Relationship between Emotional, Intelligence, Motivation and Logical Reasoning towards Academic Achievement among Secondary School Students

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Abstract

The main purpose of this study is to examine the relationship between Emotional Intelligence, Motivation and Logical Thinking of secondary school students in their academic achievement. The emotional intelligence, motivation, and logical thinking of a student play an important role in the mastery of each subject that is learned by it. In the learning process it includes important components such as cognitive and behaviour which also involves the emotion, motivation and thinking of a student. The researchers use stratified random sampling for sampling procedures. In addition, the sample used by the researcher was composed in secondary school students in Johor where the number of clusters was determined according to districts that could be made at random. The researcher selected Form 4 students throughout Johor. This refers to the Cognitive Development Theory proposed by Jean Piaget which is Form 4 student at the aged of 16 years. Demographic information is collected from participants about gender, age, race, and religion and speech language using demographic data forms. Participants will complete four parts of the questionnaire: Emotional Intelligence Self-Assessment (Schutte, 1998), Students Work Preference Inventory (SWPI) built by Amabile, TM (1987), The Group Assessment of Logical Thinking (GALT) Roadrangka, Yeany and Padilla (1983) and academic achievement of students based on PT3 results. The findings show that the correlation coefficient between emotional intelligence and academic achievement is r = - 1.62 at the significance level p ≤ 0.01. This shows that there is a correlation between emotional intelligence and academic achievement of Form 4 students throughout Johor. In addition, it also shows that there is a significant relationship between emotional intelligence and student academic achievement. However, the findings of this study were also supported by the study conducted by Azizi and others (2005) which found that there was no significant correlation between the levels of extrinsic motivation of the students with the level of academic achievement of the students. The results of one-way ANOVA analysis show

significant differences in overall mean of logical thinking according to academic achievement at secondary level (F (2.496) = 64.614, p <0.0005.). This finding succeeded in rejecting the second zero hypothesis stating that there was no significant difference in the mean of logical thinking ability according to the academic achievement of students at the secondary level. The findings of this study are also supported by a study conducted by Corpus (2005) which shows the correlation between extrinsic motivation and negative relationship with student academic achievement. The information obtained from this study can be used by the Ministry of Education, school administrators, Guidance Teachers and Counselling and parents in realizing the desire to produce quality human capital among teenagers in Malaysia. This information can also help researchers study their emotional intelligence, motivation and logical thinking.

Keywords: Emotional Intelligence, Motivation, Logical reasoning, Academic Achievement, Secondary School Students.

Background of the Study

The main purpose of this study was to examine the extent of Emotional Intelligence, Motivation and Logical Thinking of secondary school students in Johor on academic achievement. Logical thinking plays an important role as it helps students in developing critical thinking and problem solving skills that are part of the soft skills. The emotional intelligence, motivation, and logical thinking of a student play an important role in the mastery of each subject that is learned itself. This is because in the learning process it includes important components in example cognitive and behaviour which also involves the emotion, motivation and thinking of a student.

Emotional intelligence influences the students learning and academic achievement. However, psychologist has realized the importance in academic achievement. This study will identify the dimension of emotional intelligence that most influence and contribute to student academic achievement. The findings of the study on emotional intelligence in the field of education consistently show a positive correlation between emotional intelligence and academic performance. Studies also show that the intellectual development of students studied is in line with the formation and development of their emotional intelligence. The increased emotional intelligence of the students will result in the improvement of students' academic achievement (Mohd Ishak et al, 2007).

The motivational concept can also be explained based on individual traits or traits. Basically, the motivation that formed at some point was a combination of the nature or the selfishness and necessity of the time. One conclusion can be made that motivation depends on two factors, namely internal factors and external factors which are each identified as intrinsic motivation and extrinsic motivation.

The developments of thinking abilities have been discussed in the in educational view around the world. According to Cohen (1980), stated that the higher the ability of a person to think in an abstract way, the higher the ability of the person will function effectively in the society. Hence, the improvement of formal reasoning and thinking abilities among students is one of the aims in education at all level of schooling. Cognitive Development Theory, a well-known proposed by Jean Piaget has conceptualised four different stages in the cognitive development of a person in example sensorimotor (0-2 years), preoperational (2-7 years),

concrete operational (7-11 years) meanwhile for formal operational (11-16 years). The main difference among these stages of cognitive development is the way the students thinking.

Problem Statement

Emotional intelligence factors are seen as factors that influence the learning of a student. Hence it will have implications for student academic achievement. Generally the success of a student in the academic field is often associated with high levels of physical intelligence while the aspect of emotional intelligence is not given due emphasis. However, psychologists have realized the importance of the emotional intelligence of students in achieving their academic achievement.

While the academic achievement of the students is related to the level of excellence of an individual or the extent to which an individual can master the knowledge learned based on the highest points that can be collected, which can be seen and measured in value to carry out this study. The question here is that students with low emotional intelligence are also associated with students with low academic achievement level.

However, according to Van Zile-Tamsen (1998), the extent to which emotional intelligence affects academic achievement of students depends on the motivation of a student. This explains the possibility of a relationship between emotional intelligence and motivation in influencing student achievement. The finding of motivation in the field of education consistently shows a positive relationship between motivation and academic performance. However, the strength of the relationship between the two is relatively weak indicates that the motivation is not directly related to academic performance, but interacts with other variables in influencing student academic achievement (Doljanac 1994).

Learning is an important process in the development of human life independently or socially. According to Flood (2003), one's learning function along with the emotional response around. The main purpose of this study was to examine the extent of Emotional Intelligence, Motivation and Logical Thinking of secondary school students in Johor affecting their academic achievement.

Individuals are said to be different from other individuals. Psychologists state that individuals have differences in various aspects such as physical, behavioural, personality, and level of thinking. This includes differences in the motivation of an individual, especially internal motivation and external motivation. Motivation looks different for each individual in achieving a desired goal. Many studies conducted by psychologists found that there was a motivation of achievement with the achievement of a person in any field.

In the context of learning, there are high motivated learners and others who have moderate motivation in academic achievement. Ahmad Saufie Haji Ali (1996), in his study found that the results of the study showed that students with good achievement in Form Six Economy subjects are students who practice learning orientation in an understanding, have intrinsic oriented motivation achievement and adopting internal learning approaches.

The fundamental function of the schooling system in United States of America was outlined by Educational Policies Commission in 1961. The Commission stressed the importance of

logical reasoning abilities in education. According to Renner and Philips (1980), they believed that students should be given the opportunities to develop their thinking abilities as a base for the intellectual development. Meanwhile according to Lawson (1985) stressed out that schooling system is not meant for teaching of fact and concepts which are specific to a particular knowledge domain but more importantly to assist students in their thinking skills.

The main issue of the current students is that they are lack of soft skills which are personal attributes, interpersonal skills, problem solving and decision making skill to be more competitive (Shakir, 2009). In addition, logics play a bug inquire as it ads the students in developing critical thinking and problem-solving skills which are part of the soft skills (Ministry of Higher Education, 2006).

Based on the Cognitive Development Theory proposed by Jean Piaget, upper secondary school students (Age of 16 years) are the formal operational stage which they can think logically about abstract propositions and test hypothesis systematically. At the same time, they are also concerned with the hypothetical, the future and also ideologically problems. According to Wilson and Wilson (1984), formal operational reasoning is determinants of student's success in science and mathematics advanced courses at the secondary level (Wilson & Wilson, 1984). In addition, previous researchers Shemesh (1990) have found that there is a significance difference in logical reasoning abilities between male and female students. Male students performed better in Piagetian formal reasoning task compare to the female students result.

On the other hand, not many documented researches have been conducted to instrument rural student's logical reasoning abilities. Hence, the aim of this study is to gauge the logical reasoning abilities which is including conservational reasoning, proportional reasoning, controlling variables, combinatorial reasoning, probabilistic reasoning and last but not least correlational reasoning. This study also focused on to identify if there is any significant difference in rural students logical reasoning abilities based on the students gender and also including their academic achievement in secondary level.

Research Objectives
The objectives of this study are:
1. To identify the level of emotional intelligence among secondary school students.
2. To identify the level of motivation among secondary school students.
3. To identify the logical reasoning abilities among secondary school students.
4. To identify students academic achievement among secondary school students.
5. To identify the significant difference between emotional intelligence and academic achievement at secondary level.
6. To identify the significant difference between motivation and academic achievement at secondary level.
7. To identify the significant difference between emotional intelligence and academic achievement at secondary level.

Research Hypothesis

This research was guided by the following hypothesis:

Ho_1: There is no significant difference between emotional intelligence and academic achievement at secondary level.

Ho_2: There is no significant difference between motivation and academic achievement at secondary level.

Ho_3: There is no significant difference between logical reasoning and academic achievement at secondary level.

Methodology

Research Design

This research was conduct by non-experimental quantitative research and sample survey method to collect the data. The samples were selected by using a two-stage cluster random sampling technique. To analysis the data which is including independent sample t-test and one way Analysis of Variance were used to test the stated null hypothesis.

Context of the Study

This study was conducted among form 4 students in Johor which is 500 students were asked to answer the surveys. The distribution of schools and Form 4 classes according to ten districts in Johor, Malaysia. However only six out of ten districts allowed the researcher to conducted the survey. The distributions of the school involved were shown in Table 1 below:

Table 1:

Distribution of Schools and Number of Students According to Six District in Johor, Malaysia that Involved in the Survey

District	No. of Schools	No. of Students
Batu Pahat	2	90
Kulai	4	133
Mersing	1	30
Muar	1	40
Pasir Gudang	3	127
Segamat	2	80
Total	13	500

Population, Samples and Sampling Techniques

The populations of this study were Form 4 students from 13 secondary school in Johor state who registered under Malaysian Education Ministry. Population size is approximately 55,365 students and the sample sizes involved in this study are 500 students for over Johor. The average age of the population is 16 years old. Sample size in this study was determined based on the formula suggested by Krejcie and Morgan (1970) and power analysis by Miles & Shevlin (2001). Krejcie and Morgan suggested that for a population between 50,000 students, a minimum sample size are 381 is acceptable. However, the researcher took 500 students in this study. Thus, the sample size of this study is adequate compared to Krejcie and Morgan's recommendation.

To be specific, the cluster random sampling was used to identify schools and form 4 classes to be involved in this study. At the stage one; systematic sampling was used to identify thirteen schools from six districts in the Johor state. Once the schools have been chosen, simple random sampling method was used to select two form 4 classes from each school by using the random number table. All the students in the chosen classes were automatically taken as the samples in this study. The combination of sampling techniques is to ensure the representativeness of the samples that been used in this study.

Research Instruments

This study uses a questionnaire as an instrument in data collection. The researcher chose the questionnaire method in conducting this study because the information obtained was accurate and complete. Questions submitted to the respondents are statements that refer to the objectives of this study. The questionnaires in this study consist of three parts which have 78 items as a whole. The items are divided into sections in the questionnaire.

Demographic information is collected from participant about their age, sex, race and daily speech language using demographic data form. Participants will complete two questionnaires: Emotional Intelligence Self Assessment (EISE) by Goleman (1995), intrinsic and extrinsic motivational scales using the Student Work Preference Inventory (SWPI) by Amabile, TM (1997), The Group Assessment of Logical Thinking (GALT) which was built by Roadrangka, Yeany and Padilla in 1983. Group Assessment of Logical Thinking (GALT) is a paper-and-pencil test which consists of 21 items to measure students logical reasoning abilities. The distribution of items according to six different modes of logical reasoning abilities and has been cited, adapted and translated into Malay and their academic achievement levels based on Form 3 (PT3) exams they have taken in the previous year.

Validity and Reliability of the Instrument

The researcher has examined all the items in the original instrument and found that most of the items were suitable to be used in Malaysian context. Effort has been done to ensure the content and face validity of the modified and translated version of the instrument. In this matter, the items were translated into Malay language so that the respondents can understand all the items and choose their best answer. The Cranach's alpha reliability coefficient of the instrument was .49 which is considers moderate for use in this study.

Data Collection Procedures

Before administering the instrument, formal permission from the Education Ministry of Malaysia, Johor State Education Department, District Education Department and the principals of the schools involved was sought and obtained. The instrument of this study was then administered by the researcher. Students that involved in this study were gathered in the school hall and the instruments were administered to the students concurrently. The students were briefed about the instruments and the way to answer the questions. The students were given ample time which is approximately 2 hours to answered all the questions.

Data Analysis Procedures

The researchers analysed the data collected using computer software support i.e. the Statistical Package for Social Science (SPSS) version 21.0. It is used to analyse between the level of emotional intelligence, the level of motivation and the logical level of student thinking

of their academic achievement. Three methods of analysis used by researchers include descriptive methods, pilot studies and inference methods.

Descriptive analysis statistic were used to gauge the emotional intelligence, motivation and logical reasoning abilities among Form 4 students in Johor which include measures of central tendency that is mean and mean in percentage and measures of variability which is range, standard deviation and also standard deviation in percentage. Students answer on the instrument were checked and scored by researcher to ensure consistency in marking.

For the GALT instruments there were two answers for the first items in the instrument. One point will be given for both correct answers. If only one part of the answer is correct, zero point will be given. The last three items in the instruments were prepared to gauge student's combinatorial reasoning ability. One point will only be given if all the correct combination of answer is listed in the space provided. Likewise, zero point will be given if only part of the answer is correct. Possible minimum score for this instrument is zero whereas the maximum score can reach 21 points. After the assumptions of using parametric tests were met, univariate analysis such as independent sample t-test and one-way ANOVA were used to test the stated null hypothesis at a specified significance level, $\alpha = .05$.

Independent Sample t-test
Independent sample t-test was used to determine if there is any significant difference in the mean of logical reasoning abilities based on student's gender. Independent sample t-test was used to compare the overall mean of emotional intelligence, motivation and logical reasoning abilities.

One-way Analysis of Variance
One-way ANOVA was used to ascertain if there is any significant difference in the mean of emotional intelligence, motivation and logical reasoning abilities based on student's academic achievement at secondary school level. One-way ANOVA were used to compare the overall mean of three different manipulated variables which is emotional intelligence, motivation and logical reasoning abilities.

Research Findings and Discussion
The background of the respondents that involved in this study was 500 of Form 4 students in the state of Johor. The background of this respondent is described through a pie chart based on demographic characteristics such as gender, age, race, religion as well as daily speech language. The demographic characteristics have been analysed using frequency and percentage.

Gender of Respondent
Table 2:
Gender of the Respondent in the Research

Gender	No	Per cent (%)
Male	232	46.4 %
Female	268	53.6 %
Total	500	100.0 %

The table 2 above show the results finding based on respondent gender. Results showed that 232 respondent are male students who led to 46.4%. Meanwhile, the remaining 268 respondents are female students who lead to 53.6%.

Age of Respondent

In this study, the respondent that involved is Form 4 students which are 16 years old across the state of Johor. the students that involved in this study were from pure science, social science, technical science and literature class which also involved a total of six district in the Johor state; Batu Pahat, Kulai, Mersing, Muar, Pasir Gudang and Segamat.

Race of Respondent

Table 3:

Race of the Respondent in Research

Race	No	Per cent (%)
Malay	348	69.6 %
Chinese	115	23.0 %
Indian	35	7.0 %
Others	2	0.4 %
Total	500	100.0 %

The table 3 above shows the distribution of respondents according to race. A total of 348 respondents from 500 respondents are Malays, equivalent to 69.6%. As many as 115 respondents are Chinese, 23.0%, India is 35 people, 7.0% and other races are 2 people, equivalent to 0.4%.

Religion of Respondent

Table 4:

Religion of the Respondent in the Research

Religion	No	Per cent (%)
Islam	348	69.6 %
Christian	45	9.0 %
Buddha	84	16.8 %
Hindu	20	4.0 %
Others	3	0.6 %
Total	500	100.0 %

The table 4 above shows the distribution of respondents according to religion. Based on the findings, a total of 348 respondents involved were Muslim students equal to 69.6%. For students studying in Christianity, 45 respondents were 9.0%. 84 Buddhist students are equivalent to 16.8%, 20 Hindu students, which leads to 4.0%. While the rest are other religions i.e. 3 respondents from 500 respondents and a percentage of 0.6 percent.

Respondent Speech Language
Table 5:
Speech Language used by Respondent in the Research

Speech Language	No	Per cent (%)
Malay	320	64.0 %
English	90	18.0 %
Chinese	80	16.0 %
Tamil	10	2.0 %
Others	0	0.0 %
Total	500	100.0 %

The table 5 above shows the distribution of respondents according to the spoken language spoken by each respondent at home. The findings show that 320 respondents from 500 respondents speak Malay language which is equivalent to 64.0%. While 90 speakers speak English, equivalent to 18.0%, the Chinese are spoken by 80 respondents, equivalent to 16.0% and the rest are 10 respondents who speak Tamil plus 2.0%. However, there are no respondents who speak other languages than those mentioned above, namely Malay, English, Chinese and Tamil.

Analysis of Students Emotional Intelligence
This section is to answer the research question 1: "What is the level of emotional intelligence of secondary school students in Johor?"

Descriptive analysis using mean value is made by showing students emotional intelligence level. In this study, there are four dimension of emotional intelligence:

   i.   Self – awareness
   ii. Emotional management
   iii. Social skills
   iv. Empathy

Respondent has answer the survey and their emotional intelligence level were show in table below:

Table 6:
Mean Score and the Standard Deviation in the Four Dimensions of Emotional Intelligence Studied, Dimension of Self-Awareness, Dimension of Emotional Management Dimension of Social Skills and Dimension of Empathy

Emotional Intelligence	N	Mean	SD	Interpretation
Self – awareness	500	4.50	0.43	High
Emotional Management	500	4.27	0.44	High
Social Skills	500	4.22	0.47	High
Empathy	500	4.34	0.54	High
Total	500	4.25	0.47	High

The table 6 shows the mean score and the standard deviation in the four dimensions of emotional intelligence studied, dimension of self-awareness, dimension of emotional

management dimension of social skills and dimension of empathy. The level of emotional intelligence is determined by the division of mean values into three levels, namely low, medium and high levels. Low level mean values are 1.00 to 2.33, medium level mean is 2.34 to 3.67 and the high level min value is 3.68 to 5.0. Self-awareness dimensions (4.50) are at the highest level, followed by dimension of empathy skills (4.34). Overall the mean score for all dimensions of emotional intelligence namely self-awareness dimension, dimension of emotional management, dimension of social skills and empathy dimensions are at level (4.25). In general, overall teen emotional intelligence is at a high level.

Analysis of Form 4 Students Motivation
In this section, the motivation of Form 4 students across the state of Johor was measured based on four categories of motivation namely challenge, excitement, exit and reward. Based on these four categories, the researcher has made an explanation to answer the question of "What is the level of motivation to learn among form 4 students?"

Analysis of Intrinsic Motivation for Challenges Category
This section discusses the intrinsic motivation in the category of challenges among Form 4 students across the state of Johor. In the intrinsic motivation of the challenge category there were seven items divided, all items received a mean score of less than the value of 3.0 and the items were items 3, 5, 9, 11, 13, 14 and 26. This indicates that moderate motivated students in completing Difficult problems, increasing knowledge and skills, doing simple and uncomplicated things, feeling in touch with something new, solving new problems, doing work based on slow reading ability, and doing complicated work. However, the findings showed that students were less motivated towards a difficult and challenging problem solving.

Analysis of Intrinsic Motivation for Fun Category
This section discusses intrinsic motivation for the fun category among Form 4 Students across Johor. A total of 8 items are available for this category. The findings and analysis of the study showed the mean score of the intrinsic motivation of the students for the fun category. On the whole the mean score for the aspect of happiness is between 2.29 and 3.08. The overall mean score for the fun part was 2.84 (SP = 0.88). The average mean value of less than 3.0 indicates that the student has a moderate motivation for the pleasure aspect.

Analysis of Extrinsic Motivation for Outdoor Category
This section discusses extrinsic motivation in the external category for Form 4 students throughout Johor. There are ten items available for this category. The findings and analysis of the study show the mean score of the intrinsic motivation of students for the external category. On average, the mean score for the external category is between 1.96 and 3.08. The overall mean score for the external category was 2.37 (SP = 0.83). Mean less than 3.0 indicate that students have moderate motivation for the external category.

Analysis of Extrinsic Motivation for Reward Category
The mean score of the student's eccentric motivation for the reward category. On the whole, the mean score for the reward category ranges from 2.17 to 2.63. The overall mean score for the reward aspect is 2.41 (SP = 0.88). Average mean value less than 3.0 indicates that students have a modest motivation for reward categories.

Logical Reasoning Abilities among Form 4 Students

Table 2 shows the overall mean and standard deviation of logical reasoning abilities among Form 4 students in Johor, Malaysia.

Table 7:

Mean and Standard Deviation of Logical Reasoning Abilities (N = 500)

Subscales	No. of Item	*M*	*SD*	*M%*	*SD%*	*Range*
Conservational reasoning	4	1.394	1.084	34.608	27.100	0 – 4
Combinatorial reasoning	3	.436	.619	14.147	20.640	0 – 3
Controlling variable	3	.372	.582	12.263	19.403	0 – 3
Correlational reasoning	3	.320	.582	10.990	19.383	0 – 3
Proportional reasoning	5	.510	.749	10.310	14.972	0 – 4
Probabilistic reasoning	3	.174	.463	5.467	15.417	0 – 3
Overall	21	3.206	2.158	15.197	10.274	0 – 12

Descriptive statistics in Table 7 showed that the overall mean of logical reasoning abilities among Form 4 students in Johor is 3.206 (M% = 15.197) with a standard deviation of 2.158 (SD% = 12.274). The mean and standard deviation (in percentage) according to different modes of logical reasoning abilities in descending order are; conservational reasoning (*M%* = 34.608, *SD%* = 27.100), combinatorial reasoning (*M% = 14.147, SD% = 20.640*), controlling variables (*M%* = 12.263, *SD %* = 19.403), correlational reasoning (*M%* = 10.990, *SD %* = 19.383), proportional reasoning (*M%* = 10.310, *SD %* 14.972) and probabilistic reasoning (*M %* = 5.647, *SD %* = 15.417).

These research findings revealed that logical reasoning abilities among Form 4 students in Johor were low with the mean score which is in percentage in the range of 5.6% to 34.6%. Mean scores in percentage for all subscales except conservational reasoning were less than the overall mean logical reasoning abilities. Further analysis, based on Lawson's categories of cognitive development, found that 98% of the respondents are categorised at the concrete operational stage whereas only 2% are categorised at the transitional operational stage. According to Lawson (1995), students can be categorised into three level of cognitive development which is concrete operational, transitional operational and formal operational based on their performance in GALT instrument.

In table shown above, mean score in percentage according to different modes of logical reasoning in descending order are conservational reasoning, combinatorial reasoning, controlling variable, correlational reasoning, proportional reasoning and probabilistic reasoning. This finding was supported by a model of hierarchical relationship between Piagetian modes of cognitive reasoning and integrated science process skills as proposed by Yaap (1985) and Roadrangkea *et al. (1896)*. In the proposed model mentioned above, probabilistic reasoning is situated at a higher hierarchy as compared to proportional reasoning, controlling variables, combinatorial reasoning and conservational reasoning which are placed at a lower hierarchy of the model.

Students with low logical reasoning abilities might be due to an education system which is more exam-oriented. Hence, less emphasis is given to the teaching and use of thinking skills. Science teaching and learning strategies are aligned to objective with the aim to cover the entire syllabus within the allocated time. Furthermore, these type of students likely without investing too much time to nurture thinking skills among students. Moreover, school evaluation system which only emphasises the acquisition of content knowledge contributes to low logical reasoning abilities among students. According to Syed Anwar *et al.* (2000) reported that the evaluation of student's academic achievement does not give equal emphasis on the process and product component of scientific skills. Almost 100% of the evaluation of students focused on the science and technology product component such as concepts, theories and formulae.

Logical reasoning abilities of students in local higher learning institutions were reported as low. According to Syed Anwar Aly (2000), he found that only 19% of matriculation college students possess high scientific reasoning abilities, 66 % at the medium stage where as another 15% possess low scientific reasoning abilities. In the same study, Syed Anwar Aly (2000) reported that only 19% of Malaysian students with average age of 19 years old possess high scientific reasoning abilities compared to 22 % of American students with average age of 16 years old (Lawson *et al.,* 1991*)*.

Mean Difference in Logical Reasoning Abilities Based on Students Gender
Independent sample *t*-test results (Table 3) showed that there is no significant difference in the overall mean of logical reasoning abilities based on student's gender. Thus the first null hypothesis which is stated that there is no significant difference in the means of logical reasoning abilities based on student's gender is accepted.

Although male students (*M* = 3.367, *SD* = 2.373) scored higher than female students (*M* = 3.044, *SD* = 1.949) but at *t* = -1.721 and *p* = .086, the mean difference is insignificant. However, further analysis showed that male students (*M* = 1.498, *SD* = 1.201) scored significantly higher than female students (*M* = 1.289, *SD* = .966) in conservational reasoning at *t* = -2.222 and *p* = .027.

Table 8:
Independent Sample t-Test Result for Mean Difference in Logical Reasoning Abilities Based On Gender (N = 500).

Subscales	Gender	N	M	SD	T	df	P
Conservational reasoning	Male	174	1.498	1.201	-2.222*	477.331	.027
	Female	326	1.289	.966			
	Overall	500	1.384	1.084			
Proportional reasoning	Male	174	.582	.777	- 1.893	515.368	.059
	Female	326	.460	.720			
	Overall	500	.516	.749			
Controlling variables	Male	174	3.87	.612	- .684	547.000	.495
	Female	326	.352	.557			
	Overall	500	.368	.582			
Probabilistic reasoning	Male	174	.163	.440	.281	547.000	.779

	Female	326	.175	.482			
	Overall	500	.169	.463			
Correlational reasoning	Male	174	.339	.627	-.331	547	.741
	Female	326	.322	.542			
	Overall	500	.330	.582			
Combinatorial reasoning	Male	174	.398	.601	.903	547	.367
	Female	326	.446	.635			
	Overall	500	.424	.619			
Overall	Male	174	3.367	2.373	- 1.721	483.410	0.86
	Female	326	3.044	1.949			
	Overall	500	3.191	2.158			

*$p < .05$

The finding of this study revealed that up to 95.8% of male respondents and 97.2% of female respondents are categorised at transitional operational stage whereas the remaining are categorised at transitional operational stage. This finding was found consistent with the findings of Roadrangka (1995). According Micheal Liau (1982) in his research to investigate primary school student's ability in conservational of length through three of Piagetian experiments, he found that there is no significance difference in the ability of conservation between male and female students. However, the finding was contradicting with previous researchers (Shemesh, 1990). On the other hand, previous researches have found a significant difference in logical reasoning abilities between male and female students. Male students performed better in Piagetian formal reasoning tasks compared to female students.

Mean Difference in Logical Reasoning Abilities Based on Students Achievement at Secondary School Students

One-way ANOVA results in table 5 showed that there is a significant difference in the overall mean of logical reasoning abilities according to students academic achievement at secondary level ($F(2,496) = 64.614$, $p < .0005$.). This finding successfully rejected the second null hypothesis which stated that there is no significant difference in the mean of logical reasoning abilities according to student academic achievement at secondary level. Furthermore, one-way ANOVA revealed that there is a significant difference in the mean of conservational reasoning ($F(2, 496) = 35.156$, $p < .0005$), proportional reasoning ($F(2, 496) = 19.497$, $p < .0005$), controlling variables ($F(2, 496) = 13.983$, $p < .0005$), probabilistic reasoning ($F(2, 496) = 10.608$, $p < .0005$) and, combinatorial reasoning ($F(2, 496) = 14.380$, $p < .0005$) based on students' science achievement at lower secondary level.

Table 9:

One-way ANOVA Results for Mean Difference in Logical Reasoning Abilities Based On Students Academic Achievement at Secondary Level (N = 500)

Subscales	Sources of variation	SS	Df	MS	F	P
Conservational reasoning	Between group	70.785	2	35.393	35.156*	<.0005
	Within group	499.339	498	1.007		
	Overall	570.124	500			
Proportional reasoning	Between group	20.605	2	10.302	19.497*	<.0005
	Within group	262.085	498	.528		
	Overall	282.689	500			
Controlling variables	Between group	9.249	2	4.574	13.983*	<.0005
	Within group	162.266	498	.327		
	Overall	171.415	500			
Probabilistic reasoning	Between group	4.260	2	2.130	10.608*	<.0005
	Within group	99.600	498	.201		
	Overall	103.860	500			
Correlational reasoning	Between group	.295	2	.147	.435	.648
	Within group	168.146	498	.339		
	Overall	168.442	500			
Combinatorial reasoning	Between group	10.804	2	5.402	14.380*	<.0005
	Within group	186.318	498	.376		
	Overall	197.122	500			
Overall	Between group	474.691	2	237.345	64.614*	<.0005
	Within group	1821.934	498	3.673		
	Overall	2296.625	500			

On the other hand, Roadrangka (1995) found that there is a relationship between formal operational reasoning abilities and students' achievement in biology, physics and chemistry. Students at formal operational stage scored significantly higher in biology, physics, and chemistry tests compared to those at concrete operational stage. Students at formal operational stage were also found to obtain significantly higher scores in physics and chemistry tests than students at transitional operational stage. Concrete thinkers are unable to develop the understanding of abstract concepts. Conversely, formal thinkers are able to develop the understanding of concrete and abstract concepts (Inhelder & Piaget, 1958). Hence, students' success in science will be guaranteed by using different modes of formal operational reasoning (Lawson, 1982b, 1985; Linn, 1982, Tsaparlis, 2005, Tai, Sadler & Loehr, 2005, Lewis & Lewis, 2007). For instance, Lewis and Lewis (2007) emphasised the need to include a focus on the development of formal thought as well as a content review in the efforts to help at-risk students in general chemistry.

Implication of the Study
The findings of this study have positive implications for adolescents who are in schools throughout Malaysia. Based on the findings of the study, emotional intelligence is an important competence in one's life. Cognitive efficiency needs to be balanced with affective and behavioural efficiency because a balanced personality characteristic of physical, spiritual,

emotional and intellectual holistically reflects first-class quality human capital (Rorlinda, 2009).

The implications of this study suggest that school adolescents need to have clear abilities and understanding of the concepts and key elements contained in emotional intelligence. Among these abilities are self-awareness, social skills, self-management and empathy. This ability should be owned by today's schoolboys because this emotional intelligence is not only important in everyday life and is even more needed in future careers. Teenagers who are demanding in schools today need to be helped to have emotional intelligence and be translated into daily life. The results of the study have shown that the school adolescents studied have a high level of emotional intelligence. This means that teens need to enhance the emotional intelligence comprehensively, especially in terms of generating personal competencies such as communication skills, adaptation, social responsibility, and skills associated with soft skills.

The importance of logical reasoning abilities in our education system as emphasized by Renner and Philips (1980); The purposes- the common thread of education is the development of the ability to think need to be really understood by all the relevant parties especially Curriculum Development Centre, schools, teachers and all the students who are involved directly or indirectly in the planning and implementation of science curriculum in this country. As pointed out by Renner and Philips (1980), students should be given more opportunities to develop their thinking abilities for intellectual development via various approaches. Furthermore, Yaman (2005) has shown that problem based learning (PBL) approach was effective in the development of logical reasoning skills. On the other hand, according to Koray and KOKSAL (2009), the creative and critical thinking based laboratory method was also found effective in developing creative and logical reasoning abilities.

On the other hand, logical reasoning abilities should be given new emphasis in the teaching and learning of science in the effort to improve students academic achievement at all levels of schooling. Hence, schooling system is not meant for teaching of facts and concept which are specific to a particular knowledge domain but to assist students in acquiring thinking skills (Lawson, 1985). Besides that, children who have reached Piaget's concrete operational level in this study have begun to shed the egocentrism found in the preceding level and are capable of taking the perspective of others. Transitional thinkers will, as in the present study be the children who are near adolescence stage. Children in this phase of life are forming an identity, though not aware of it.

Refer to research findings indicate that logical reasoning is the least dominated among the form four students. Therefore, the teaching and learning process should be planned appropriately so students are actively involved in problem solving activities. Students should be given task which is related to the non-routine problems and the real life situations so that they could enhance their critical and analytical thinking skills. This would lead them to the acquisition of the abstract thinking skills. Teachers' creativity is of outmost important. They need to be creative and to infuse such skill in their teaching activities. Student's involvement in group work activities in the classroom could provide such opportunity for the students to become effective thinkers is one of the major concerns of the Malaysia Ministry of Education. According to Witkin, *et. al* (1977), assisting students would be one of the ways to facilitate them in the acquisition of the required critical and analytical thinking skills.

Recommendations

The findings of this research indicated that majority of the students are Field Dependent. This could be due to the teachers teaching styles which focused on the teacher-cantered learning (Dorothy and Diane, 1994). Teachers should execute activities that would cater the diver's cognitive styles of the students. Research by Ross (2001) suggested that teacher should be flexible with their academic teaching styles and use diverse assessment to cater for the needs of the students.

Findings also showed that majority of the students were at the concrete stage of logical thinking. Teachers should be responsible in ensuring the level of the students level of logical reasoning improved. They could inculcate the thinking skills in the classroom by stressing the importance of formal which is abstract thinking skills. This could be done by providing the students with thinking operations in their homework and classroom activities. The frequency of these activities would improve their level of logical thinking.

Recommendations for Further Research

This research is a correlational study. It did not investigate causal relationship. It is recommended that further research be carried out to investigate the causal relationship on the variables. Such investigation would be enhancing the understanding on the factors affecting the students' academic achievement. Furthermore, further research could be carried our by involving more data to verify the results. Besides that, similar research could be done but on different level of educations such as on the primary and also university students. It is hoped that such comparative study would give clearer pictures on the variable and thus enhancing their potential in learning. Lastly, a qualitative research to be exploring the students' logical reasoning abilities is recommended. Research method involving interviewing of students and observing their learning activities would be given an insight of the students' logical reasoning abilities.

Conclusion

In discussing the issue of parental involvement and the effect of either positive or negative on adolescent emotional intelligence, some things need to be emphasized as intrapersonal skills and interpersonal skills that lead to self-esteem, self-control, adaptation, social responsibility and communication.

Apart from emotional intelligence, students also need to know the level of motivation and knowledge in improving their learning motivation. Not every learning style is used properly, as students need to find the most appropriate learning styles for them to achieve an effective learning process. With this, the goal of improving student academic achievement with excellent academic achievement will be achieved.

The students' logical reasoning and academic achievement should be taken into account in the teaching and learning in schools. Teaching styles that matched the student's logical reasoning could enhance the students learning. As a conclusion, teachers should reflect on their current practices and match the needs of the students. More problem solving activities should be emphasized in the teaching and learning process.

References

Akdeniz, A.R., (1993). *The implementation of a new secondary physics curriculum in Turkey: An exploration of teaching activities.* Unpublished Doctoral Dissertation, University of Southampton, UK.

Bitner, B.L. (1991). Formal operational reasoning modes: Predictors of critical thinking abilities and grades assigned by teachers in science and mathematics for students in grades nine through twelve. *Journal of Research in Science Teaching*, *28*(3), 265-274.

Boulanger, F.D., & Kremer, B.K. (1981). Age and developmental level as antecedents of science learning. *Journal of Research in Science Teaching*, *18*(4), 371-384.

Çepni, S. & Özsevgeç, T. (2002). *Science teachers' assessment tools and their relation with students' cognitive development.* Paper presented at the "Education: Changing Times, Changing Needs, First International Conference on Education", at the Faculty of Education Eastern Mediterranean University, Gazimagusa, Turkish Republic of Northern Cyprus from May 8-10, 2002.

Cohen, H.G. (1980). Dilemma of the objective paper-and-pencil assessment within the Piagetian framework. *Science Education*, *64*(5), 741-745.

DeLuca, F.P. (1981). Application of cluster analysis to the study of Piagetian stages of intellectual development. *Journal of Research in Science Teaching*, *18*(1), 51-59.

Hernandez, L.De., Marek, E.A., & Renner, J.W. (1984). Relationships among gender, age, and intellectual development. *Journal of Research in Science Teaching*, *1*(4), 365-375.

Hofstein, A., & Mandler, V. (1985). The use of Lawson's Test of Formal Reasoning in the Israeli science education context. *Journal of Research in Science Teaching*, *22*(2), 141-152.

Howe, A. C., & Shayer, M. (1981). Sex related differences on a task of volume and density. *Journal of Research in Science Teaching*, *18*(2), 169-175.

Howe, A.C., & Durr, B.P. (1982). Analysis of an instructional unit for level of cognitive demand. *Journal of Research in Science Teaching*, *19*(3), 217- 224.

Inhelder, B., & Piaget, J. (1958). *The growth of logical thinking: From childhood to adolescence*. New York: Basic Books, Inc.

Keig, P.F., & Rubba, P.A. (1993). Translation of representation of the structure of matter and its relationship to reasoning, gender, spatial reasoning, and specific prior knowledge. *Journal of Research in Science Teaching*, *30*(8), 883-903.

Koray, Ö., & KÖKSAL Mustafa Serdar. (2009). The effect of creative and critical thinking based laboratory applications on creative and logical thinking abilities of prospective teachers. Asia Pacific Forum on Science Learning and Teaching, 10(1). Article 2. Retrieved from http:// www.ied.edu.hk/apfslt/v10_issue1/koksal/index.htm#con

Krajcie, J.S., & Haney, R.E. (1987). Proportional reasoning and achievement in high school chemistry. *School Science and Mathematics*, *87*(1), 25-32.

Krejcie, R.V., & Morgan, D.W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, *30*(3), 607-610.

Lawson, A.E. (1978). The development and validation of a Classroom Test of Formal Reasoning. *Journal of Research in Science Teaching,15*(1), 11-24.

Lawson, A.E. (1982a). The relative responsiveness of concrete operational seventh grade and college students to science instruction. *Journal of Research in Science Teaching*, *19*(1), 63-77.

Lawson, A.E. (1982b). Formal reasoning, achievement, and intelligence: An issue of importance. *Science Education, 66*(1), 77-83.

Lawson, A.E. (1985). A review of research on formal reasoning and science teaching. *Journal of Research in Science Teaching, 22*(7), 569-617.

Lawson, A.E., Nordland, F.H., & DeVito, A. (1975). Relationship of formal reasoning to achievement, aptitudes, and attitudes in preservice teachers. *Journal of Research in Science Teaching, 12*(4), 423-431.

Lewis, S.E., & Lewis. J.E. (2007). Predicting at-risk students in general chemistry: comparing formal thought to a general achievement measure. *Chemistry Education Research and Practice*, *8*(1), 32-51.

Linn, M.C. (1982). Theoretical and practical significance of formal reasoning. *Journal of Research in Science Teaching*, *19*(9), 727-742.

Marek, E.A. (1981). Correlations among cognitive development, intelligence quotient, and achievement of high school biology students. *Journal of Research in Science Teaching*, *18*(1), 9-14.

Meehan, A.M. (1984). A meta-analysis of sex differences in formal operational thought. *Child Development*, *55*, 1110-1124.

Michael, Liau, T.L. (1982). *Three Piagetian experiments: an investigation into the ability of Malaysian primary school children from a school with an urban character and from a school with a rural character to conserve length.* Unpublished master's thesis, Universiti Sains Malaysia, Penang.

Miles, J., & Shevlin, M. (2001). *Applying regression and correlation. A guide for students and researchers*. London: Sage Publications.

Mitchell, A., & Lawson, A.E. (1988). Predicting genetics achievement in nonmajor's college biology. *Journal of Research in Science Teaching*, *25*(1), 23-37.

Moshman, D. & Thompson, P.A. (1981). Hypothesis testing in students: sequences, stages, and instructional strategies. *Journal of Research in Science Teaching*, *18*, 4, 341-352.

Özsevgeç, T. (2002). *Determination of the Relationships Between Middle School Students' Profiles and Their Cognitive Development Levels in the Selected Science Topics*. Unpublished Master Thesis, Karadeniz Technical University, Turkey.

Piburn, M. (1980). Spatial reasoning as a correlate of formal thought and science achievement for New Zealand students. *Journal of Research in Science Teaching*, *17*(5), 443-448.

Piburn, M.D., & Baker, D.R. (1989). Sex differences in formal reasoning ability: Task and interviewer effects. *Science Education*, *73*(1), 101-113.

Pusat Perkembangan Kurikulum, Kementerian Pendidikan Malaysia (2001). *Huraian Sukatan Pelajaran Sains KBSM Tingkatan Empat*. Kuala Lumpur: Kementerian Pendidikan Malaysia.

Renner, J.W., & Philips, D.G. (1980). Piaget's developmental model: A basis for research in science education. *School Science and Mathematics*, *80*, 193- 198.

Roadrangka, V., Yeany, R.H., & Padilla, M.J. (1983). *The construction of a Group Assessment of Logical Thinking (GALT).* Paper presented at the 56th annual meeting of the National Association for Research in Science Teaching. Dallas, Texas, April, 5-8.

Roadrangka, V. (1995). Formal operational reasoning ability, cognitive style and achievement in Biology, Physics, and Chemistry concepts of Form 4 students in Penang, Malaysia. SEAMEO Regional Centre for Education in Science and Mathematics, Penang.

Shemesh, M. (1990). Gender-related differences in reasoning skills and learning interests of junior high school students. *Journal of Research in Science Teaching*, *27*(1), 27-34.

Schneider, L.S. & Renner, J.W. (1980). Concrete and formal teaching. *Journal of Research in Science Teaching*, *17*, 6, 503-518.

Staver, J.R., & Halsted, D.A. (1985). The effects of reasoning, use of models, sex type and their interactions on post-test achievement in chemical bonding after constant instruction. *Journal of Research in Science Teaching*, *22*(5), 437-447.

Syed Anwar Aly. (2000). Hypothetico-deductive reasoning and concept acquisition: Implications for strategies in the Malaysian smart schools. Kertas dibentangkan dalam *Simposium Pendidikan Sains dan Teknologi,* Pulau Pinang, 30 Mac – 2 April, 2000.

Syed Anwar Aly & Merza Abbas. (2000). Penyerapan kemahiran saintifik dalam proses pengajaran dan pembelajaran kimia di tahap menengah. Kertas dibentangkan dalam *Seminar Pendidikan Sains dan Matematik*, UiTM Shah Alam, 2 – Oktober, 2000.

Tai, R.H., Sadler, P.M., & Loehr, J.F. (2005). Factors influencing success in introductory college chemistry. *Journal of Research in Science Teaching*, *42*, 987-1012.

Tobin, K.G., & Capie, W. (1981). The development and validation of a Group Test of Logical Thinking. *Educational and Psychological Measurement, 41*, 413-423.

Tsaparlis, G. (2005). Non-algorithmic quantitative problem-solving in university physical chemistry: a correlation study of the selective cognitive factors. *Research in Science and Technological Education*, *23*, 125- 148.

Wilson, A.H., & Wilson, J.M. (1984). The development of formal thought during pretertiary science courses in Papua New Guinea. *Journal of Research in Science Teaching*, *21*(5), 527-535.

Yaman, S. (2005). Effectiveness on development of logical thinking skills of problem based learning skills in science teaching. *Journal of Turkish Science Education*, *2*(1), 31-33.

Yap, K.C. (1985). *Validation of hierarchical relationships among Piagetian cognitive modes and integrated science process skills for high school students with different cognitive reasoning abilities.* Unpublished doctoral dissertation, University of Georgia.

Yeany, R.H., Yap, K.C., & Padilla, M.J. (1986). Analyzing hierarchical relationships among modes of cognitive reasoning and integrated science process skills. *Journal of Research in Science Teaching, 3*(4), 277-291.