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How do good teachers teach for critical thinking

Sabri Mohd Salleh*, Eng Tek Ong, and Mohmad Noor Mohmad Taib
Sultan Idris Education University, Malaysia

An ex-post facto study was conducted to determine which teacher practices can promote critical thinking among secondary school students. A total of 1200 students in 12 schools in a district in Selangor participated in the study. The study employed an extreme group causal comparative design where students who tested high in critical thinking as measured using the Cornell Critical Thinking Test Level X (CCTT-X) were compared with students who obtained low scores in the CCTT-X. Twelve experiences with regard to teacher practices in the classroom differed significantly between the high and the low scorers when analysed with the Mann-Whitney U Test. Implications of the study, particularly on ways to teach better to promote critical thinking are discussed.

Key words: Critical thinking, Teacher practices, Malaysia

Introduction

There are a variety of approaches to teach critical thinking amongst which three are the most common: the stand alone, the infusion and immersion approaches (McKendree, Small, & Stenning 2002). Maria Salleh (2014) in a survey of teachers of MARA Science Colleges discovered that 92.5% of them perceived the present curriculum has too much content to allow for the teaching of thinking. Results of a modified higher order level thinking test for the three upper levels of Bloom's Taxonomy conducted by Tee, Jailani Md Yunos, Razali Hassan, Yee, Atan Hussein, and Mimi Mohaffyza Mohamad (2014) among Form One students of Malaysian schools have shown low performance amounting to not more than 30%. Among the three approaches to teaching critical thinking, the stand alone approach is not much favored due to, amongst others, constraint of time and resources. Given that the present curriculum is already overloaded as perceived by teachers (Maria Salleh, 2014) and that adding yet another stand alone thinking curriculum will plausibly cause further stress and burnout among teachers (Yu, Wang, Zhai, Dai, & Yang, 2014), infusion and immersion approaches are therefore, much preferred over the stand alone approach. Facilitation of learning on how to better infuse the teaching of thinking will greatly benefit future teachers whose problems and concern have been succinctly described in Goh (2011) and Goh and Wong (2014).

* Email: sabri.ms@fppm.upsi.edu.my

The thesis of this article is that the success of the teaching and learning of critical thinking highly depends on three main elements existing in the classroom, namely the teacher, the students and the supporting resources, of which the practice of the teacher is the main factor. The decision by the schools to use infusion and immersion approaches supports the notion than critical thinking is not only about the content but also about how it is taught (Kakai, 1998). The infusion approach entails in-depth instruction in the subject matter plus explicit instruction on general critical thinking principles and hence requires formal training in order for it to be effectively implemented (Ennis, 1989). The immersion approach, by contrast, does not focus on critical thinking skills and abilities during the direct and explicit teaching of the subject matter. Rather, students are expected to acquire these thinking skills as a natural consequence of engaging with the subject matter (Ennis, 1989).

Background of the study

What a teacher practices during teaching is not something that happens without a reason. Instead, what a teacher practices in the classroom depends on three main factors: [1] the teacher's personality due to his/her nature, training and experience integrated into that nature; [2] the teacher's education in becoming a teacher especially those involved in educating the teacher and the model of teaching that serves as the guiding element in the teaching or training of the teacher; and [3] the experience of being a teacher which starts with his/her first day in school and the formal and informal requirements imposed on him/her by the school and society especially those that relate to the assessment of the teaching abilities and public examinations.

The implementation of these practices, generally, occurs in three phases, namely [1] pre teaching; [2] teaching; and [3] post teaching.

Pre teaching phase

The preparation of teachers to infuse critical thinking in their teaching starts as early as possible. The transformation process forms the major components in teacher knowledge that integrates the content and the pedagogy (Shulman, 1987). Preparation involves how to make the content suitable for teaching whether through meta-cognitive questions (Costa, 2001), how to improve critical thinking (Paul & Elder, 2000) and creating diverse perspective and active learning based on constructivism (Harpez, 2005). Accordingly, such pre teaching preparation is a complex activity and can be influenced by a variety of factors (Beijard & Verloop, 1996).

During teaching

This phase will be discussed with respect to [1] behavior and teachers' encouragement towards the behavior expected of the students, and [2] teaching methods that are related to inculcating critical thinking.

Costa (2001) categorizes the behavior that encourages, invites, maintains and enhances students' thinking in the classroom into four categories, namely (a) **Questioning** that challenges students' intellect and helps pupils to gather, process and relate information gathered to form meaningful relationships, (b) **Structuring of the class** for thinking in which interaction of individuals, small groups and larger groups is capitalized on so as to facilitate discussion and the movement of students, considering

space, time and resources required. Costa (2001) argues that students portray higher performance if the teaching is structured in such a way that students were informed of the learning outcomes they are to achieve and what is expected of them, proper use of time and the direction the teacher is heading for is communicated to the students, (c) **Responding** whereby the way in which a teacher responds to students will influence the students' behaviors as compared to teachers who use only one way communication in their teaching, and (d) **Modeling** in which a teacher acts as a model in portraying the required behavior in tandem with those portrayed by practicing thinking individuals and this can be emulated by the students.

(1) Behaviors and teachers' encouragement towards the behaviors expected of the students

Teachers' practices that encourage critical thinking include aspects in the affective domain such as comprehending the intellectual development of the pupils (Gallagher, 1998), caring attitude (Kelly, 2011), accepting the individual differences and modeling the behavior expected of the students (Knepper, 2001), clarity in communication (Land & Smith, 1997), reinforcing and utilizing students ideas (Terenzini, Springer, Pascarella, & Nora, 1995), creating good interpersonal relations (Potts, 1994), practicing wait time (Tama 1989), giving meaningful assignments and giving students the opportunity to make their own decision (Yung 2001), having high expectations of the students (McInerney & McInerney, 1998), patience in allowing students to make their own conclusion (Swartz, 1991), making the students feel appreciated (Myrick, 2002), and encouraging the openness among pupils (Cleland & Pearse, 1995).

(2) ***Methods that are related to inculcating critical thinking***

The success of teaching critical thinking depends more on how it is taught (Burbach, Matkin, & Fritz, 2004) because there is no one best teaching method. The process of teaching requires enough time especially when students are required not only to observe the dualistic perspective of an event but also exploring a variety perspectives (Kurfiss, 1988). Even though one can argue that colleges in tertiary education is more able to contribute to the teaching and learning of critical thinking (Angelo, 1995), a similar case can made for the teaching of critical thinking in secondary schools (Ares & Gorrell, 2002) and even as early as grade primary school students (Quellmaz, 1991).

Even though studies using small groups and inquiry methods have been demonstrated to better improve the quality of the learning of critical thinking as compared to the more traditional methods of teaching (Mullen, 2000), Hirose (1992) argues that conventional methods such as lectures and expository methods still can encourage critical thinking if these methods are infused with minor innovations especially involving active learning. For example, one of the active learning techniques that can improve critical thinking when integrated into lectures is by allowing students to discuss for two minutes the contents of the lecture which will result in better comprehension of the lecture materials.

There is a plethora of suggestions made by educationist in emphasizing the know-how of improving critical thinking abilities (Chambers, Munday, Sienty, & Justive,

1999; Cookson, 2005; Easterbrooks & Scheetz, 2004; Marzano, Brandt, Hughes, Jones, Presseisen, Rankin, & Suhor, 1991). Nevertheless without proper research especially using well thought out research designs and sensitive instruments, these suggestions will not provide the empirical evidence required. The analyses of 55 published articles since 1990 concerning critical thinking by ten Dam and Volman (2004) indicate that a majority of these published articles are more of theoretical suggestions rather than empirical findings.

Questioning seems to be one of the cheaper and better ways of improving critical thinking. Costa (2001), drawing on the studies by Gallagher and Ashner (1963) and Newton (1981), reported the existence of correlations between teacher questions and students' responses. Gallagher and Ashner (1963) discovered that students who were asked divergent questions by their teachers developed divergent thinking as compared to those students who were asked recall type questions. Additionally, Newton (1981) observed that students who were questioned or asked higher level questions performed better in critical thinking and performance tests.

Even though questioning may improve critical thinking, this practice is not widespread as it involves questions that require answers beyond levels 1 and 2 of the Bloom taxonomy. Sirotnik (1983) in his studies of 1000 classes in the primary and secondary school classrooms discovered that less than 1 % of the interaction time was used for questions that require other than yes and no answers. Questions that seemed to be divergent lost their importance when students realize that teachers only prefer answers that the teachers themselves know.

Post teaching phase

It is an accepted fact that active learning can develop critical thinking. Nevertheless, the development of critical thinking if not monitored with the relevant assessment instruments may fail to show the improved abilities. As with other forms of content, an alignment between learning outcomes, teaching, learning activities and assessment is deemed essential. Cross and Steadman (1996) suggested that teachers still evaluate their students using lower level questions. Studies by Savage (1998) and Bates (2000) provided empirical evidence that teacher assessment does not encourage critical thinking. Savage (1998) discovered that 70 – 80% questions asked by teachers are of recall nature. Similarly, Bates (2000) conducted a study involving 16 teachers concerning their teaching practices and discovered that 80% of their 113 learning outcomes can be categorized in the lower levels of Bloom Taxonomy. Similarly, he discovered that 99% of the 1,174 test items are also of the lower levels of Bloom Taxonomy. Improvement of critical thinking is deemed to be related to teacher practices especially with regard to the use of questions.

Given the review of the literature, it can be surmised that there is indeed a scarcity of empirical study on critical thinking among secondary school students in Malaysia, particularly with regard to the differences in quality of teaching experienced by students who scored highly in critical thinking as compared to their counterparts who scored much lower in critical thinking. Accordingly, this study aims to seek illumination to this research question: *Is there a difference in the quality of teaching experienced by students obtaining high critical thinking scores as compared to the quality of teaching experienced by students achieving lower critical thinking scores?*

Methodology

Design of the study

This study employed an extreme group ex-post facto design. This research design was deemed appropriate as it compares the experiences of students obtaining high scores in critical thinking test with the experiences of their counterparts who obtained lower scores in critical thinking test. The experiences here refer to the quality of teachers teaching those students. The teacher practices that can develop critical thinking among students were determined by two criteria, namely (1) there exist a significant difference in the mean rank scores of the items on quality of teaching among the high and low scorers of critical thinking, and (2) there exist a significant correlation between critical thinking scores and scores in the quality of teaching practised by the teachers. Item accepted as reflecting the quality of teaching that promotes critical thinking must fulfill both of these criteria in addition to having *p* value of less than 0.05.

Sample

1200 students of forms 1, 2 and 4 of all 12 secondary schools in a district in Selangor, Malaysia

Instrumentation

The study employed two instruments, namely The Cornell Critical Thinking Test Level X (CCTT-X) developed by Ennis, Millman, and Tomko (1985), and *Soal Selidik Persekitaran Pembelajaran Pemikiran Kritis* (SPPK) or the Learning Environment for Critical Thinking Questionnaire developed and validated by Sabri Mohd Salleh (2008). The former instrument is a 71-item critical thinking test which has been claimed by its developers to be a general critical thinking test that measures "critical thinking skills as a whole" (Ennis et al., 1985, p.1). The reliability of CCTT-X ranges from 0.67 to 0.90 (Ennis et al., 1985). The latter instrument is a questionnaire consisting of 17 items measuring the quality of teaching. Validity and reliability of the CCTT-X has been reported in Ennis et al (1985). The SPPK was validated by a panel of experts comprising of two (2) university professors, an officer from the Ministry of Education and 10 teaching staff of the Teacher Training College involve in teaching how to infuse Higher Order Thinking among teacher trainees. Reliability was ascertain to be 0.80 done among students from another district not involved in the main study.

Analysis of data

As the data do not fulfill the parametric assumptions, the data were analyzed using the Mann Whitney U test for difference between the high critical thinking scorers and the low critical thinking scorers. The Spearman correlation was employed to determine the correlation between critical thinking scores and the quality of teaching.

Results

Table 1 summarises the mean rank scores of items on quality of teaching (as analysed with Mann-Whitney U Test) between high (T) and low (R) scorers of critical thinking, in addition to the correlation between items on quality of teaching and critical thinking scores of the students (as measured by Spearman correlation). Significance is displayed at "Asym Sig" column for Mann Whitney U Test and "p" column for Spearman correlation.

As shown in Table 1, 12 of the 17 items are significant for both criteria, namely Mann-Whitney U Test and the Spearman correlation. Item 1 poses the statement "when teaching, the teacher normally asks the class to elaborate on the advantages and disadvantages". Pupils having high scores in critical thinking as measured by the CCTT-X showed a mean rank of 407.29 for this item as compared to pupils having low scores in critical thinking who showed a mean rank of 370.18 for the same item. Mann Whitney U Test was significant, $z=-2.396$, $p = .027$. This indicates that the responses given by high and low critical thinking scorers are significantly different, whereby teachers of high scorers in critical thinking display such practice (Item 1) in their teaching statistically significantly different from (or, more often than) teachers of low scorers of critical thinking.

Spearman correlation between critical thinking score and Item 1 displayed $r=.08$, $p=.01$. This indicates that there is a significant relationship between critical thinking scores and students' responses to Item 1, in that the higher the critical thinking score, the more the exposure students have to the practice of elaborating on the advantages and disadvantages as reflected in this item.

Although this is a causal comparative study with the limitations in which no manipulation of variables is involved as the groups are already formed and that such design provides weaker evidence for causation, it can be concluded that students who are high scorers in critical thinking self-reported that their teachers displayed the practice of "asking students to give advantages and disadvantages" much more often than the self-report of lower scorers of critical thinking on similar practice by their teachers. Until further confirmation through experimental studies, we can, for the time being, conclude that, by asking students to give advantages and disadvantages during interaction especially questioning, can improve students' critical thinking.

Similar line of explanation and interpretation to that of Item 1 are offered for items 4, 5, 6, 9, 10, 11, 12, 14, 15, 16 and 17 as displayed in Tables 1 and 2. All these items portray the practices of the teachers of the high scorers of critical thinking which may provide an explanation as how these high scorers in critical thinking acquire their critical thinking ability.

Table 1: Difference between students (high scorers and low scorers) in critical thinking for items that fullfilled both criteria

		Difference between groups						Correlation	
Item No.		Mean Rank	Sum of Ranks	Mann Whitney	Wilcoxon W	Z	Asym Sig.	r	p
1	R	370.18	134376.50	68310.5	134376.5	-2.396	.027	.08	0.1
	T	407.29	169433.50						
4	R	373.76	135676.50	69610.5	135676.5	-1.962	.05	.07	.02
	T	404.17	168133.50						
5	R	373.10	135436.50	69370.5	135436.5	-2.043	.04	.06	.03
	T	404.74	168373.50						
6	R	353.85	128449.00	62383	128449	-4.33	<.001	.14	<.001
	T	421.54	175361.00						
9	R	373.66	135638.50	69572.5	135638.5	-1.951	.05	.06	.05
	T	404.26	168171.50						
10	R	359.12	130361.00	64295	130361	-3.746	<.001	.12	<.001
	T	416.94	173449.00						
11	R	364.47	132303.00	66237	132303	-3.108	.002	.12	<.001
	T	412.28	171507.00						
12	R	362.84	131712.00	65646	131712	-3.329	.001	.10	<.001
	T	413.70	172098.00						
14	R	368.21	133661.50	67595.5	133661.5	-2.628	.01	.09	.002
	T	409.01	170148.50						
15	R	364.81	132425.00	66359	132425	-3.019	.003	.10	.001
	T	411.98	171385.00						
16	R	371.41	134822.00	68756	134822	-2.215	.03	.06	.03
	T	406.22	168988.00						
17	R	358.56	130157.00	64091	130157	-3.74	<.001	.13	<.001
	T	417.44	173653.00						

R = low critical thinking scorers, T = high critical thinking scorers

Table 2: Statement of Items Corresponding to Items in Table 1

Item No.	Description of Item
1	When teaching, teacher normally asks the class to elaborate on the advantages and disadvantages.
4	After teaching the critical thinking skills, teacher normally gives us practices based on those critical thinking skills that have been taught.
5	After teacher's demonstration, teacher allows us to practise the critical thinking skills.
6	Teacher often uses the words that encourage us to think such as "compare", "classify", "analyze", "predict", "hypothesise" .
9	If any of the students makes mistakes, teacher corrects the mistakes without embarassing the student.
10	When any of the students argues or gives an opinion, teacher always helps us to identify the strengths and weaknesses of the argument presented.
11	Teacher always encourages us to carefully consider every idea before rejecting any idea.
12	Normally teacher would ask the students to provide evidence to back up their answers.
14	For every question that teacher asks the students, teacher would hear answers from a number of students, only then will teacher help us make a conclusion.
15	Teacher accepts our answers without making fun of our answers.
16	When teacher asks us to discuss an issue, normaly we have enough time to present the contents of our discussion
17	Most of the time, teacher would ask questions that have more than one right answer.

Among the 17 items posed to students of high and low critical thinking scores, five items did not fullfill the criteria. This indicates that these five items are not practices that can differentiate the teaching practices experienced by students of high and low scorers. The five items are displayed in Tables 3 and 4.

Table 3: Five Items that did not Fullfill the Criteria

Item No.	Description of Item
2	We do feel scared when we need the to question the teacher.
3	Normally after teacher has asked us a question, teacher would allow us enough time to think of the answer.
7	When teaching in class, normally teacher does most of the talking.
8	I do not feel scared when answering questions posed by the teacher or my classroom peers.
13	When deciding issues to be discussed, teacher would encourage the students themselves to decide on the more relevant issues.

Table 4: Difference between students (high scorers and low scorers) in critical thinking for items that did not fullfill both criteria

		Difference between groups						Correlation	
Item No.		Mean Rank	Sum of Ranks	Mann Whitney	Wilcoxon W	Z	Asym Sig.	r	p
2	R	387.76	140758.00	74692.0	140758.0	-.269	.788	.009	.744
	T	391.95	163052.00						
3	R	395.56	143587.50	73486.5	160222.5	-.667	.505	-.036	.209
	T	385.15	160222.50						
7	R	387.13	140529.50	74463.5	140529.5	-.341	.733	.011	.707
	T	392.50	163280.50						
8	R	396.18	143815.00	73259.0	15999.5	-.742	.458	-.015	.606
	T	384.60	159995.00						
13	R	380.37	138073.00	72007.0	138073.0	-1.174	.240	.035	.335
	T	398.41	165737.00						

R = low critical thinking scorers, T = high critical thinking scorers

Discussion

There is a plethora of strategies which could be employed to ensure the enhancement of students' thinking abilities. However, when we only consider the statements of teaching practices in the 12 items that fulfilled both criteria (i.e., showing significances in Mann-Whitney U Test and the Spearman correlation) and that exemplified the quality of

teaching that promotes critical thinking skills, the statements of these items could be plausibly clustered into the following three themes.

1. Expanding the horizon of thinking

Students are allowed and encouraged to convey facts, arguments and ideas but their responses will be accompanied by the necessary evidence (Item 12). Before presenting any ideas, students are encouraged to consider multiple perspectives (Item 11), to consider the pros and cons of an idea (Item 1), and to identify the strengths and weaknesses of an argument or an idea (Item 10).

2. Practices during teaching

During teaching, teachers who teach the high scoring students in critical thinking often use words that encourage critical thinking (Item 6). In their interaction during questioning, responses from several students were considered first before the class makes their conclusion (Item 14). Questions posed by the teacher are normally divergent in nature (Item 17). Student who makes mistakes or answers incorrectly feels safe from being humiliated by the teacher or their peers (Item 9, 15). All discussion ends with presentation to the class (Item 16). This reduce the feeling of wasting time discussing normally felt in classroom discussion

3. Practices after teaching

After the teacher finishes teaching, students are given opportunities and time to practice what they have learned with respect to thinking skills (Items 4 & 5).

Among the 17 items posed to high and low scorers of critical thinking, five items failed to discriminate the teacher of these groups of students. These items are Items 2, 3, 7, 8 and 13. All these five items failed to fulfill the criteria decided upon prior to analyzing the data.

Teacher practices have been reported to be dependent on text books (Pizzini, Abell & Shepardson, 1988), lacks opportunities for discussion among students (Seidman, 2004), and failure to guide students to seek answers (Hafnner & Rainbruber, 1998) may be some of the reasons accounting for low correlations between critical thinking and quality of teaching as a whole. The quality of teaching can improve critical thinking if deficiencies as elaborated by Sparapani (1998) can be overcome that is (1) too little time allocated (2) perception that teaching thinking amounts to more work (3) attitudes of teachers to prepare only simple activities (4) limited teaching aids especially relating to teaching thinking (5) classroom environment that is not conclusive to learning critical thinking such as classroom furniture arrangement and (6) assessment aspects.

As oppose to stand alone approach and infusing which seem to takes a quantum of the teachers' time, pervasive approaches does not require any extra effort or time other what the teacher normally contributes. The development of critical thinking among students can be improved if teacher practices requesting students to accompany their argument with evidence and making the classroom safe for argument. This article presents three themes with empirical evidence that may help to develop critical thinking among students.

Conclusion

In situation where the current curriculum seems so compact to make room for teaching thinking and yet society demands that of the schools, pervasive approach seems an possible option to be considered. Without any extra resource required from the schools and teachers, teaching with questioning practices may alleviate the current dilemma in improving critical thinking abilities of the students.

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