

Developing Measurement Instrument for Critical Thinking Skills of 21st Century Education

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Abstract

Life in the 21st century demands a variety of skills, thus hopefully education can prepare students to master these skills in order to be a successful person in life. Essential skills in the 21st century are relevant to the four pillars of life which are learning to know, learning to do, learning to be, dan learning to live together. Each of the four principles contain specific skills that need to be empowered through learning activities, such as the skills of critical thinking, problem solving, metacognition, communication, collaboration, innovation and creation, information literacy, and so on. Developing a measurment instrument of critical thinking skill aims to provide an overview on the steps or ways being implemented by educator in developing the instrument as a measurement of students' critical thinking skills, especially developing the instrument on the subject of mathematics. The steps in developing measurment instruments of critical thinking skills are composing instrument specifications, writing instrument, reviewing instrument, conducting instrument testing, analyzing instrument items, improving instrument, and assembling instrument.

Keywords: Measurement, Critical Thinking Skills, 21st Century Education

Introduction

The development rate of science and technology as well as the process of globalization requires the community to quickly adapt in changes to the value system and life pattern. These new demands require for breakthroughs in thinking, conceptualising, and actions. The future society, the global community demands human beings to be creative, critical, flexible, open, innovative, dexteritive, competitive, sensitive to problems, control information, able to work in cross-field team work, and adapt to change (Semiawan, 1998).

The 21st century is marked as a century of openness or a century of globalization, meaning that human life in the 21st century undergoes fundamental changes that are different from the life order in the previous century. It is said that the 21st century is a century that asks for quality in all efforts and work of human beings. By itself the 21st century asks for quality human resources, generated by institutions that are managed professionally, thus to produce superior results. These new demands require for

breakthroughs in thinking, conceptualising, and actions. In other words, a new paradigm is needed in facing new challenges, said by philosopher Khun. According to the philosopher Khun if these new challenges are encountered using the old paradigm, then any attempt will be failed. The new challenge demands a breakthrough in thinking process when the desire is a quality output that can compete with the work in the open world (Tilaar 1998: 245).

One of the most prominent features in the 21st century is the increasingly interconnected world of sciences, thus the synergy among it becomes faster. In the context of the utilization of information and communication technology in the education world, it has proven to be more narrow and decline the factor of "space and time" which has been the determinant aspect of speed and success in mastering sciences by mankind (BSNP: 2010). The acceleration of increasing knowledge is supported by the application of media and digital technology called information superhighway (Gates, 1996).

The 21st century has many differences with the 20th century, such as in work, social life, and self-actualization. The 21st century is marked by the rapid development of information technology and the development of automation where many routine and repeated jobs are replaced by machines, both production machines and computers. As already known in the 21st century both society and education world has been completely changed. Schools that are understood to date have been formed since the 19th century in order to develop children's education and also encourage industrialization. So initially the schools were formed to support the formation of civil society and also industrialization. Therefore since 1989 when Germany has united, began the era of globalization till now, in which in the North America, Europe, and East America has occurred early globalization. The Asian countries have not become one due to cultural and tribal diversity, but at some point it will happen as in the western countries. So the country/market will become one and maybe the currency will be one too. In the old times, market was per country but now because of globalization, a communications unit will become widespread (JICA, 2016).

Thinking ability is ability in processing mental operations that include knowledge, perception, and creation. Thinking ability is ability in using the mind to seek meaning and understand something, explore ideas, make decisions, think solutions with the best judgment, and problems revision of the previous thinking process. Thinking ability is divided into two parts, which are Low Order Thinking Skill or LOTS and Higher Order Thinking Skill or HOTS. The students' higher order thinking skill is one of the nation's intellectual-level barometers. As an agent of change, students must be able to demonstrate their identity in ways that are intellectual, moral, and elegant. Therefore, in the 21st century, the learning process conducted in schools and universities must be optimal, in order to produce competent graduates. HOTS being referred to in this study is the ability to think critically. This is reinforced opinion about some of the characteristics of HOTS according to Conklin (2012), the

characteristics of higher-order thinking skills: higher-order thinking skills encompass both critical thinking and creative thinking.

Based on the explanation, creating and developing critical thinking instrument is something that needs to be done. It aims to train students' critical thinking skills in solving problem, and for educators to train the ability to develop HOTS-based problems. So it needs to be studied further, the ways or steps in developing measurement instrument of students' critical thinking skills.

Literature Review

Critical Thinking

Critical thinking is a mental process for analyzing the information obtained. The information is obtained through observation, experience, communication, or reading. In addition, Brookhart (2010: 4) mentioned that critical thinking by Barahal are reasoning, questioning and investigating, observing and describing, comparing and connecting, finding complexity, and exploring the point of view.

Critical thinking is reasoned and reflective thinking by emphasizing decision-making on what to believe or do. Therefore, the indicator of critical thinking ability can be derived from the students' critical activities as follows: (1) looking for a clear statement of each question; (2) finding reason (3) trying to well understand the information (4) using the credible source and mention it, (5) paying attention to the overall situation and condition, (6) striving to remain relevant to the main idea; (7) considering the original and fundamental interests; (8) looking for alternatives; (9) being open minded; (10) taking position when there is sufficient evidence to do something; (11) seeking explanation as much as possible ; (12) be systematic and orderly with parts of the whole problem.

Critical thinking includes: (1) ability to identify assumptions given, (2) ability to formulate problem points, (3) ability to determine the effect of a particular set of things, (4) the ability to detect them in the usual way based on different perspectives; (5) The ability to disclose data/definition/theorem in solving the problem; (6) Ability to evaluate relevant arguments in the resolution of a problem.

21st Century Skills Education

In an era of globalization, which is full of challenges and competition between individuals, everyone is required to have qualities and skills capable in answering each challenge. Skills in question are skill in using technology, skill in managing information, skill in learning, skill in innovating, skill in living, skill in career, and skillf in self-improvement in global awareness. Thus the mastery of these skills must be owned by every Indonesian student who becomes the backbone of the battle and hope of this nation.

Education of the nation's characters becomes very important and becomes a solution to overcome the above problems. This is the responsibility of the 21st century education. For the Character Building (students' character education) needs to be added in the skills of students in the 21st century. According to Mr. Eka, the 21st century desperately needs skill especially in the following matters:

- Creativity and Innovation. Humans who will succeed in the 21st century are them with creativity and diversity of ideas. Therefore, in this creative dimension, the teachers must be creative. It is no longer expected that students' ability only at the level of describing something, but how students are able to developing, implementing and conveying new ideas to others; be open and responsive to new and different perspectives.
- Critical Thinking and Problem Solving. There are two kinds of problem in here, the problem in academic and authentic. The academic problem is of course a problem related to the realm of cognition they live in. Authentic problem is more of a problem they encounter everyday around them. Students are expected to be able to use their ability to try to independently solve the problems they face, students also should have the ability to compose and disclose, analyze, and solve problems.
- Communication. In the 21st century, survive students are those who can communicate in various ways, both written and verbal. Students are required to understand, manage, and create effective communication in various forms and contents in oral, written, and multimedia. The students is given the opportunity to use their ability to express their ideas, either during discussion with his friends or when solving problems from their teachers. Students should no longer be anti-ICT, they should be familiar with technological communication. So does their teachers.
- Collaboration. Apparently life in the 21st century is no longer depend on competition. In fact, successful people in this century are people who can work together or collaborate with various interests. Students should be capable of their ability in teamwork and leadership; adapt in various roles and responsibilities; work productively with others; placing empathy in its place; respecting different perspectives. Students also perform personal responsibility and flexibility, at work and public relations; establish and achieve high standards and objectives for onerself and others; understand the ambiguity.

21st Century Education Paradigm

Ministry of Education and Culture formulated the learning paradigm of the 21st century emphasizeing learners' ability to find out from various sources, formulating problems, analytical thinking and cooperation and collaboration in solving problems (Litbang Kemdikbud, 2013). The explanation of 21st century learning framework according to (BSNP: 2010) are as follows: (a) critical-thinking and problem-solving

skills, able to think critically, laterally, and systemically, especially in the context of problem solving; (b) communication and collaboration skills, able to communicate and collaborate effectively with various parties; (c) critical-thinking and problem-solving skills, able to think critically, laterally, and systemically, especially in the context of problem-solving; (d) communication and collaboration skills, able to communicate and collaborate effectively with various parties. Creativity and innovation skills, able to develop their creativity to produce innovative breakthroughs; (e) information and communications technology literacy, able to utilize information and communication technology to improve daily performance and activities; (f) contextual learning skills, able to undergo contextual independent learning activities as part of personal development, and (g) Information capabilities and media literacy, able to understand and use various communication media to convey ideas and carry out collaborative activities as well as interactions with various parties.

To encounter learning in the 21st century, everyone must have critical thinking skills, digital literacy knowledge and skills, information literacy, media literacy and mastering information and communication technology (Frydenberg & Andone, 2011). A number of studies on the application of information technology that supports 21st century learning have been conducted in various countries. Trilling & Fadel (2009) said that in the 21st century, education must always move along with the progress of the times. This movement is based on a change of educational paradigm from the conventional to the modern century education. The summary of the paradigm shift can be seen in table 1 below.

Table 1. Paradigm Differences of Old Education and 21st Century Education.

Old Paradigm	21 st Centudy Paradigm
Teacher Centered	Student centered
Direct teaching	Interactive teaching
Knowledge	Skills
Learning material	Process
Basic skills	Applied skills
Facts and principles	Questions and problems
Theory	Practice
Material-based	Project-Based
Time-limited	According to the needs
Competitive	Collaborative
One-size-fits-all	Personalized
Focused on the class	Focused on the global community
Text-based	Web-based
Summative test	Formative evaluation
Learn to continue school	Learning for life

(Source: Trilling & Fadel, 2009)

Result and Discussion

The steps in developing this critical thinking instrument are

- Determining the purpose of the test. The purpose of the test is determined by the test taker. However, this research is a study of the development of critical thinking instrument, the goal is to understand how substantial students' critical thinking skills are.
- Arrange the test blueprint. Setting up the test blueprint is a very important step. Set up the test blueprint based on the indicators that have been made.
- Determining the length of the test. From all the questions items, must pay attention to the length of each item to be tested. No more than half a page for one item.

When the indicator has been determined, and the length of the test instrument known, the next step is to write down the instrument. This instrument is made in accordance with the Enhanced Indonesian Spelling System, and should be re-read after the instrument has been made, with the purpose of whether the writing, editorial, and sentence intentions are correct. The review of this instrument was done by experts on mathematics lessons. This stage was called the validation process by the expert. The results of the review by the validator indicated the quality of the instrument that has been made. If not yet valid, it needed to be fixed / revised based on the suggestions provided by the validator. After the repair was completed, the instrument was given back to the validator in order to each item to be assessed. After all the items that have been prepared are analyzed and improved, the next was to assemble the items into one unified instrument.

The ability then must be trained. Thus, in the process of classroom learning the educators need to provide questions or exercises that contain questions about critical thinking, or when holding a test/exam educators provide the questions that contain the questions of critical thinking, although only a few items. This is in line with the Council for Curriculum, Assessment and Examinations (CCEA), that teachers and practitioners should have some guidance on how the thinking skill can be improved within the first year of school, and how to assess whether children's think in a constructive way or not .

Activities undertaken by lecturers to understand students' critical thinking skills are called measurement activities. The success of educators in conducting trial to students, such as providing a test that contains the question of critical thinking can be known through a measurement. The results of measurements made by educators can be trusted if in some times the educator is measuring the same subject and the results obtained are relatively the same (reliable). It will be applicable if the measured instrument does not change.

In addition to reliable, the instrument that will be used as a measurement by the educators, must be estimated the validity. A measuring instrument can be said to

have a high degree of validity if the instrument created performs its measuring function. If an instrument produces data irrelevant to the purpose of measurement (not in accordance with the measuring function), the instrument has a low validity.

Conclusion

To be successful in the 21st century, this study is expected to give an overview on how this 21st century education is oriented towards Higher Order Thinking Skills (HOTS). Learning that is oriented to higher order thinking skills (HOTS) is needed by educators, in order to measure and understand the readiness and ability of students in higher thinking activities. Preparing students to work, being a good citizen, and able to face life in the 21st century is a hard work. Globalization, technology, migration, international competition, global market changes, transnational environments, and political change are all pointed to the skills and knowledge being needed by students.

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