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THE EFFECT OF GENDER AND GDARE LEVEL ON RURAL SARAWAK INDIGENOUS SECONDARY SCHOOL STUDENTS' ATTITUDES TOWARDS CHEMISTRY LESSON TO ENHANCE LEARNING

Murugan Mini Ratamun
National University of Malaysia

Kamisah Osman
National University of Malaysia

Abstract: The aim of this study is to investigate the interaction effects between gender and grade level among rural indigenous secondary school students' attitude towards chemistry of Sarawak, Malaysia. The students' attitudes were measured using Attitude towards Chemistry Lesson scale (ATCLS) form of a multidimensional questionnaire to provide the interaction effects between gender and grade levels. The subscales which are involved in ATCLS are liking for chemistry theory lessons, liking for chemistry laboratory work, evaluative beliefs about school chemistry and behavioural tendencies to learn chemistry. ATCLS was administered to 470 rural indigenous secondary school students between age 16-18 years old which involve 177 males and 293 female students. Only two grade levels were chosen in this study that is form 4(245) students and form 5 (225), students. The two-way MANOVA statistical analysis was used to identify the effects of gender and grade level on rural indigenous secondary school students' attitude towards chemistry. The finding show that gender (Wilks' lambda = 0.955, F (4, 463) = 5.47, $p < 0.001$) and grade level (Wilks' lambda = 0.969, F (4, 463) = 3.68, $p < 0.05$) have a significant effect on attitude towards chemistry. The finding also shows that no significant interaction effect on gender and grade level (Wilks' lambda = 0.983, F (4, 463) = 2.03, $p > 0.05$) on rural indigenous secondary school students' attitude towards chemistry.

Keywords: Attitude, gender, grade level, indigenous students, learning chemistry.

Introduction

Chemistry is an important area of Science. Chemistry is a subject that is unique and interesting. Chemistry is also important as it relates to our daily life activities. Other than that chemistry can help to develop many areas of knowledge to bring new technology in this modern world. However, the chemistry subject is considered to be one of the difficult subject among Malaysian students (Chu & Hong 2010; Abu Hassan Kassim 2003). Therefore, it is important to developing a positive attitude toward chemistry between the school students because the positive attitude will help them to change the perception and understanding of chemistry. According to Yunus & Ali (2013), most students lose interest in chemistry was due to the attitude of their own. The positive attitude is important to improve academic achievement in chemistry.

The main goal in developing chemistry curriculum are to understand students attitude while learning (Abrahams 2009). The attitude of the students in learning chemistry is a complex contract. A negative attitude towards chemistry is also due to the wrong approaches from using teaching materials by teachers and teachers weak in handling informal teaching in classroom (Najdi 2009). Good teaching can be carried out if the teacher can evaluate the curriculum that has been developed. The authorities designing curricula should provide a space for teachers to make evaluations of the curriculum (Fensham & Bellocchi 2013; Van Houtte, Demanet & Stevens, 2013). Chemistry teacher can conduct lessons more effectively if they can identify the weaknesses and strangeness of a curriculum (Cheung 2011).

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*Corresponding author: Murugan Mini Ratamun E-mail: mnlmurugan@gmail.com

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Learning outcomes of the curriculum of chemistry can be divided into three main domains of cognitive, psychomotor and affective. The focus of this study is to the affective domain which includes the outcomes of motivation, attitudes, values, self-esteem and self-efficacy. Affective domain is a domain that is important to the teaching of chemistry. Many teachers do not focus on this domain and they also are not familiar with how to assess students' attitudes (Cheung 2011). Although the behaviour, values and attitudes have been adopted in various curriculum in Malaysia but it did not become part of the formal assessment procedure (Yahaya & Hasan 2011; Nurzatulshima Kamarudin, Lilia Halim, Kamisah Osman, & Subahan T 2009). Many studies regarding attitudes to Malaysian secondary school students' towards science have been carried (Iksan, Halim, & Osman, 2006; Kamisah, zanaton, 2007; Kususanto, Fui, & Lan, 2012) but fewer studies were found about Malaysia secondary school students' attitudes towards chemistry (Fah, 2014). Other than that there are no study found about Sarawak indigenous students' attitude towards science or chemistry. Therefore the purpose of this study was to examine the interaction effect of gender and grade level with respect to indigenous secondary school students' attitudes toward chemistry lessons in Sarawak, Malaysia perspective.

Problems in Learning Chemistry

The main problem in learning chemistry are low students understanding about the content of chemistry curriculum. This can be seen from the students' achievement of chemistry in secondary schools is still at a low level (Edomwonyi-otu & Avaa, 2011). This is because many students still weak in mastering the basic concept of chemistry. This statement is supported by the results of chemistry SPM 2014 examination performance report. Students often have problems with science subjects due to students' response that science is too difficult, less efficient, less problem-solving skills, boring and too abstract (Asarudin Ashari, 1995; Mohd Nor & Tay, 2010; Taber, 2002). Most students have a low understanding of the basic concepts of Chemistry and this left them in the learning process of chemistry. Teachers should plan lessons based on the theory of constructivism to make sure the basic concepts of chemistry can be improved (Mohd Nor & Tay, 2010). Low basic understanding of chemistry will disrupt the learning process at a higher level. A basic understanding of chemistry is important so that teaching is not considered difficult, boring and too abstract. A chemistry teacher at the school should play a role by planning lessons using a variety of methods so that the basic and abstract knowledge of chemistry can be understood by all students.

Understanding abstract concepts in chemistry are important. Learning concepts and theories of chemistry at high levels is difficult if students cannot master an abstract concept (Sirhan, 2007). This abstract concept often combined with the mathematical concept of a chemical that causes students' understanding become more difficult which chemistry learns requires a set of skills at a high level (Peter Fensham, 1998; Zoller 1990; Taber, 2002). Other than that, chemistry also is considering a difficult subject because students having difficulty to understand the concept of problem-solving. In addition, students' sets in their mind that chemistry are considered irrelevant and less popular compare to other subjects. There is a space between the students' expectation and the way of teaching. Teachers are afraid to change according to the students' learning expectation. The learning can become more meaning full if teacher relates the teaching with the real word phenomena that students' always experiences it in their daily life. However teaching chemistry considered has no relevance to the real world and chemistry curriculum does not give impetus to promote chemical knowledge that is expected by students' (Holbrook, 2005). Students also building alternative ideas about science topics that can course the misconception. Teachers need to change an alternative idea of students to the right idea to avoid misconceptions. Existing information of students would interfere the information given by the teacher and the information provided will lead to misconceptions of the lesson (Taber, 2009).

Chemistry is a part of science knowledge that always involves teaching problem-solving and give the students' ability to obtain evidence and assess the evidence to make judgments, decisions or actions. One of the big challenges in chemistry is a continuous interaction between the two plates of the level of thinking that is macroscopic and microscopic. This challenge of the chemical interactions led the students' especially new students' think chemistry is a difficult subject to understand. (Bradley, J. D. & Brand, 1985). This information is supported by a study conducted by Johari (2007) which states that thinking microscopic level refers to the art world of atoms, molecules and ions that form a basic understanding of chemistry. This will explain the thought of macroscopic levels through the experience on the observation of an environment either in the laboratory activities or other activities in daily life. Examples of a macroscopic level of thinking are concerned with the discoloration and sediment in chemical reactions.

Student Attitudes Toward Chemistry

The meaning of attitude is a tendency to think, feel, or act positively or negatively toward objects of our environment (Eagly & Chaiken, 1993).The attitude object can be anything, such as chemistry, chemists,

chemistry lessons, chemistry topics that taught in school, chemical education research, and industrial chemistry but the focus of this study is to evaluate the students attitude toward chemistry in a normal classroom of a secondary school. The normal classroom refers to learning theories and doing practical activities in a chemistry lab (Cheung 2009). The attitude towards chemistry is very important and this attitude will express interest or feelings towards studying chemistry. Other than that attitude will help to improve student academic performance and this is an important outcome of a science education in school. This attitude also will play a substantial role in students life to make a choice to choose the field of their future study. The students' attitude toward chemistry also will determine the capacity of human resources in the chemical field. The attitude of the students in learning chemistry is a complex contract and the negative attitude of students to learn chemistry is due to the teachers' teaching approaches (Najdi 2009).

National capacity of science and technology can only be achieved when countries have sufficient human resources for the specified period of time. To achieve that purpose various ways have been used by the government to create human capital that has self-esteem, values, knowledge, skills, critical thinking and creative thinking. Attitudes towards science will lead to the creating of good quality of human capital. The quality of human capital will determine the development of a country. Good quality of human capital is produced from schools. Students' quality is depending on anxiety and attitude of subjects that they learn in school. Research regarding the relationship between anxiety levels with attitude toward the chemistry shows that the anxiety level of the chemical science students' is moderately high but attitudes towards chemistry are high. The study also shows that there is a significant relationship between the level of anxiety and students' attitudes toward chemistry. This suggests that the high attitudes towards chemistry will reduce the anxiety level of students in chemistry (Fah 2014). The way of teaching of chemistry plays an important role in determining the attitude of students towards chemistry. The use of inquiry learning and the use of practical activities can increase students' positive attitude towards chemistry (Kar & Saleh 2012).

Chemical complexity levels also play an important role in assessing the attitudes of students in chemistry. This level of complexity is also one of the factors that influence the higher-order thinking skill (HOTS) among students (Van Houtte et al. 2013). Chemistry content complexity levels is based on curriculum designed. Besides that, the content and curriculum of chemistry itself have caused students to be negative. The majority of the negative attitude of students' towards learning chemistry can be changed if they carry out practical activities in the laboratory. However, some study shows that the practical work won't change the students' attitude towards chemistry and suggested that those involved in science education need to build a deeper understanding of the attitudes of students while building a curriculum (Abrahams, 2009).

Gender Differences in Student Attitudes toward Chemistry Lessons

Gender is probably the most significant variable related towards pupils' attitude to science'(Simon & Collins, 2003) but not many studies done to find the effect of gender to the students' attitude toward chemistry lesson. In the study conducted by Salta & Tzougraki (2004) found that no significant differences in attitudes towards chemistry between boys and girls but the girls showed the high negative attitude towards the level of content difficulty of chemistry. This is due to social norms of female students believe that the chemistry is not suitable for them because they think this field is cannot be chosen for their future studies. They think chemistry field is more suitable to male nature. This information is supported by many chemists and chemistry scientists are male. Other than that information from books, films, television programs and newspaper showed many men more prominent in the chemistry. Meta-analysis of the research literature from 1970 to 1990 concluded that more male students showed a positive attitude in all branches of science than girls. However academically high-performance girls in study show more positive attitudes compare to academically high-performance of boys (Weinburgh, 1995).

The study of Lang, Wong, & Fraser, (2005) among 497 tenth grade students from three independent schools in Singapore also found that high-performance girls in studies were more positive toward chemistry compares to boys. The study conducted on 437 students using a questionnaire is designed to get the students' perception of science or scientists, students' perception on activities outside of school that gives them the experience of science, students' perception of the importance of science, and the students' perception of characteristics of future works found that boys are more interested in the topic of science related to chemistry, while girls are more interested in the topics of science related to biology (Jones, Howe, & Rua, 2000). Quasi-experimental studies on 286 ((145 male and 141 female) students from Township schools in Oyo, Oyo State, Nigeria found that boys are a more positive attitude towards chemistry and show high ability in chemistry research (Adesoji & Raimi, 2004).

Changes in Student Attitudes toward Chemistry Lessons across Grade Levels

In Malaysia chemistry is taught when students are in form 4 and form 5. Students who choose science stream when they move from form 3 to form 4, chemistry is one of the subjects that should be taken. The age of students is in the range of 16 to 18 years old. There are not many studies on attitudes towards chemistry with changes in the level grade or age. In a study conducted by (Cheung, 2009) over 954 students from grade 4 to grade 7 of high school students ranging from the ages of 16 to 19 years found that there is a significant change in attitudes towards chemistry across the grade levels. In addition, there is a significant interaction effect between grade level and gender on attitudes towards chemistry. This shows that the level of age and grade of students will influence their attitudes toward chemistry. While the study of Hofstein, Ben-Zvi, Samuel, & Tamir, (1977) showed that there is a change in attitudes towards chemistry when they progress from grade 11 to grade 12. These findings show that a positive attitude towards chemistry decrease when student progress from grade 11 to grade 12. While the study of Menis (1989) showed that a positive attitude towards chemistry students is increasing as student progress from grade 11 to grade 12 in which the study was conducted on 3460 students from the USA. Both of these studies showed that is no significant interaction effect between gender and grade level on the students' attitudes toward chemistry.

The study from sample of 197 Turkey high school students from grade 9 to11 shows that grade level had a significant effect on the attitude toward chemistry as a school subject in terms of enjoyment and importance dimensions. Data from this study conclude that high school students' attitude towards chemistry lessons decreased significantly with increase in grade level (Can & Boz, 2012). Another study of (Belge Can, 2012) reported that high school students' attitude towards learning chemistry decreased significantly with increase in grade level and conclude that Turkey high school students do not achieve the educational objective of developing positive attitudes toward chemistry lesson.

Purpose of the Study

The purpose of this study was to measure the main effect and interaction effect of gender and grade level on rural Sarawak, Malaysia indigenous secondary school students' attitude towards chemistry lesson. This is following Kah Heng & Karpudewan, (2015) suggestion that research can be conducting involving students from different states in Malaysia so the outcomes could be generalised.

Methods

Instrument

The instrument used in this study was a questionnaire. The questionnaire that was used is 'Attitude Toward Chemistry Lessons Scale (ATCLS) developed by (Cheung 2009). This questionnaire was used to observe samples of indigenous high school students in the state of Sarawak. This questionnaire contained 12 items related to attitudes toward chemistry. The questionnaire has four subscales that is liking for chemistry theory lessons (3 items), liking for chemistry laboratory work (3 items), evaluative beliefs about school chemistry (3 items) and behavioral tendencies to learn chemistry (3 items). The 12 items used have been translated into Malay languages from English. ATCLS was used for studies in Hong Kong and Cronbach's alpha values of all four subscales are between 0.76 to 0.86 (Cheung, 2009) and in another studies conducted in Turkey recorded, the Cronbach's alpha reliability coefficient of ATCLS is 0.81 (Ayyildiz & Tarhan, 2009) and 0.93 (Belge Can, 2012). The internal consistency of the instrument is relatively high. Due to its high internal consistency it was decided to use the ATCLS in this study.
This questionnaire is modified to a five-point Likert scales with label scale 1 is strongly disagree, scale 2 is disagree, scale 3 is partly agree, the scale 4 is agree and scale 5 is strongly agree (Ayyildiz & Tarhan, 2009; Belge Can, 2012). To facilitate the students, the questionnaire was modified to bilingual that is English and Malay. Normally the combination of positive and negative items are often used to investigate attitudes to reduce the effects of acquiescence and bias responses but ATCLS is designed without negatively worded items (Cheung, 2009). This is because research found that negative item that is changed from positive item will cause a separate factor that allows measurements inappropriate (Spector, Van Katwyk, Brannick, & Chen, 1997; Burke, 1999; Gotlib & Meyer, 1986; Pilotte & Robert K. Gable, 1990; Miller & T. Anne Cleary, 1993; Schmitt & Stults, 1985).

Table 1. Attitude toward chemistry lessons scale

Subscale	Number of Item	Item
Liking for chemistry theory lessons	3	Q1: I like chemistry more than any other school subjects. Q5: Chemistry lessons are interesting Q9: Chemistry is one of my favorite subjects
Liking for chemistry laboratory work	3	Q2: I like to do chemistry experiments Q6: When I am working in the chemistry lab, I feel I am doing something important Q10: Doing chemistry experiments in school is fun
Evaluative beliefs about school chemistry	3	Q3: Chemistry is useful for solving everyday problems Q7: People must understand chemistry because it affects their lives Q11: Chemistry is one of the most important subjects for people to study
Behavioral tendencies to learn chemistry	3	Q4: I am willing to spend more time reading chemistry books Q8: I like trying to solve new problems in chemistry Q12: If I had a chance, I would do a project in chemistry

Sample

Secondary schools in Malaysia starting from grade 1 to grade 5. Students who are in grades 1 to 3 are categorised as lower secondary while grade 4 and 5 are in the upper secondary. Learning chemistry will only begin when students are in grades 4 and 5 that is in upper secondary. Students who are in the lower secondary will study science only. When students enter into grade 4, they were given the opportunity to choose courses according to their interest. The selection of courses in grade 4 also depends on PMR or PT3 result that was carried out during the grade 3. Students who choose to go into science courses will take chemistry as one of the compulsory subjects. Each session of school will start in January and ends in November. Usually, age of students in upper secondary education is around 16 to 18 years old.

This study was conducted at secondary schools in the district of Simunjan and Serian, state of Sarawak. Simunjan district has 5 schools while the Serian district has 6 schools. All schools in the area are categorized as rural schools and most of the students in these schools are indigenous students from Malay, Iban and Bidayuh ethnic. The students are from a different socio-economic background and different intellectual level. The number of boys and girls at every grade is almost the same. Chemistry teachers will administer the questionnaire during the session of classroom instruction. All participation is voluntary and no incentives were offered. A total of 470 students of grade 4 and grade 5 participated in this study. Table 2 show the distribution of students according gender and grade level.

Table 2. Distribution of students by gender and grade level

Gender	Male	177
	Female	293
Grade Level	Form 4	245
	Form 5	225
Total Responden (N)		470

Data Analysis

Data were analyzed using SPSS. Type of analysis was used is 'two-way multivariate analysis of variance (MANOVA) to determine the effect of the interaction between gender and grade level with a score of four categories surveyed. Two-way MANOVA is suitable because for all 4 categories are positively correlated (Cheung, 2007). If the two-way MANOVA analysis states a statistically significant relationship between gender and grade level, then further analysis will be conducted to determine where significant interaction effect was.

Results and Finding

To identify the reliability of the instrument for this study a pilot test was conducted. The Cronbach's Alpha value was compute is 0.86. This value of Cronbach's Alpha is acceptable and almost same with previous studies (Ayyildiz & Tarhan, 2009; Belge Can, 2012). The two-way MANOVA results showed that main effect independent variable gender (Wilks' lambda = 0.955, F (4, 463) = 5.47, $p < 0.001$) and main effect independent variable grade level (Wilks' lambda = 0.969, F (4, 463) = 3.68, $p < 0.05$) have a significant effect on attitude towards learning chemistry. Gender and grade level show no significant interaction effect (Wilks' lambda = 0.983, F (4, 463) = 2.03, $p > 0.05$) on secondary school students' attitudes towards chemistry for combine of all four dependent variables. Further analysis was performed to identify which subscales of the ATCLS show significant interactions. Analysis results show that only 1 out of 4 subscale [Evaluative beliefs about school chemistry $F(1, 466) = 13.80$, $p < 0.001$] exhibit significant interaction effect with main effect independent variable gender. Other dependent variables not exhibit significant effect with gender [Liking for chemistry theory lesson, $F(1,466)=0.38$, $p > 0.05$; Liking for chemistry laboratory , $F(1,466) = 0.01$, $p > 0.05$; Behavioral tendencies to learning chemistry, $F(1,466) = 0.76$ $p > 0.05$]. The analysis also show that only one subscale [Evaluative beliefs about school chemistry, $F(1,466)=7.01$, $p<0.05$] exhibit significant interaction effect with main effect independent variable grade level. Furthermore only 1 dependent variables [Evaluative beliefs about school chemistry $F(1,466)=6.11$, $p < 0.05$] exhibited significant interaction effects between gender and grade level.

The two-way MANOVA results indicated that subscale 'Evaluative beliefs about school chemistry' exhibit significant effect with gender. The further analysis was done to identify whether the results favored the male or female students. The mean score value for male is 4.20 and the mean score value for female is 4.41. This indicate that mean scores for female students are higher compared to their male counterparts in this particular subscale. Furthermore two-way MANOVA results also indicated that subscale 'Evaluative beliefs about school chemistry' exhibit significant effect with grade level. Further analysis was done and the results show that mean score for form 4 students is higher compare form 5 students which form 4 mean score is 4.39 and form 5 mean score is 4.23. Table 3 show the mean score of gender and grade level with 4 subscale of attitude towards chemistry. Other than that analysis of results also indicated the research population, gender and grade level contributed 50% of the changes in the dependent variable 'Evaluative belief about school chemistry ' and 11% of the changes in the dependent variable 'Liking for chemistry laboratory'. Figure 1 and figure 2 show the changes in students' mean score 'attitudes toward chemistry' by gender and grade level.

Table 3. Mean score of gender and grade level with four subscales

Dependent Variable	Gender	Grade Level	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Liking for chemistry theory lessons	Male	Form 4	3.943	.072	3.801	4.084
		Form 5	3.989	.071	3.850	4.128
	Female	Form 4	3.911	.053	3.806	4.016
		Form 5	3.941	.058	3.827	4.054
Liking for chemistry laboratory work	Male	Form 4	4.437	.064	4.312	4.562
		Form 5	4.456	.063	4.333	4.578
	Female	Form 4	4.361	.047	4.268	4.453
		Form 5	4.519	.051	4.418	4.619
Evaluative beliefs about school chemistry	Male	Form 4	4.345	.066	4.215	4.474
		Form 5	4.044	.065	3.917	4.172
	Female	Form 4	4.418	.049	4.322	4.514
		Form 5	4.407	.053	4.303	4.511
Behavioral tendencies to learn chemistry	Male	Form 4	3.793	.072	3.653	3.934
		Form 5	3.744	.070	3.606	3.883
	Female	Form 4	3.703	.053	3.598	3.807
		Form 5	3.726	.057	3.613	3.839

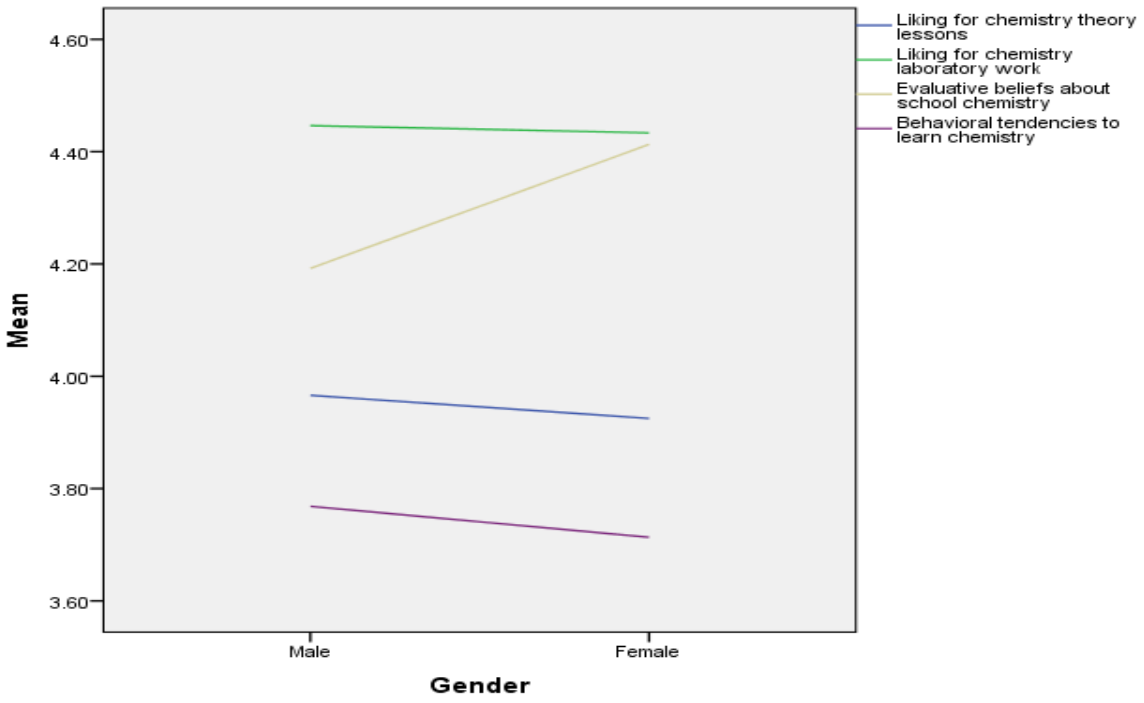

Figure 1. Changes in students' attitudes toward chemistry mean score by gender

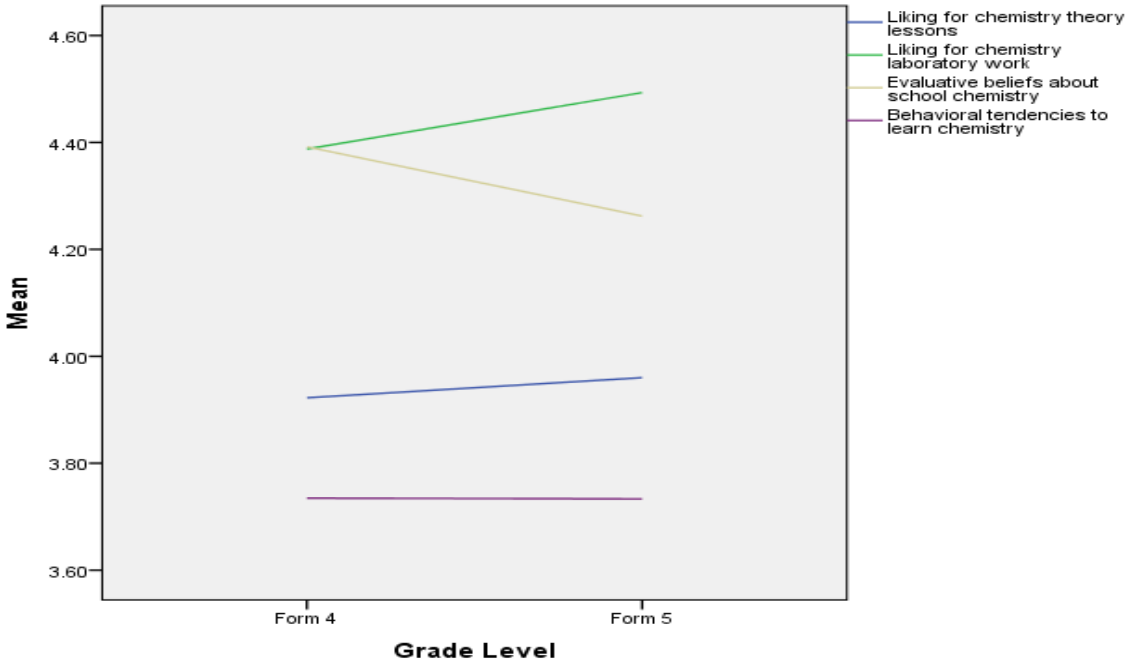

Figure 2. Changes in students' attitudes toward chemistry' mean score by grade levels

Discussions

Attitudes towards chemistry means students like or dislike to learning chemistry. Positive attitudes will help to improve the students achievements (Salta & Tzougraki, 2004a). Many previous research, result show that attitude is one of effective component that will influence students' learning (Kah Heng & Karpudewan, 2015). Improving students attitude become most important factors in teaching and learning. Various method was used to improve students attitude in particular subject. For instance, extra instruction and inquiry skills during experiment in physical lab was successfully improve students' attitude toward chemistry (Koksal & Berberoglu, 2012). Additionally, in a study conducted on 45 female and 45 male students from three secondary schools in Minna, Nigeria found learning using computer simulation can change the attitude of students to be motivated to

learn chemistry (Gambari, 2016). Similarly, this study is made to evaluate the factors that will influences students' attitudes toward chemistry. Main focus of this study is to find interaction effects between gender and grade level on rural area indigenous secondary school students' attitude towards chemistry.

The two-way MANOVA outcomes can be summarized that is not significant differences were noticed among two grade levels (form 4 and form 5) for 'liking for chemistry theory lesson' subscales of dependent variables. Any way got slightly decrease in students mean score among grade level for this subscale. Meanwhile mean score male students (3.97) for subscale 'Liking for chemistry theory lesson' is slightly higher compare to female students mean score (3.93) and mean score increasing trend was noticed with the grade level (form 4 to form 5) for female and decreasing trend for male. This finding is quite similar with previously studies (Cheung, 2009; Barnes, McInerney, & Marsh, 2005) and these findings also contradict with the finding from Kah Heng & Karpudewan,(2015) and Salta & Tzougraki, (2004b) research.

The finding for subscale 'liking chemistry laboratory work' got slightly increase in students mean score among grade level (form 4= 4.40, form 5= 4.49). Mean score male students (4.45) is slightly higher than mean score female students (4.44) for this particular subscale. Other than that gender never show a significant effect with the subscale 'liking chemistry laboratory work' with the attitude of male more favourable to chemistry laboratory work. Meanwhile the interest of male students in laboratory work is increase from form 4 (4.44) to form 5 (4.47) and mean score for female students also is increase from form 4 (4.36) to form 5 (4.52). Increasing trend was noticed for this subscale with the grade level (form 4 to form 5) for male and female. This finding is quite different with the study among 312 boys and 185 girls in 18 secondary 4 independent school students from Singapore which reported that females students preferred to using more laboratory learning environment compare to male students (Quek, Wong, & Fraser, 2002).

For the subscale of evaluative beliefs about school chemistry, mean score female students (4.41) is higher than mean score male students (4.20) and also found that, the students mean score of grade level decrease from form 4 (4.39) to form 5 (4.23). Meanwhile male and female students showed more stable and positive attitude towards chemistry from the perspective of evaluative beliefs which the female students mean score slightly decrease from form 4 (4.42) to form 5 (4.41) and mean score for male also decrease from form 4 (4.35) to form 5 (4.04). This finding is similar with the finding of Kah Heng & Karpudewan, (2015). The analysis also show that there is significant different change in attitude across gender and grade level for subscale evaluative beliefs. This finding is similar with finding of Can & Boz, (2012) and Belge Can, (2012) where gender and grade level had significant effects on high school students' attitudes toward chemistry.

Other than that for subscale behavioural tendencies to learn chemistry, mean score male students (3.78) is higher than female students (3.71) and the students mean score of grade level is almost same for form 4 and form 5. The analysis also show that there is no significant different change in attitude across gender and grade level for behavioural tendencies but mean score for male is decrease from form 4 (3.79) to form 5 (3.74) and for female is increase from form 4 (3.70) to form 5 (3.73). Male and female for this subscale experienced slightly positive attitude towards chemistry. This finding also similar and consistent with the finding of Cheung, (2009) were no significant different in change of attitude across the gender and grade level for behavioural tendencies.

The planning in teaching is important to develop positive attitude toward science subjects. The development of positive attitude will prepare students to make decisions for the problems in science (Koballa & Crawley, 1985). The students' achievement for the subjects of chemistry in secondary schools is still at a low level (Edomwonyi-otu & Avaa, 2011). Learning difficulties and low achievement in chemistry is due to the negative attitude of students towards the subject (Yunus & Ali, 2013). The attitude of students' is so much related with teaching strategies of teacher in classroom (Najdi, 2009). From the data obtained, mean score for male and female is different for each subscales. Figure 1 show that male mean score is higher than female mean score in 3 subscale that is liking chemistry theory lesson, liking chemistry laboratory work and behavioural tendencies to learn chemistry. Meanwhile female mean score is higher than male mean only in one subscale that is evaluative beliefs about school chemistry. Even though the male students score mean is higher in 3 subscale but the difference is not significant. It show that the attitude differences among this 3 subscale is very small and no gap between male and female students' attitude in learning chemistry in early stage across this 3 subscale compare to subscale evaluative beliefs about chemistry where there was a gap between male and female with statistically show a significant different. This outcome suggests that all students generally has same prior attitudes towards chemistry in early stage of learning and teacher need to plan a teaching strategies according to their attitudes. Female students more understand that chemistry is useful, affect their lives and important subjects compare to male students.

Male students liking for chemistry laboratory work is increasing from form 4 to form 5. This may be due to teacher teaching strategic in grade 4 where by teacher used cookbook style of doing experiment work (Kassim, 2014). This is because teacher assumed that students' are not familiar with laboratory equipment and

environment. Meanwhile when students are in grade 5, teacher understand that they become more efficient with laboratory environment and equipment, so teachers change to inquiry strategic in teaching experiment. Other than that the experiment presented in textbook are needed the students to follow procedures in a cookbook style and students do not have opportunities to explore themselves. Normally male students expect a more challenging nature in learning compare to female students (Kah Heng & Karpudewan, 2015). Male students more active and show more positive attitude in inquiry base chemistry laboratory work compare to female students (Wolf & Fraser, 2008).

Female students felt that chemistry is very useful for solving everyday problems. They understand the important of chemistry in their daily life. Chemistry more important and useful for female across the grade level. This finding also similar and consistent with the finding of Kah Heng & Karpudewan (2015). Chemistry teacher should play an important role to reduce the gap between male and female about understanding the important and usefulness of chemistry. Teacher are suggested using laboratory method to ensure the improvement of the students attitude towards chemistry (Adesoji & Raimi, 2004). Chemistry teachers should carry out activities based on gender differences so that every student has an opportunity to change their attitudes towards chemistry. Female students understand the benefits, uses and importance of chemistry but they still think that chemistry is a difficult subject. This is because the natural attitude of female students who think that boys are better than girls in chemistry. This results suggest that teacher should plan lessons based on constructivism theory to improve the basic concepts of chemistry. Low basic understanding of chemistry will disrupt the attitude of students. A basic understanding of chemistry is important because chemistry is considered difficult, bored and too abstract subject (Mohd Nor & Tay, 2010). Teacher at school need to use a variety teaching methods, appropriate teaching material, better approaches and different pedagogical skills to improve the basic knowledge and attitude of chemistry within the gender framework. Learning chemistry also must related with our real world to motivate students to learn chemistry and develop students ability to solve real problem based their knowledge and skills (Cheung, 2009).

Male students showed a decreased trend in attitude of majoriti subscale from form 4 to form 5 while the female showed an increased trend in most subscale except subscale evaluative beliefs about school chemistry with very marginal reduction that is only 0.01. This finding is similar with (Can & Boz, 2012) that have claimed that female students attitude increased compare to male students in form 4 and form 5. This is probably due the nature of female students that always put their hard work in study compare male students (Cotton, Joyner, George, & Cotton, 2015). The hard work in study make their attitude towards chemistry improve when across the grade. Other than that, this changes also because at end of form 5, students have to sit for public examinations with the results will determine their further studies in tertiary education (Kah Heng & Karpudewan, 2015).

Recommendations

The results from this study cannot be generalized because the data was used is cross-sectional and size sample is too small and other than the above conclusion need to verified with a representative sample using a longitudinal research design (Cheung, 2009). Further research is recommended to identify the underlying reasons for gender differences across the grade level in attitude towards chemistry among indigenous rural area student in Sarawak, Malaysia. Further study also is needed to understand why indigenous rural area male students' attitude is decreasing when across a grade level compare to indigenous rural area female students. It is also suggested that research can be conducted involving indigenous students from the different rural area in Malaysia so that the outcomes can be generalized.

Conclusion

The aim of this study is to investigate the interaction effects between gender and grade level among rural indigenous secondary school students' attitude towards chemistry in Sarawak, Malaysia. The students' attitudes were measured using ATCLS survey form with multidimensional questionnaire to provide the interaction effects between gender and grade levels. For this purpose, the two-way MANOVA statistical analysis was used. This analysis is more trustworthy compare to other statistical analyses because two-way MANOVA will avoid any type 1 error in research. This study is comparing the attitude towards chemistry lessons among male and female students and also find the information about attitude towards chemistry for male and female changes of grade level from form 4 to form 5.

There was a significant effect between gender and attitude toward chemistry lesson. Mean score from research was showed that male students have more positive attitude towards chemistry compared to female students in

majority subscales expect 1 subscale that is evaluative beliefs about school chemistry. Other than that female students attitude toward chemistry lesson become more positive across grade level from form 4 to form 5 meanwhile male students attitude toward chemistry lesson become less positive across the grade level (Can & Boz, 2012). The result shows that female students put more hard work to get good result in public examination at form 5. This will improve their attitude towards chemistry and this outcomes needs further exploration (Cotton et al., 2015; Kah Heng & Karpudewan, 2015).

Overall the result show that students attitude towards chemistry lesson is positive in the range 3.71 to 4.45 based on scale 1 to 5. This shows that attitude among indigenous students towards chemistry is positive in line with nation's education objectives to reduce the education gap in urban and rural areas. Positive attitude among students will help Malaysia's to become develop country in year 2020. The outcomes showed that gender and grade level will influence the level of chemistry attitude and teachers need to take into account these two factors in teaching and learning among indigenous rural area students.

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