DEVELOPMENT OF CRITICAL THINKING SELF-ASSESSMENT SYSTEM USING WEARABLE DEVICE

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ABSTRACT

In this research the author defines critical thinking as skills and dispositions which enable one to solve problems logically and to attempt to reflect autonomously by means of meta-cognitive activities on one's own problem-solving processes. The author focuses on providing meta-cognitive knowledge to help with self-assessment. To develop students' critical thinking, it is important for students to be able to use critical thinking rubric and assess themselves. Critical thinking self-assessment system has three components, video recording system using a wearable device, critical thinking rubric and meta-cognitive activities.

KEYWORDS

Critical Thinking, Self-assessment, Wearable Device, Meta-cognitive Knowledge, Meta-cognitive activity

1. INTRODUCTION

To develop students' ability to work together to solve problems is an important factor in education.The ATCS21 Project proposed 21st century Skills as ways of thinking, tools for working, ways of working and ways of living in the world (ATCS21).Recently, research into the assessment and teaching of 21st century skills has forged ahead, and MOOC learning environments have also been provided (e.g. at the University of Melbourne).According to ATCS21, critical thinking is one aspect of ways of thinking. A number of researchers such as Dewey (1910), Glaser (1941), and Ennis (1985) define critical thinking as reflective and logical thinking. The Association of American Colleges and Universities（AACU） defines critical thinking as a habit of mind characterized by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion. AACU also provides a rubric known as a value rubric as a critical thinking assessment tool. The critical thinking value rubric has five categories: explanation of issues, evidence (selecting and using information to investigate a point of view or conclusion), influence of context and assumption , student's position (perspective, thesis/hypothesis) and conclusions and related outcomes (implications and consequences).The value rubric is used to rank students' activities on four different levels. For instance, the highest level (capstone) in the evidence category is 'Information is taken from source(s) with enough interpretation/evaluation to develop a comprehensive analysis or synthesis. Viewpoints of experts are questioned thoroughly'. On the contrary, the lowest level (benchmark) is 'Information is taken from source(s) without any interpretation/evaluation. Viewpoints of experts are taken as fact, without question. 'To develop their critical thinking, it is important for students to be able to use this rubric and assess themselves.

The author focuses on providing meta-cognitive knowledge to help with self-assessment. In this research the author defines critical thinking as skills and dispositions which enable one to solve problems logically and to attempt to reflect autonomously by means of meta-cognitive activities on one's own problem-solving processes. To provide information on meta-cognitive activities, a record of the learning process is required.

One approach for recording this information is using computer log data. Log data about students' activities such as browsing the web, writing comments, reading web pages and discussing with peers on the bulletin board system will provide useful information. These data have already been used with assessments such as PISA and the National Assessment of Information Utilization Ability in Japan (2015).

On the other hand, computing is merely one aspect of students' activities. Students also read books, write comments or memos, and hold discussions with peers and teachers. Furthermore, computer log data are of no direct use in students' meta-cognitive activities. To provide information needed for meta-cognitive activities, the entire record of the learning process is required. Students' video-recorded data would seem to be particularly useful in assisting their meta-cognitive activities. In addition, the author mentions individual differences among students. It has recently been discovered that there are differences among individuals with regard to critical thinking (Gotoh . Individual differences such as personality, disposition toward critical thinking and self-efficacy will be discussed).

2. METHOD

Elementary school children, junior high school students, senior high school students and university students took part in this study. The material selected was cooperative problem solving, such as integrated studies and the knowledge constructive jigsaw method. Elementary school children at an elementary school attached to Niigata University gathered information about how to promote Niigata City and proposed a promotion plan. Niigata University students took part in the knowledge constructive jigsaw method and discussed their own career design from the point of view of technical / functional competence, general managerial competence, autonomy / independence, security / stability, entrepreneurial creativity, service / dedication to a cause and pure challenge.

2.1 Learning Environment

This system has three components of which the first is a video recording system using a wearable device. To record the entire learning process, a wearable device such as Google Glass or Sony Wearable Glass is used. A lesson protocol was developed using the recorded video. Using these data, the researcher extracted samples that meet the requirements of the rubric described below.

2.2 Critical Thinking Rubric

The second component is the critical thinking rubric. As already mentioned, previous research exists on the critical thinking rubric (Griffin, et.al 2012, Beyer 1985, Miyake 2014, VALUE project). The critical thinking rubric was used as a tool to enable students to carry out self-assessment and reflection. It is important for students to be able fully to understand and use the critical thinking rubric. For this reason, the critical thinking rubric was modified to suit each school level. For instance, the university rubric has four levels: capstone, upper milestone, lower milestone and benchmark similar to the VALUE Rubric. In contrast some elementary school rubrics have only two levels.

2.3 Meta-cognitive Activities

The third component consists of meta-cognitive activities. The integrated study project consists of several small units. At the end of each small unit the author requested students to reflect on their learning from the point of view of their own critical thinking performance. To assist these activities, students' watch a video that meets the requirements of the critical thinking rubric. The video of the sample extracted by the researcher undoubtedly helps students with their self-assessment. After watching the video, students assessed their own learning using the critical thinking rubric. At the university level, samples were displayed in which information is taken from source(s) with enough interpretation/evaluation to develop a comprehensive analysis or synthesis and viewpoints of experts are questioned thoroughly. Students and teachers discussed points in the samples of students' activities where students showed excellence. Discussion provides a viewpoint from which students are able to assess their own learning activities. Students also become aware of their strengths and weaknesses.

3. EXPECTED RESULT

A pilot study was started at Niigata University and at the elementary school attached to Niigata University. At the elementary level, It was found that some children felt that self-assessment without any video recording was difficult. A wearable device seems to be useful because these devices provide a natural angle and clear sound. At the university level, these devices provide supportive information to evaluate students' activities. In terms of evidence, one of the critical thinking categories, the upper milestone was: 'Information is taken from source(s) with enough interpretation/evaluation to develop a coherent analysis or synthesis and viewpoints of experts are subject to questioning' whereas the lower milestone was: 'Information is taken from source(s) with some interpretation/evaluation, but not enough to develop a coherent analysis or synthesis. Viewpoints of experts are taken as mostly fact, with little questioning'.

A movie of the learning process recorded by a wearable device will provide useful information to enable a more precise understanding of the differences in these levels. Meta-cognitive activities and reflection will enable students to attain a deeper level of self-assessment. Differences among individuals are also taken into consideration. In particular, the difference in the problem solving process between those who are highly disposed towards critical thinking and those who are not, is not yet known. Using a critical thinking disposition scale the author extracted two types of students and compared problem- solving process, meta-cognitive activities and relfection and self-assessment between these two types.

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