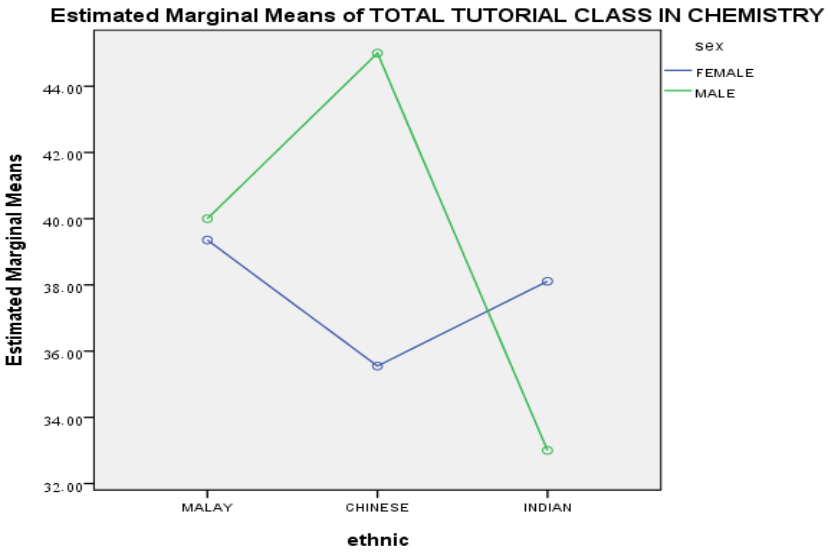

Figure 3. Effects of gender and race on attitudes towards chemistry

The results of the Multiple Comparisons (Scheffe test) presented in table 11 showed that there is a significant differences between Malay students on one hand and students on the other hand, Malay have more positive attitudes towards tutorial class in chemistry than the Chinese and Indian students have.

Table 11: Multiple Comparisons (Scheffe test)

(I) ethnic	(J) ethnic	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Malay	Chinese	2.6292*	1.10440	.020	.4229	4.8354
	INDIAN	2.8733*	1.33392	.035	.2085	5.5381
Chinese	Malay	-2.6292*	1.10440	.020	-4.8354	-.4229
	INDIAN	.2441	1.41941	.864	-2.5914	3.0797
Indian	Malay	-2.8733*	1.33392	.035	-5.5381	-.2085
	CHINESE	-.2441	1.41941	.864	-3.0797	2.5914

3. Laboratory Class in Chemistry

Table 12 shows the main ANOVA summary results of students' attitudes towards laboratory class in chemistry.

Table 12: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	673.068[a]	5	134.614	5.464	.000
Intercept	109676.270	1	109676.270	4451.671	.000
GENDER	39.014	1	39.014	1.584	.213
RACE	124.321	2	62.160	2.523	.088
GENDER * RACE	514.260	2	257.130	10.437	.000
Error	1576.774	64	24.637		
Total	230707.000	70			
Corrected Total	2249.843	69			

a. R Squared = .299 (Adjusted R Squared = .244)

The main effect of gender was not significant, F (1, 64) = 1.584, p = .213 and the main effect of race was not significant also, F (2, 64) = 2.523, p = .088. However, the interaction effect was significant, F (2, 64) = 10.437, p = 0.001. The plot of the mean "attitudes towards laboratory class in chemistry" score for each combination of groups of "Gender" and "Race" is plotted in a line graph, as shown in figure 4.

Figure 4. Effects of gender and race on attitudes towards chemistry

Figure 4 shows that gender type effects the Chinese and Indian students' attitudes towards laboratory class in chemistry. The Chinese males have more positive

attitudes than the females Chinese students. On the opposite, the Indian female students have more positive attitudes than the Indian male students do have.

Summary

This research aims at investigating the pre-service teachers' attitudes towards chemistry. The results reveal that pre service teachers have positive attitudes toward chemistry in general. Results showed that the most important items are (The lecture material is relevant to the course objectives, Lecturer explain the problem clearly to me, The material presented in the tutorial is useful, Problem tutorial covers all parts of the course, the material in this tutorial was presented in an interesting way, and the experiment is interesting).

Considering the different in pre-services teachers' attitudes in Chemistry according to their gender and race, the researcher used 2-way analysis of variance to compare the attitude toward chemistry according to the students' race (Malay, Chinese, and Indian). The main effect of gender was not significant, this showed that there are no any differences in pre-service teachers' attitude toward chemistry according to gender, while, the main effect of race was significant in "attitude towards chemistry in general" and mean "attitudes towards lectures class in chemistry". The results of the Multiple Comparisons (Scheffe test) showed that the Malay students have more positive attitudes towards studying chemistry than the Chinese students do, and Malay have more positive attitudes towards tutorial class in chemistry than the Chinese and Indian students have.

On the other hand, the interaction effect was significant in all the comparisons, the results showed that gender and race type effects the Chinese and Indian students' attitudes towards chemistry. The Chinese males have more positive attitudes than the females Chinese students. On the opposite, the Indian female students have more positive attitudes than the Indian male students have. Similarly, attitudes towards lectures class in chemistry. The Malay and Indian females have more positive attitudes than the males. On the opposite, the Chinese male students have more positive attitudes than the Chinese female have. Regarding the attitudes towards tutorial class in chemistry, the Malay and Indian females have more positive attitudes than the males. On the opposite, the Chinese male students have more positive attitudes than the Chinese female have. Results also shows that the Chinese males have more positive attitudes than the females Chinese students. On the opposite, the Indian female students have more positive attitudes towards laboratory class in chemistry than the Indian male students do.

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