A Case Study of Critical Thinking Behavior in an Online Collaborative Inquiry

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Abstract: This paper reports on a case study to investigate whether the scores obtained from various critical thinking instruments were correlated to the extent to which student exhibited critical thinking behavior in authentic problem-solving situations. On the one hand, students' critical thinking skills and dispositions were examined using three instruments. On the other hand, student participants were introduced to use an online discussion environment to conduct collaborative inquiry. The students' online discourse reflects their engagement in authentic problem-solving practices as they tackled the learning tasks assigned by the teacher. Content analysis was performed to identify instances of critical thinking behavior in the online discourse using Perkins and Murphy's framework. The results suggest that students' context-free critical thinking skills and dispositions have been improved after the collaborative inquiry. And the context-specific critical thinking test is useful as a predictor of students' critical thinking behavior exhibited in authentic contexts.

Keywords: collaborative inquiry, critical thinking instruments, critical thinking behavior

Introduction

Critical thinking is often considered as requisite ability for citizens in the 21st century [1]. The concept of critical thinking has maintained a strong focus on the micro-skills related to critical thinking [2, 3], which have been criticized as inadequate. Recent research studies give more emphasis to developing habits of mind to think critically, i.e. nurturing the dispositions towards critical thinking [4-6]. Another trend in critical thinking research is the realization that good performance on generic critical thinking skills tests does not guarantee the ability to exercise critical thinking in authentic problem-solving contexts. Existing literature suggests that engaging students' in knowledge building discourse could be a satisfactory and effective way to improve critical thinking [7, 8]. However, limited empirical studies have investigated students' critical thinking while they engage in extended collaborative inquiry. This paper examines students' critical thinking using different instruments, including: (1) two standardized surveys on generic critical thinking skills and dispositions, (2) a constructed response instrument designed to measure context-specific critical thinking skills. Further, this paper explores whether students' scores on the three critical thinking instruments were correlated in any way to the extent to which the students exhibited critical thinking behavior in the online discourse.

1. Literature Review

1.1 Critical Thinking

The conception of critical thinking can be traced back to John Dewey's views on reflective thinking [9]. In the ensuing years, many philosophers have taken interest in developing the conception of critical thinking based on Dewey's ideas [10]. Ennis is one of the most influential philosophers who defines critical thinking as a set of skills and dispositions [11]. Moreover, McPeck points out that critical thinking is always thinking about something, and the instruction for critical thinking should engage students in certain activities with context-specific knowledge [12]. In line with the trends in critical thinking development, educators have shown growing interest in fostering students' critical thinking skills and nurturing critical thinking dispositions through engaging them in collaborative inquiry in authentic problem-solving contexts.

1.2 Ways to Measure Critical Thinking

This paper reviews some popular instruments of critical thinking and reviewed different ways to measure critical thinking, including multiple-choice tests, constructed response tests, and the online learning discourse. In the following, three ways of testing are introduced and discussed in detail.

In the multiple-choice tests, generic cognitive skills are commonly included, such as inductive or deductive inference [13]. Students are presented with "general scenarios" which do not require specific knowledge. Based on the given passages, they identify the assumptions in what other people said and make judgments on the credibility of the provided sources or other's observation. However, these tests in multiple-choice style are only recognition tasks. So they only examines the evaluative aspects of critical thinking rather than the productive aspects [14]. And they fail to reveal the thinking processes of the students.

In terms of the tests allowing constructed responses, students are asked to respond to a set of semi-structured questions. So this kind of tests contains both the evaluative and productive aspects of critical thinking. The constructed response tests generally involve content, either problems in daily life or context-specific topic. Comparing with multiple-choice tests, these tests are more open-ended. The disadvantage of constructed response tests is that the grading task is difficult and time-consuming. Guidelines and trainings must be provided on making flexible and reasonable complex judgment in grading the test.

The online discourse is a new way to examine a continuous flow of evidence of students' critical thinking behavior that autonomously exhibited during the learning process. The online discussion environment can be designed to support students' collaborative inquiry and sustained knowledge building, such as sharing useful information, exchanging ideas with others upon the specific course topic. Although the online discourse can demonstrate how students may exhibit critical thinking in complex problem-solving contexts, the open-endedness and authentic context make it difficult to measure any critical thinking skills or dispositions.

In summary, these multiple-choice tests can be easily administered and scored. But it is not appropriate to use the multiple-choice tests to assess students' ability to employ several skills together when working on a complex problem. Hence, this kind of test should be only part of the assessment. Comparatively, essay-format tests are considered to provide more leeway in answering which can gather more information on students' productive thinking. For example, in the Ennis-Weir test, students are prompted and pushed to use certain critical thinking skills. But still they are not sufficient to reveal students' critical thinking dispositions in solving authentic problems. So it is argued that critical thinking assessments need to provide opportunities for students to use any critical thinking skills they want to apply in an open-ended yet focused problem situation [15].

2. Design and Method

2.1 Research Context

This paper selected a school which has established a strong curriculum focus within the Integrated Humanities (IH) subject on developing students' critical thinking and designing inquiry-based task to promote children's critical thinking skills. The humanities teacher believed that the use of an asynchronous online environment will enhance the collaborative inquiry process and foster critical thinking. The teacher's class at secondary two was invited to participate in this study. This is the first year for the teacher and his students to use Knowledge Forum® (KF). The thirty-two students were involved in the humanities module and guided to engage in problem-solving inquiries on different topics related to the task of designing a new tourist attraction in Hong Kong. The inquiry extended over a period about 3 months.

2.2 Instrumentation

All participants completed two standardized tests on critical thinking skills and dispositions, and they also filled out a peer critique form which can reflect their critical thinking ability within the subject-matter context. More importantly, instances of critical thinking behavior in the online discourse were used as evidence of students' ability to exercise critical thinking in authentic contexts. The details of the instruments and the framework employed to measure critical thinking are described as following:

1. The adapted Cornell Critical Thinking Test, Level X (CCT-X) [16]

The test measures context-free critical thinking skills, such as induction, deduction, observation, credibility and assumption.

2. The Inventory of Belief and Critical Thinking Disposition (IBCTD) [17]

This instrument is a Likert-scale questionnaire to measure critical thinking dispositions, including (a) systematic and analytic; (b) open-minded and empathetic; (c) intellectual; inquisitive, and (d) holistic and reflective.

3. The Constructed Response Test on Critical Thinking Skills: Critique Form

The peer critique form is a customized version of the Ennis-Weir essay test [18]. This test can measure context-specific critical thinking skills, which includes identifying relevance, appropriate definition, appropriate use of authoritative sources, appropriate reasoning, consideration of different possibilities, and overall strength of the argument.

4. Critical Thinking Behavior as Exhibited through the Online Discourse

Students' online discourse was analyzed to using Perkins and Murphy's framework, which consists of four critical thinking processes: clarification, assessment, inference and strategies [19]. The unit of analysis used to code the online discourse of students was an "idea unit", a segment of discourse containing an identifiable idea or a single coding category. There can be more than one critical thinking process in a note. The inter-rater reliability was conducted on 20% of the total number of notes. The Cohen's kappa was 0.86, indicating a good level of agreement between two raters.

3. Results & Analysis

3.1 Critical Thinking Exhibited in Students' Online Discussions

All of the discussion notes were coded, but not all notes could receive a code. Overall, 591 of the 1017 (58% of the total number of notes) were identified as containing evidence of critical thinking processes, resulting in a total of 652 idea units being coded. 21 out of 32 students were found to exhibit all the four critical thinking behaviors during the online inquiry. In general, the critical thinking skill most frequently demonstrated by the students was clarification, while assessment was demonstrated least. Table 1 presents the findings broken down by stage.

Table 1 *Distribution of idea units with critical thinking processes in different views*

	Clarification		Assessment		Inference		Strategies		Total idea units	
	N	%	N	%	N	%	N	%	N	%
Critical thinking behavior	341	52%	72	11%	142	22%	97	15%	652	100%

3.2 The Relationship between the Critical Thinking as Measured by Three Instruments and Critical Thinking Behavior exhibited in the Online Discourse

Table 2 shows the results of correlation analyses between the scores obtained from three critical thinking instruments and the number of units coded as critical thinking processes. There was a stronger correlation between the post-test scores for CCT-X and IBCTD test with the four exhibited critical thinking behaviors in the discourse. Take the CCT-X test for example, while no significant correlation was found between the pre-test score and the four critical thinking behavior in the discourse, the post-test score was significantly correlated to the number of clarification (r = 0.42, p < 0.05), assessment (r = 0.50, p < 0.01), and strategies (r = 0.59, p < 0.01). On the other hand, the contextual critical thinking test (Critique Form) showed a significant correlation with critical thinking behavior, such as the number of processes of inference (r = 0.41, p < 0.05), and strategies (r = 0.48, p < 0.01). Therefore, these findings suggest that Critique Form is a useful predictor on students' critical thinking behavior exhibited in the discourse. And engaging students in critical thinking in authentic problem solving can potentially improve their context-free critical thinking skills and dispositions.

Table 2 *Correlations between scores of three critical thinking instruments and critical thinking behavior exhibited in the online discourse*

	Online Critical Thinking Behavior			
Total score	clarifications	assessments	inferences	strategies
CCT-X pre-test	0.30	0.13	0.22	**0.43***
CCT-X post-test	**0.42***	0.35	**0.50****	**0.59****
IBCTD pre-test	0.23	-0.09	0.24	0.30
IBCTD post-test	**0.38***	0.03	0.29	0.36
Critique Form test	0.28	0.28	**0.41***	**0.48****

Note. * p < .05, ** p < .01

4. Discussion

In this paper, three instruments were employed to measure students' critical thinking skills and dispositions. And students engaged in an extended online collaborative inquiry where they were faced with authentic problems and tackling the learning tasks assigned in the humanities module. Content analysis was conducted to examine students' critical thinking behavior exhibited in the online discourse. The results suggest that most students can apply the four critical thinking processes, with the highest percentage of units coded as clarification and the lowest percentage coded as assessment. The correlation results suggest that students' context-specific critical thinking skills, as measured by the Critique Form, are valuable as a predictor of students' critical thinking performance in authentic contexts. Also, students' critical thinking skills and dispositions can be improved as reflected by their scores in context-free tests through engaging in an extended collaborative inquiry. This paper has implications for curriculum developers and practitioners who seek to design authentic learning tasks to promote collaborative inquiry and foster critical thinking in secondary students. And it contributes to the literature on the predictive value of critical thinking instruments on students' ability to exercise critical thinking in authentic problem-solving contexts.

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