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ScienceDirect

Procedia Social and Behavioral Sciences 7(C) (2010) 264–273

Procedia Social and Behavioral Sciences

International Conference on Learner Diversity 2010

The Effectiveness of Inquiry Teaching in Enhancing Students' Critical Thinking

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Abstract

This quasi-experimental study examined the effectiveness of inquiry teaching in improving students' critical thinking in History. 41 Form 4 students were chosen as the treatment class while another 42 students were in the control class. Experiments related to inquiry teaching were carried out for eight weeks. Pre and post tests were performed on both groups. Results showed a significant difference of 0.05 between the treatment and control groups. Findings found the treatment group showed a higher increase in critical thinking than the control group. The findings indicated that inquiry teaching is effective and should be emphasized in schools.

Keywords: Teaching inquiry, History, Critical thinking, Teaching and learning, Teacher training

1. Introduction

The Malaysian education system aims to produce students who are able to think, be knowledgeable in many areas, and have profound knowledge in ICT. This situation certainly calls for a reformation which can be carried out by an integrated approach. Therefore, the Curriculum Development Centre (CDC) has been working on achieving these goals with emphasis on student-centred learning.

This is due to the fact that more emphasis on teacher-centred traditional methods has been given before this. Students only receive information without taking into consideration their ability to think. This has pruned the student's ability to think and led them to receive instructions without doing any analysis and synthesis. The main principle of learning is that it should grow, nourish and develop interest in what students have learned. Passion should be nurtured so that students can explore the beauty of knowledge and be the master of a better and meaningful learning. This means if students are given the opportunity to try something new, it would give them the means and opportunities to produce the best for themselves.

The method used by a teacher to teach has an impact on the students understanding of the concept and learning. Therefore, to achieve Vision 2020, teachers must change and diversify their teaching methods in class. This is important so that teachers can increase their knowledge, be more confident in teaching, and are able to impart current knowledge to students. Unskilled workers are unable to carry out their duties properly in their daily routines.

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doi:10.1016/j.sbspro.2010.10.037

Hence, unskilled teachers will further complicate the teaching process. Teachers have to increase their knowledge over time (Omardin Ashaari 1999). This will have a long term effect on teachers as well as students.

In order to achieve these goals the Ministry of Education has recommended inquiry teaching as a teaching method that is said to be of interest to students and can help create a more positive attitude towards learning History. Nevertheless, the question remains to what extent inquiry teaching is carried out by History teachers to make students interested in learning History, as more emphasis is given in learning Mathematics and Science?

Inquiry teaching plays an important role in the KBSM History curriculum in producing a balanced individual in terms of physical, emotional, spiritual and intellectual development, and understanding, realising, and appreciating the history and socio-cultural background of the country. Thus an effective method is needed so that History remains as a subject which has positive effects on students. Teaching should be conducted in accordance with the requirements of CDC for the benefits of the society and to achieve the nation's genuine aspirations.

Based on the discussion above, it is clear that the teacher should choose a good student-centred approach. Inquiry teaching can be used as an approach that can ignite critical thinking and improve students' achievement in History. Inquiry teaching is recommended by the Ministry of Education (KBSM History syllabus form 4 in 2002) as a more student-centred approach. The dynamic nature of inquiry teaching allows students to use their imagination and thoughts to make appropriate interpretations of the acquired knowledge and questions posed. Teachers act as facilitators in acquiring knowledge and not as presenters of knowledge.

2. Background

According to Tajul Ariffin and Nor Aini (1999) values in the Malaysian society need to be strengthened based on a national culture even though our education outlook has an international concept, which is 'Thinks Globally and Act locally'. Therefore, our education system should be able to produce individuals as stated in the National Education Philosophy (1987) and thus achieve Vision 2020 (1991).

Teaching History has been enacted and implemented in the New Curriculum for Secondary School (KBSM) since 1988 to replace the old secondary school syllabus (KLSM). The main goal of KBSM is to promote human development which is more balanced, integrated, and comprehensive. Thus, the process should be student-centred. Teachers should ensure that students are actively involved in the teaching and learning process. KBSM uses an integrated approach that combines aspects of knowledge, values and skills (CDC 2001). Implementation of this curriculum also requires the involvement and full participation of several parties such as school management, teacher training institutions and university lecturers.

In 2001, CDC had launched a review on several KBSM subjects. In this review, CDC introduced learning through thinking. It is a learning process that encourages students to think critically and creatively using thinking strategies such as problem solving, conceptualizing, and making decisions as found in inquiry teaching (CDC 2001).

Inquiry teaching proposed by CDC is a teaching and learning approach which can enhance one's thinking ability (CDC 2001). Thinking skills and scientific expertise can be developed during the inquiry process of learning. In addition, inquiry activities can also add the interest and motivation to learn because they are 'hands-on' and 'minds-on'. In fact, these activities promote effective learning among students (Piburn & Baker 1993). Students' positive attitude towards the subjects learnt and career choice is related with their interest. This method also encourages students to acquire investigating or discovery techniques through the inquiry activities carried out (Trowbridge & Sund, 1973).

3. Background Research

Accordingly, a serious step should be taken to determine the extent of inquiry teaching carried out in schools as it is one approach that can help encourage students to be interested in learning History and thus, improving their performance in the subject. Such efforts must be undertaken because this approach has proven to develop students' potential, in terms of physical, emotional, spiritual and intellect, through 'hands-on' and 'minds-on' cooperative group activities and enhance their interest to learn which leads to nurturance of positive attitude towards learning.

This means students' critical thinking level can be improved by using a proactive method in teaching and learning History. Inquiry teaching can lead students to think and thus enhance their critical thinking. All the information can be elucidated with ease. Questions posed by teachers will be easily processed by students and answers will be based

on their critical thinking. The continuity of inquiry teaching in class will train and guide students to seek answers through thinking. In fact, students will be able to think of a simple solution quickly. This would indirectly result in an increase of students' interest in History. However, teachers should create a learning environment that will motivate students to learn through inquiry. In addition, students will feel happy with what they do, have interesting experiences while conducting inquiry activities, and have a deep curiosity for the topics learnt in History. Inquiry teaching can increase students' interest in learning a subject and form positive attitude towards learning. This method, of course can be applied to teaching History which require students to think and find answers through inquiry.

4. Literature Review

According to Zahara & Nik Aziz Azleena (2007) previous research findings on inquiry approach were seen in terms of skills, or were more focused on teachers' efforts to teach critically, than evaluating the students, who determined whether the approach is effective or otherwise. Researchers saw this as important because a skill is said to be effective in teaching when students show positive reaction towards learning. In addition, the change in students' attitude could be seen when they appreciated the content of the subject, especially History, which forms the basis of human values in students.

Several theories and models considered suitable for use in this study are the Constructivism Learning theory (Von Glasersfeld 1990), Piaget Cognitive Theory (1952), and Bruner Developmental Theory (1915). The model used in this study is the Social Science Inquiry Model.

Many theories have been written and applied in education today. Overall most of the theories discuss the ability of students to undergo the teaching and learning process with teachers as mentors. This has led to the development of critical thinking in students in finding answers and doing experiments on given problems. Experts such as Jean Piaget, Robert Gagne, Bruner, and David Ausubel were among prominent psychologists who had produced learning theories that have played major roles in the development of modern teaching theories. Jean Piaget (1896-1980) was a psychologist played an important role in influencing the education field (Kellough & Kellough 1996). Learning theories are usually divided into two, namely cognitive and behavioural. This study focused on learning theories such as Constructivism Theory and Cognitive Development Theory.

4.1 Inquiry Teaching

Inquiry teaching is an approach to inquiry-based problem solving through various means and methods such as experiments and studies based on text books. Inquiry activities refer to the process of finding and getting information or understanding a concept, theory or question, and using it to carry out investigations on the problem. Discovery is an inquiry process found in exploratoration which involves the question of what is found and how an answer is obtained. Discovery strategies are made by identifying the knowledge content, facts, and processes. CDC (2001) has placed emphasis and suggested that inquiry teaching is one method in teaching and learning History, whether at the primary or secondary level.

In Social Science, inquiry learning is an approach or method that is very important, especially in History. The use of inquiry model findings can improve students' creativity and thinking in their efforts to understand History. This is emphasized by well-known historians such as Collingwood, Marwick and Barraclough in their writing. They believe that using inquiry teaching can develop students' natural skills in learning History. This is also supported by Abdul Rahim Abdul Rashid (1999) in his book 'History of Education: Philosophy, Theory and Practice' where he stated through inquiry, historians had been able to develop History as a scientific, objective, and subjective lesson for students to learn.

According to Abdul Rahim Abdul Rashid (1999), inquiry means questioning something to get answers to what someone has learnt. Discovery is a process involving efforts to understand, collecting, analysing, making inferences, and formulating ideas about anything relevant.

Inquiry is a process of finding and investigating problems, developing hypotheses, designing experiments, collecting data and making conclusions to solve problems. Inquiry is also a process of searching for the truth, information or knowledge through questioning. The inquiry process begins with collecting information through sight, hearing, touch, taste and smell. Omardin (1996) defines inquiry as a matter of questioning techniques and finding answers to the questions raised. It involves careful observation and measurement, making hypotheses,

interpreting and developing theories. Inquiry experimenting requires skills, reflections, and taking into account the strengths and weaknesses of the methods used.

Inquiry teaching plays an important role in solving problems in teaching and learning. In fact, it also plays an important role in developing students' thinking to achieve success. This was also stated by Arends (2001). The use of inquiry teaching has taken place since the 1950s and 1960s in the United States where more focus was given on problem solving activities. The purpose of inquiry teaching is to develop students' critical and creative thinking skills.

4.2 Types of Inquiry Teaching

There are four types of inquiry teaching as described by Tafoya et. Al (1980) and CDC (2001). These approaches are different based on whether the activities are teacher-based, student-based, or teacher-and-student based. Tafoya et.al (1980) and CDC (2001) explain that these approaches have the characteristics as described below. These four types of inquiry activities are the essence of this study. These four approaches are also known as levels in inquiry by CDC(2001).

- Confirmation Inquiry: In this activity, students conduct a research to prove a concept, theory or principle. Students have to know what should be the result of these activities. In this inquiry activity, the teacher will give students a problem or a research question, explain how to conduct the research, and provide a proper study for them. All the steps in the experiment or study in the inquiry are given by the teacher. Confirmation inquiry is a teacher-centred activity. Inquiry activities undertaken by students are not obtained through discussions or ignited by students but by the teacher or acquired through textbooks. Students carry out experiments or researches based on teacher's instructions or instructions in the textbook. This activity is referred as level 0 by the CDC.
- Structured Inquiry: In this activity, the teacher gives a problem or research question and students do not know the outcomes of the experiments conducted in the inquiry method. The research methodology will be explained by the teacher. The teacher will also determine the activities, materials, and equipment for students to conduct researches using the inquiry approach. The aim is to enable students to get outcomes of the inquiry process such as the concepts, theories, principles, variables from the analysis carried out, and subsequently making generalizations. This activity is referred as Level 1 by CDC.
- Guided Inquiry: In this activity, teachers guide students to conduct inquiry activities when students need them. Problems or research questions are given by teachers, but students will determine the manner or method to carry out researches to solve the problem. Students will get the outcomes of the inquiry process from the inquiry activities carried out. In these activities, teachers will guide students to carry out inquiry activities correctly. This is to prevent them from getting disappointed when they do not get answers from the research. Guidance is also given to ensure the research does not diverge from its original purpose. Teachers are also responsible for providing information in order to obtain the required results. Teachers will ask students many questions but will not give the exact answers (Carin & Bass 2001). This activity is referred as Level 2 by CDC.
- Open Inquiry: Students will determine the problem or research question; the ways and means of solving problems, and getting results based on evidence obtained through the inquiry activities conducted. These activities also provide opportunities for students to conduct inquiry experiments that involve a variety of skills to be mastered. Open inquiry helps students to further develop existing skills such as communication skills, critical and creative thinking skills, manipulative skills, and techniques in carrying out researches. This stage is referred as Stage 3 by CDC.

4.3 Critical Thinking

According to Klein (1966) the word critical is derived from the Latin language 'criticus', which means able to evaluate. The *Dewan Bahasa dan Pustaka* Dictionary (1998) defines critical as not easily accepting or agreeing with something (the good and bad sides are given consideration first). Both definitions explain that evaluation needs to be done towards any information or matter before it is accepted or rejected.

According to Ennis (1962) critical thinking is a true assessment of any statements. His opinion emphasized the same thing, a true assessment. This is a determinant of critical thinking. In other words, critical thinking has no meaning without any real evaluation. Ennis' concept is supported by D'Angelo (1971) where he stated critical thinking as a process of evaluating the statements, arguments, and experiences. According to D'Angelo opinions should be based on objectivity and evidence. Thus, the definition of critical thinking has become more

comprehensive. It covers an assessment of the truth and should be based on objectivity and available evidence. But there are other definitions for critical thinking as well. But the majority of the definitions of critical thinking are similar to that proposed by Ennis.

Paul (1987) stated that critical thinking is divided into two parts, weak critical thinking and strong critical thinking. Weak critical thinking is used to intimidate the ability of people someone is not agreeable with or consider as enemies. On the other hand, strong critical thinking is not confined to one's own opinions. This shows critical thinking skills can be defined as the ability to use the mind in evaluating the reasonableness of an idea, examining the depth of ideas, and the weaknesses of an argument.

Phillips (1999) divided critical thinking into three groups, that is, low level of critical thinking, high level of critical thinking, and the thinking process. For Phillips (1999) low level of critical thinking involves comparing and contrasting, observing, classifying, collecting, and categorizing. High level of critical thinking involves reasoning, making inferences, knowing ideas, formulating, verifying resources, and making inductions, deductions, and assumptions. The thinking process involves making decisions and solving problems. A person is said to possess critical thinking skills when he shows any one of the three levels of critical thinking described.

According to Fisher (1998), people who think critically:

a) Have the determination to see something more thoroughly and in detail
b) Analyse ideas in search of a more thorough and detailed explanation
c) Analyse ideas to find a more accurate explanation
d) Are open and broad minded

4.4 Review of Previous Related Studies

There are many previous studies that explore the relevance of inquiry teaching and students' higher level of critical thinking in History or the effectiveness of other teaching methods which is almost equal to that of inquiry teaching in increasing students' level of critical thinking and achievement in other subjects.

Many studies on inquiry teaching implemented in the teaching and learning process have been conducted abroad and locally but none had related inquiry teaching with increasing students' critical thinking level. Although it is difficult to find previous studies related to this research, studies carried out by Garret et.al (1976) seem to be most appropriate. The results showed that inquiry teaching and learning showed a lot of positive impact in stimulating students' thinking skills. Inquiry teaching allows students to participate actively in solving problems or answering questions posed by teachers. Students will make efforts to answer the questions posed by teachers and teachers act as facilitators until students get the intended answers.

Further research by Garret et.al (1976) on 100 students enrolled in a discovery inquiry teaching method course in Social Science found that the teaching model could train students to think divergently, in a higher thinking level, and have positive attitudes. These findings support the notion put forward by Arends, Hyde & Bizar that discovery inquiry is an intellectual process and can form a higher thinking level.

In his study, Lott (1983) from the Institute for Research on Teaching Michigan State University, East Lansing, stated that students' achievement showed an increase when the discovery inquiry method was used. He also suggested future researches should emphasize on the levels of inquiry for treating different curriculum.

Short et al. (1996) conducted a study of an inquiry teaching project and found that students needed sufficient time to ask questions and important issues. Thus, teachers must give students adequate time to prepare questions or think about something. Adequate time is needed for students to get answers, particularly for high-level questions. Short also considered inquiry teaching as providing opportunities for students to learn and understand other cultures and appreciating them.

A study conducted by Gay and Howard (2000) found that teachers' approach of using inquiry methods in the classroom stimulated students' thinking. This method also increased the students' level of critical thinking even though they are from different areas or regions. This shows that the approaches adopted by teachers are very important to move up students' critical thinking to a higher level. Nevertheless, these approaches rely on teachers' experiences and beliefs in teaching and learning activities in the classroom.

5. Research Objectives

As a whole, the objective of this study is to determine until what extent is inquiry teaching effective in increasing students' level of critical thinking in History. In addition, this study also compares the level of critical thinking among students of different races after going through the inquiry teaching and learning process. In particular this study is based on three research questions as listed below:

1. Are there any effects of inquiry teaching to enhance students' critical thinking and achievement in History in the treatment group before and after following the inquiry teaching method?
2. Is there a difference in students' level of critical thinking in the treatment and control groups before and after following the inquiry teaching method for treatment group and traditional method for control group?
3. Is there any difference in the increase of critical thinking skills in History among students of different races in the treatment and control groups?

6. Research Methodology

The design is a quasi experimental study of the treatment class and control class and pre and post tests conducted. This design was also meant to get answers through the research conducted. A sample of 41 students from Form 4 Science class were chosen as the treatment class while the control class consisted of 42 Science class students. All the samples are students of Matang Jaya Secondary School, Kuching, Sarawak. Experiments related with inquiry teaching were carried out for eight weeks. Experimental research is considered as good research design and is done to test the hypotheses (Chua Yan Piaw 2006). Quasi-experiment studies involve two groups, that is, the treatment and control groups which are randomly selected. The instruments used in this study were survey forms distributed before and after teaching the two sample groups.

The validity of an instrument refers to the extent it measures what it is supposed to measure (Alias 1999). A valid measurement tool can measure precisely the intended variables. Reliability reflects the stability of the measuring tool. According to Mohd Majid (2004) the reliability index of a good questionnaire is higher than 0.60.

The Cronbanch alpha statistical analysis was carried out in the pilot study conducted at Matang Technical Secondary School, Kuching, Sarawak. A high Cronbanch Alpha level was obtained (Alpha=0.9031). This indicated the questionnaires had a high reliability and were suitable for use in the actual study.

7. Result and Discussion

The effectiveness of inquiry teaching in the treatment class compared with the control class in terms of students' increased critical thinking.

An independent sample t-test was carried out to answer the first research objective. Results showed using the inquiry teaching method in the treatment group was effective. This means using the inquiry teaching method has been effective in improving students' critical thinking in the treatment group compared with students in the control group.

This difference in students' improved critical thinking (mean difference =. 5392, t =- 7347 and 0.000 sig = $p < 0.05$) could be seen before and after inquiry teaching was carried out in the treatment group.

The mean value of students' critical thinking in the control group was higher after inquiry teaching method was implemented in class than before it was implemented. Table 1 shows the independent t-test results (independent sample t-test). There were significant differences between the treatment and control groups in terms of improved students' critical thinking before and after the inquiry teaching method was implemented based on some characteristics of critical thinking in History.

Table 1 t-test showed no significant difference in the effectiveness of Inquiry teaching in class treatment compared with control classes on improving students' critical thinking.

Variables	Class	N	Mean	Mean Difference	t	Sig. (p)
Critical Thinking	Treatment	41	4.2195	.5392	7.347	.000
	Control	42	3.6803			

*Significance level p < 0.05

An independent sample t-test carried out to answer the second research objective. Results showed there was a significant difference between the level of critical thinking and achievement among students in the treatment and control groups after inquiry teaching and traditional teachings were implemented in class.

This means exposure to the inquiry teaching method has improved the level of critical thinking and achievement of students in the treatment group. This could be seen in the mean difference between the treatment and control groups before inquiry teaching was implemented (mean difference = -.8846, t= -18.087 dan sig. p=.000 < .05) and after inquiry teaching was implemented.

Table 2 shows the results of the independent sample t-test for the second research objective.

Independent variable	Group classes	N	Mean	Differences	T	Sig.(p)
Critical thinking level pre	Treatment	41	2.7515	-.8846	-18.087	0.000
	control	42	3.6361			
Critical thinking post	Treatment	41	4.2195	.5392	7.303	0.000
	Control	42	3.6803			

*Significance level p < 0.05

Table 3 t-test showed no significant differences level of critical thinking students of class treatment and control groups before and after class teaching and traditional inquiry.

A Manova analysis was carried out to answer the third research objective. Results showed there was a significant difference in the level of critical thinking among students of different races in the treatment group before and after inquiry teaching was implemented.

A post hoc analysis showed the difference was found before inquiry teaching was implemented in the treatment group (f = 0.579, sig = 0.037 < 0.050). Students of all races did not show a different level of critical thinking after inquiry teaching was implemented in the treatment group (f = 1857, sig = 0. 314> 0. 050).

Table 3 Manova analysis of the differences in the level of critical before and after inquiry teaching was carried out.

Dependent variable	Group	N	Mean	Standard deviation	Nilai F	Sig. (p)
Critical Thinking pre	Malay	25	2.7886	0.17392	0.579	0.037
	Chinese	9	2.6190	0.13469		
	Other	7	2.7891	0.17998		
Critical thinking post	Malay	25	4.2152	0.19300	1.857	0.314
	Chinese	9	4.3069	0.23823		
	Other	7	4.1224	0.36562		

*Significance level $p < 0.05$

Table 4 shows the Post Hoc test results of the MANOVA analysis conducted. Results showed there was a significant difference between the Malay and Chinese students' critical thinking level before inquiry teaching was implemented (mean difference = 0.1695, sig. = 0. 034 < 0. 050). The Malay students showed a higher mean value than the Chinese students before inquiry teaching was implemented. There was no significant difference among students of other races with Malay or Chinese students prior to the implementation of inquiry teaching (p > 0050).

Table 4 Post Hoc Test Results: Level of students' critical thinking before and after inquiry teaching was implemented (Treatment group).

Dependent variable	(I) race	(J) race	Mean Difference (I-J)	Standard error	Sig.(p)
Critical Thinking Pre	Malay	Chinese	0.1695*	.06509	0.034
		Other	-0.0005	.07160	1.000
	Chinese	Malay	-0.1695*	.06509	0.034
		Other	-0.1701	.08439	0.122
	Other	Malay	0.0005	.07160	1.000
		Chinese	0.1701	.08439	0.122

*Significance level $p < 0.05$

Based on the Post Hoc Tukey HSD analysis, there was a significant difference among the Malay and Chinese students' level of critical thinking (0.034 ($p < 0.050$). The Chinese students showed a lower mean of 2.1690 and the Malay students showed a higher mean of 2.7886. However, there was no significant difference in the level of critical thinking between students of other races and the Chinese or the Malays.

The Manova data analysis showed there was a significant difference in the level of critical thinking among students of different races in the treatment group before inquiry teaching was implemented and there was no significant difference in the level of critical thinking among students of different races in the treatment group after inquiry teaching was carried out.

The finding in this study is not similar with Sola & Ojo (2007: 124-132) who stated inquiry teaching did not contribute much to develop students' thinking compared with the project and demonstration methods.

7. Conclusion

The findings which showed the effectiveness of inquiry teaching in enhancing students' critical thinking in History has a meaningful impact on students. This is based on research findings that show the usability and applicability of inquiry teaching the classroom. Research findings showed there was a significant difference between the level of critical thinking among students in the treatment and control groups. There was also a significant difference between students' level of critical thinking based on their races. Research findings showed inquiry teaching can lessen the gaps among students in learning History. Thus, teachers are encouraged to carry out inquiry teaching in classrooms. Inquiry learning requires a higher order of thinking which will promote a higher level of students' critical thinking. Choosing the right and effective teaching method plays an important role in producing quality students and putting knowledge forward.

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