

## **CONCEPT CARTOON- A CONSTRUCTIVIST STRATEGY TO ENHANCE POSITIVE ATTITUDE TOWARDS SCIENCE IN MALAYSIA: AN ANCOVA REPEATED MEASURES APPROACH**

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**Abstract:** *This research aims to examine the effectiveness of the Concept Cartoon approach in enhancing students' attitude towards science. A Quasi-experimental research design was employed involving 60 primary school students from two schools in Penang, Malaysia. Data was analyzed using One-Way-ANCOVA approach. Thirty students from school A were assigned as a control group and science subject was taught employing conventional teaching approach, and thirty students from school B were assigned as the experimental group and were taught employing concept cartoon approach. The results showed a significant difference between post-test mean scores of the Attitude towards Science in the experimental group that was taught using concept cartoon teaching approach as compared to the control group that was taught using the conventional teaching approach. The experiment supports that teaching science employing concept cartoon approach enhanced students' attitude towards science in the case of Malaysian schools students.*

**Keywords:** *Concept Cartoon, Attitudes towards Science, Science Education*

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### **Introduction**

Constructivist teaching strategy suggested solving problems collaboratively as a means of learning. Through classroom socialization, constructive communications are promoted. Constructivist teaching approach is designed to manifest students' scientific demeanour through exchange and sharing of perspectives with peers. Hence, students' understanding towards a topic in science is organically self-constructed and their attitude towards science is nurtured. Role of the teacher and the students in a classroom that employs constructivist

approach are pre-programmed - teacher actively facilitates the learning process, while students participate in active learning. For instance, teacher guides students' learning by asking questions that leads students to develop their own conclusions on the topic discussed. In contrast, traditional classroom teacher's role is to actively disseminate information to students, while the students are viewed as the passive recipients of information. In traditional teaching, the cognitive processes are not designing to be manifested. Therefore, students' attitude towards science and scientific demeanour among students is claimed to be much lower.

Malaysia is a developing country where the teachers possessed good credentials of constructivist teaching and a popular approach is Problem Based Learning (PBL) (Han et al., 2016; Norfarah et. al., 2017; Norfarah & Mohd Ali, 2017). To exert the effect of PBL approach to enhance students' attitude towards science, concept cartoon is an approach that is psychologically friendly to primary school students that aged between 7 to 12 years old (Chong & Ch'ng, 2017). These groups of students are more receptive to concept cartoon that is stimulating and fun. Chong and Ch'ng (2017) studied the concept cartoon on photosynthesis topic employs a qualitative research method in Malaysian context. However, Chong and Ch'ng (2017) study captured primary school students' responses on the effectiveness of concept cartoon teaching approach through interview. Therefore, this research attempted to measure the effectiveness of concept cartoon approach using quantitative method. Therefore, this research aimed to uncovers the empirical evidence on the effectiveness of concept cartoon approach to improve students' attitude towards science in Malaysia. It is hypothesised that concept cartoon is effective to improve students' attitude towards science.

Researches on concept cartoon approach in teaching science in Malaysia are scanty (Chong & Ch'ng, 2017). A more popular constructivist teaching approaches discussed by educational scholars in Malaysia are Problem Based Learning (PBL) (Norfarah et al., 2017; Han et al, 2016; Zain et al., 2010) and Project Based Learning (PjBL) (Jamali et. al., 2017) that incorporates aided teaching approach such as mind mapping, concept mapping and graphic organizer chart. The effectiveness of PBL and PjBL can better be enhanced through inclusion of concept cartoon. Concept cartoon is not a new approach, it was explored by many educational scholars in other countries (İnan & Kaya, 2017; Kabapinar, 2005; Dünder & Şentürk, 2012; Sexton, 2010; Chin & Teou, 2009; Naylor, Keogh, de Boo & Rosemary, 2002; Ingec, 2008; Kaptan & İzgi, 2013) and its' positive outcome resonate with the aim of this research.

Kaptan and İzgi (2013) defined attitude as tendency that constituted an individual's views, feelings and behaviours on a psychological object in a regular manner. Attitude has three components (1) cognitive, (2) affective and (3) behavioural (Foley & McPhee, 2008). On the other hand, Timur (2012) defined attitude towards science as a belief system or set of values related to a scientific object, to the subject of science or to the influence of science on the society. For this research attitude towards science is referred as an index and benchmark information that can be used to improve Malaysian students' performance in science subject. Therefore, this study adopted Attitude towards Science Inventory (ATSI) questionnaire as the instrument to measure students' attitude towards science.

Concept cartoon is cartoon-style drawings presenting characters with different viewpoints around a particular situation about the science involved in daily situation (Roesky &

Kennepohl, 2008). In science teaching, the cartoon-style drawings presenting a few characters arguing about an everyday situation that relates to science. It is designed and accustomed to the local situation to intrigue, promote discussion and to stimulate scientific thinking by putting forward a range of viewpoints. Concept cartoon is a visual representation of a few characters in settings familiar to students accompanied by written language in speech bubbles (Keogh & Naylor, 1999; Sexton, 2010). Unlike comic cartoon, concept cartoon presented educational concepts. Concept cartoon is a visual stimulant that offers different explanations regarding a scientific phenomenon. This visual stimulus promotes seamless learning through compare and contrasting about a scientific fact (Atasoy et al., 2013; Keogh & Naylor, 1999). The versatility of concept cartoons are validated through its application in various subjects such as in development of reading skills in English and teaching of problem solving in Mathematics (Keogh & Naylor, 1999). Concept cartoons can also be used as an alternative assessment (Youngjin Sons et al., 2008). Concept cartoon is used to get access to learners' ideas, to probe their level of understanding and to highlight any confusion they may hold. Concept cartoon can be used to assess students' prior conceptions, students' progress and difficulties with learning, and students' learning outcomes (Youngjin Sons et al., 2008).

In addition, concept cartoons were developed as an effort to build the relationship between constructivist approach, epistemology and classroom applications (Keogh and Naylor, 1999). According to Educational Broadcasting Corporation (2004), constructivism stated that people actively constructed their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. They constructed new opinions by relating them with old knowledge (Dündar & Sentürk, 2012). Therefore, the learners' prior ideas had to be taken into account in planning teaching and learning activities (Keogh & Naylor, 1996). Besides that, constructivist approach also required social interacting environments for meaningful and enduring learning (Ekici, Ekici & Aydin, 2007). In this case, the concept cartoons approach, targeting active participation among students, provides social environment to express ideas freely without being judged, especially in science and technology courses (Saka et al., 2006). In other words, concept cartoons provide enjoyable classroom discussions (Ekici, Ekici & Aydin, 2007). To reiterate, this paper will examine the effect of concept cartoon on students' attitude towards science among Malaysian primary school.

## **Methods**

Quasi-experimental design was used in this research. The non-equivalent control group design was used, in which the experimental group was taught by using concept cartoon teaching approach while the control group was taught using conventional teaching approach. The quasi-experimental design was chosen because the school administrators' demands the researcher to keep existing classroom intact. Gay, Mills & Airasian (2011) stated that when random assignment was not possible, quasi-experimental design that provided adequate control could be used. Hence, only purposive sampling of intact groups into the experimental group and the control group could be done.

The control group and experimental group were selected from two different schools in order to avoid interactions between participants, thus reducing validity threats and conformation effect. This could also minimize possible reactive effects from the rearrangement of the samples because since the existing intact groups were selected, the groups might not know that they were involved in the study (Gay, Mills & Airasian, 2011). The two schools were selected because they were easily accessible and located in the same district. 30 respondents

were selected for each group to provide a manageable size of data and it still fulfilled the minimum requirement for experimental type of statistical analysis.

In this study, both the control group and the experimental group were pretested. Then, the intervention which was the concept cartoon teaching approach was carried out in the experimental group over 4 weeks; the control group was taught by using the conventional teaching approach. After that, both the control group and the experimental group were given the posttest. The results of the pretest and posttest scores were analyzed using ANCOVA to determine the effect of the intervention in enhancing students' positive attitude towards science. The pretest and posttest were identical and the test was referred as the Attitude towards Science Inventory (ATSI). The research design of the study was shown in Table 1 below.

**Table 1: Research Design of the Study**

Experimental Group	O <sub>1</sub>	X	O <sub>2</sub>
Control Group	O <sub>3</sub>		O <sub>4</sub>

Legend:

X = Concept cartoon teaching approach

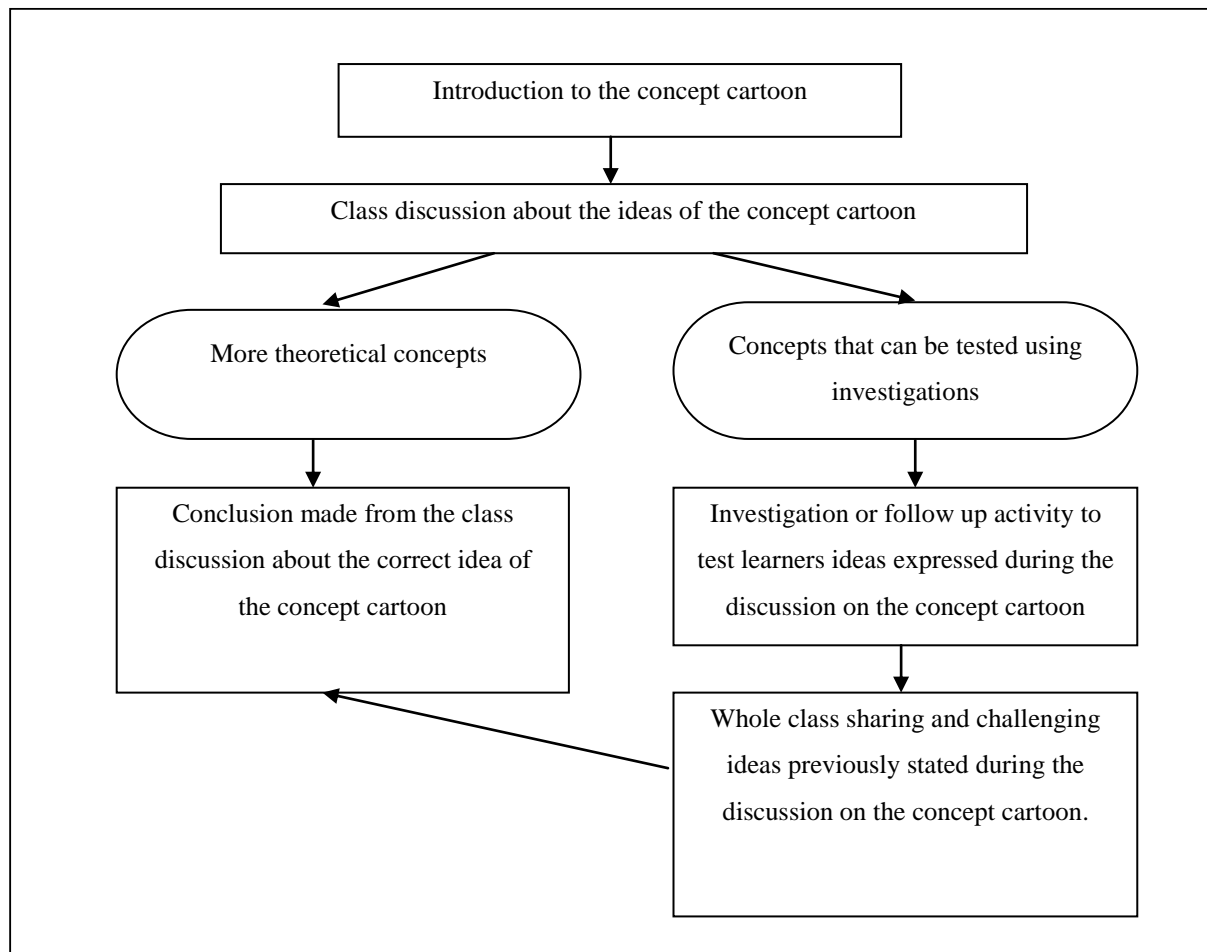
O<sub>1</sub> and O<sub>3</sub> = Pretest

O<sub>2</sub> and O<sub>4</sub> = Posttest

The independent variable was the teaching approach. The experimental group was taught using the concept cartoon teaching approach using the Concept Cartoon Teaching Approach Teacher's. On the other hand, the control group was taught using conventional teaching approach. The dependent variables were the effectiveness of concept cartoon in enhancing students' positive attitudes towards science.

### ***Concept Cartoon Teaching Sequence***

The phases of teaching follow the steps recommended by Kabipanar (2005). The steps start with (1) introduction of concept cartoons, (2) discussion about concept cartoons, (3) investigation about ideas in the cartoons and (4) re-interpretation of the ideas in the concept cartoons based on the investigation findings. However, there are steps that are not possible to be carried-out for example step (3) investigation - this is particularly for a more theoretical-based topic. These phases are parallel with the proposed steps by Keogh and Naylor (1999). Keogh and Naylor (1999) concept cartoon teaching approach involves: (1) a simple introduction to the concept cartoon; (2) learners reflected on the concept cartoons and discussed their ideas; (3) appropriate teacher interaction and intervention based on students' idea during discussion on the concept cartoon; (4) investigation or activity to follow up the learners ideas expressed during the discussion on the concept cartoon facilitated by the teacher and (5) whole class sharing and challenging ideas previously stated during the discussion on the concept cartoon.



**Figure 1: Steps of Concept Cartoon Used in the Research**

### ***Attitude Towards Science Measures***

Attitude is one of the affective variables in which educators are interested in several reasons (a) attitudes are relatively durable, (b) attitudes are learned and can therefore be taught and (c) attitudes are related to behaviour. There is a belief that, in general, affective variables are as important as cognitive variables in influencing learning outcomes. A commonly used definition of attitude is a learned disposition to respond in a consistently favourable or unfavourable manner with respect to a given object (Fishbein & Ajzen, 1975). Attitude is a state of readiness, a tendency to respond in a certain manner when confronted with certain stimuli. Clearly both these definitions highlight a consistent behavioural response in relation to a given attitude.

The main instrument used by Gogolin & Swartz (1992) was the Attitude towards Science Inventory (ATSI) which had been adapted from previous research with groups of mathematics students. The same instrument was chosen for the research due to its ease of use, availability and apparent psychometric quality. Moreover, the data from the resulting Likert type scale could be subjected to analysis in order to compare the results from various groups of respondents. Various statistical analyses could be used on the scores produced, including comparison with the theoretical distributions - Quadrinomial and Normal, the F-test and the t-test. The assumption was made that the reliability and validity tests carried out previously would be acceptable since the student samples appeared to exhibit similar backgrounds to those of Gogolin & Swartz's study.

The ATSI instrument requires respondents to read 48 statements and to tick boxes according to their level of agreement with each one (strongly agree, agree, disagree and strongly disagree). Each statement addresses one of the six attitude factors; perception of the science teacher, anxiety towards science, value of science, self concept, enjoyment of and motivation towards science. 'Perception of the science teacher' is the term used to describe a set of questions relating to the respondents' previous experiences and recollections of their feelings about the science teachers they had known. 'Self concept' relates to a student's belief in his/her own ability to do and to understand science and may be closely related to self esteem. 'Motivation' questions cover both intrinsic and extrinsic factors.

Responses to the statements were given a numerical value in order that the results could be subjected to statistical analysis. Strongly agree was given a score of four while strongly disagree a score of one. For each respondent the attitude scores for each factor and the total score were calculated. It was recognised at the outset that there would be a number of potential difficulties arising from the manner of delivery of the questionnaire. However, such problems cannot be avoided completely. The questionnaire was given to the students during the first session of a ten-week unit on science which was aimed at developing students' scientific knowledge, understanding and skills, and preparing them to teach science during their first teaching practice. It was introduced by the author to the classes of about twenty students at a time. Attempts were made to ensure a consistent, positive approach and assurances of anonymity were given. Two thirds of the students studied the unit during Semester 1 and the others during Semester 2.

The timing of the first meeting and the accompanying sense of excitement and hope, perhaps reinforced by the style of presentation, may have induced more positive responses than would otherwise have been given. The variation between semesters may have been an indeterminable factor as may have been the effects of different lecturers. The completion of the questionnaire within a class environment may also have had an effect, leading to group responses rather than individual responses, although this approach did guarantee a good return rate.

The peer group effect may have been insignificant in Semester 1 because the students had not met each other before but could have played an important role in the response patterns in Semester 2. However, the students were asked not to discuss their responses with each other.

### **Data Analysis**

The effectiveness of concept cartoon teaching approach in enhancing students' positive attitude towards science was measured using the Attitudes towards Science Inventory (ATSI). Before and after the intervention, ATSI was administered to both the control group and experimental group. The ATSI was adapted from the instrument developed by Weinburgh and Steele (2000). It consisted of 25 items.

The pilot test of the ATSI was done on 30 students. The reliability coefficient of Cronbach's alpha of the test was found to be 0.72. Nunnally (1978) suggested that 0.7 as an acceptable reliability coefficient for an instrument. The data showed that the ATSI was reliable and was suitable to be utilized to measure students' positive attitudes towards science. The content validity of ATSI was checked by 2 science teachers with more than 10 years of experience and 2 science teachers with master's degree in science education.

After data collection, the quantitative data were analysed. Pretest-posttest designs are widely used in behavioural research, primarily for the purpose of comparing groups and/or measuring change resulting from experimental treatments. The focus of this article is on comparing groups with pretest and posttest data and related reliability issues. The measurement of change provides a vehicle for assessing the impact of concept cartoon, as well as the effects of traditional teaching interventions.

#### ***ANCOVA with Pretest-Posttest Data***

The purpose of using the pretest scores as a covariate in ANCOVA with a pretest-posttest design is to (a) reduce the error variance and (b) eliminate systematic bias. With randomized designs (e.g., Designs 1 and 2), the main purpose of ANCOVA is to reduce error variance, because the random assignment of subjects to groups guards against systematic bias. With nonrandomized designs (e.g., Design 3), the main purpose of ANCOVA is to adjust the posttest means for differences among groups on the pretest, because such differences are likely to occur with intact groups. It is important to note that when pretest scores are not reliable, the treatment effects can be seriously biased in nonrandomized designs. This is true if measurement error is present on any other covariate in case ANCOVA uses more than one (i.e., the pretest) covariate. Another problem with ANCOVA relates to differential growth of subjects in intact or self-selected groups on the dependent variable. Pretest differences (systematic bias) between groups can affect the interpretations of posttest differences.

Let us remind ourselves that assumptions such as randomization, linear relationship between pretest and posttest scores, and homogeneity of regression slopes underlie ANCOVA. In an attempt to avoid problems that could be created by a violation of these assumptions, some researchers use ANOVA on gain scores without knowing that the same assumptions are required for the analysis of gain scores. Previous research has demonstrated that when the regression slope equals 1, ANCOVA and ANOVA on gain scores produce the same F ratio, with the gain score analysis being slightly more powerful due to the lost degrees of freedom with the analysis of covariance. When the regression slope does not equal 1, which is usually the case, ANCOVA will result in a more powerful test.

Another advantage of ANCOVA over ANOVA on gain scores is that when some assumptions do not hold, ANCOVA allows for modifications leading to appropriate analysis, whereas the gain score ANOVA does not. For example, if there is no linear relationship between pretest and posttest scores, ANCOVA can be extended to include a quadratic or cubic component. Or, if the regression slopes are not equal, ANCOVA can lead into procedures such as the Johnson-Neyman technique that provide regions of significance.

#### **Results**

One Way ANCOVA was used to determine the effect of the concept cartoon teaching approach on the students' Attitudes towards Science post-test mean scores. The result was presented in Table 2. The One Way ANCOVA result showed that there was a significant difference between the Attitude towards Science posttest mean scores of the experimental group taught by using concept cartoon teaching approach and the control group taught by using the conventional teaching approach,  $F(1, 57) = 6.92, p = 0.01 (p < 0.05)$ .

**Table 2: The Result of One Way ANCOVA analysis for the Attitudes towards Science Posttest Mean Scores of Different Teaching Approaches (Concept Cartoon & Conventional) with the Attitudes towards Science Pretest Mean Scores as the Covariates**

Dependent Variable: Attitude towards Science Posttest Mean Score						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	967.42	2	483.71	19.41	.00	.41
Intercept	310.54	1	310.54	12.46	.00	.18
Pretest Mean Score	743.16	1	743.16	29.82	.00	.34
Teaching Approach	172.43	1	172.43	6.92	.01	.11
Error	1420.58	57	24.92			
Total	240528.00	60				
Corrected Total	2388.00	59				

a. R Squared = .405 (Adjusted R Squared = .384)  
b. Computed using alpha = .05

The effect size of the intervention was indicated by the value of partial eta squared. The partial eta squared was found to be 0.11. Therefore, the difference in the teaching approach was accounted for 11% of the post-test mean score variance, when the pre-test mean score was controlled statistically.

**Table 3: Attitudes towards Science Posttest Mean Scores**

Dependent Variable: Attitude towards Science Posttest Mean Score				
Teaching Approach	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Concept Cartoon	64.70	.91	62.87	66.53
Conventional	61.30	.91	59.47	63.13

a. Covariates appearing in the model are evaluated at the following values: Pretest Mean Score = 62.48.

In addition, Table 3 above showed that the Attitude towards Science post-test mean score of the experimental group taught by using concept cartoon teaching approach (Estimated Marginal Mean = 64.70, Standard Error = 0.91) was higher than the Attitude towards Science post-test mean score of the control group taught by using conventional approach (Estimated Marginal Mean = 61.30, Standard Error = 0.91), when the difference between the pre-test mean scores was controlled. Hence, in this study, the concept cartoon teaching approach was effective in enhancing students' positive attitude towards science.

## Discussion

This finding is consistent with Kaptan and Izgi (2013) which provided evidence that concept cartoon was effective in developing elementary students' attitudes towards science. The obvious plus point of employing concept cartoon are: learners were highly motivated and could focus longer on task, sustained their interest and communicate confidently with their friends. This finding is also consistent with Naylor and Keogh (2012) statement that concept cartoon helps enhanced learner' motivation regardless of their ages, backgrounds and situations, including those with emotional and behavioural problems. Furthermore, according to the research done by Sasmaz-Oren and Meric (2014) and Choong and Ch'ng (2017)



students commented that concept cartoon raised their interest and made the learning of science enjoyable and pleasurable, besides providing long lasting and deep learning. In fact, most of the students expressed their desire to continue learning science using concept cartoons (Sasmaz-Oren & Meric, 2014; Choong & Ch'ng, 2017).

Besides that, concept cartoon also created a non-threatening atmosphere which encouraged students who were lack of confidence to voice out their views during the lessons and motivated the students to learn (Kabipinar, 2009). Afraid of making mistakes makes students' reluctant to voicing out their ideas. This anxiety was minimized through using concept cartoons because the students were not the one who is suggesting the ideas, but the conversation starts by making statement whether to agree or disagree with the ideas expressed by the cartoon characters (Kabipinar, 2005; Keogh & Naylor, 1999). This softening the opening-up of the conversation, later contributed to their active participation and motivation in learning science.

Apart from that, this finding was also parallel with the findings of the study carried out by Keogh and Naylor (1999). Students were observed to participate in deep discussion for long periods of time as well as maintain high levels of interest and motivation when concept cartoons were employed. Even the naughtiest student as well as normally quiet and less confident students involved in the discussion actively. The cartoon characters acted as the voices speaking for the less confident students, therefore increasing their confidence to put forward their opinions (Keogh & Naylor, 1999).

It is quite often debated that number of students opting for science is declining in many countries of the world. Students are inclined towards opting soft subjects like social sciences and humanities. A similar trend is evident in Malaysia. There are several reasons for this trend. The researchers usually attribute it to improper teaching, boring curriculum, and lost interest towards science subjects. If investigated meaningfully, these factors are sources which lead to decreasing attitude towards science learning that is one of the major contributors in student choice to select science as subject and subsequently performance in science. There has been several tools and studies conducted in developed countries to find the attitude of students towards science learning and reported evidence that change in attitude towards science is important factor in selection of science as subject and profession (Nasir & Kono, 2004). Promotion of learning of science among students at all levels of education has been the prime focuses of the educational policy 2009-10. So, there is need to explore different factors that possibly have any effect on science learning especially at school level and attitude is one of these factors. Attitude towards science learning can help us to understand the present trend of the students and will also help to explore the differences among school students on the basis of gender, locality, paternal qualification and occupation.

Studies that have been conducted into students' attitudes to science generally rely on the use of a questionnaire. Such instruments have usually been tested for reliability and validity, though there remain a number of problems in interpreting the results. Responses to questionnaires may contain an unknown bias due to factors which cannot be determined e.g. circumstances affecting each individual or group at the time of the questionnaire. Evidently any conclusion of an absolute nature must be regarded with caution. However distinctions between groups may be determined, although these in turn may be due to the self-selecting nature of the groups.

Comparison between studies is not always simple as there is no standard 'attitude test' and no agreed definition of terms even on such expressions as 'mature'. Many of the students involved in this research would have studied discrete areas of science previously. Indeed, in the exploratory interviews, students referred to the physics lessons or the biology or chemistry teacher. The ATSI questionnaire did not address these different elements, and further interviews were not carried out to determine which element/s of science the students had in mind when completing the questionnaires.

The findings about teacher perception are similar to those of Gogolin & Swartz (1992). It is not asserted that teacher perception is not influential in the formation of attitude, but rather that each of the subject groups were influenced similarly. Also, it should be noted that Haladyna, Olsen & Shaughnessy (2006) concluded that the teacher's enthusiasm was a contributory factor in developing students' attitudes towards science. Thus, it may be that in regard to the 'teacher perception' factor the ATSI test has poor discriminatory quality.

Previous scientific achievement and mathematical ability were not considered during the present study. Probably it would be of great value to determine causal links between a students' past experience, of whatever form, and current attitude and choice of subject. Students' attitudes are greatly influenced by their past experiences and carry the associated behaviour into the classroom. There may be other relevant factors which have not been studied including the link between science grade and attitude towards science. Furthermore, there is a need to link attitude scores with achievement in science and science teaching during the course.

It is crucial that positive attitudes towards science are developed and maintained in order that learning can take place. Much work has already been done in the planning and delivery of courses and materials to enable students to develop in the areas in which they perceive the greatest need. Peer and tutor support need to be embedded in the courses. Teacher training courses continue to be developed to help improve students' attitudes (Mulholland & Wallace, 1995). These and other courses need further detailed investigation and evaluation. However, it seems probable that courses which specifically address improvement of attitude could have a direct effect on learning outcomes.

## **Conclusion**

Malaysian primary school students are accustomed to their culture of not expressing their attitude openly. They are like any other Asian students - more reserved in discussing their opinion openly hence, these cultures intertwine into classroom learning. Most of the time they try not to manifest their cognition, attitude and behaviour. However, by using concept cartoon students who seem reluctant to talk at the initial intervention are found to immerse in the discussion later. For those students who are more involved in classroom discussion in the initial stage, concept cartoon intervention prolonged their good attitude towards science concept being discussed. From the observation, Malaysian primary school students enjoyed being allowed to discuss on the concept cartoon given with their peers. Though, this research cannot conclude that concept cartoons are any more or less effective than other types of constructivism teaching strategies such as mind mapping or problem-based learning. This research only concludes that concept cartoon is able to enhance student's attitude towards science compared to students who did not received concept cartoon intervention in teaching science.

This result implies that Malaysian science teachers can blend concept cartoon with another constructivist strategy. Concept cartoon intervention was able to modify students' attitude towards science and from the researchers' observation students positively engaged in discussion about the concept cartoons. Students are more incline to explore their understandings through investigation and research. Thus, concept cartoon teaching approach was effective in enhancing students' positive attitudes in learning science in this study. This result implies that Malaysian science teachers are encouraging to adopt this teaching approach in order to provide enjoyable and meaningful learning for students. Concept cartoon approach is definitely a wise choice to promote fun and enjoyable science learning particularly for primary school student. Future research in concept cartoon can uncover whether concept cartoon can increase students' motivation in learning science.

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