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CRITICAL THINKING SKILLS OF HIGH SCHOOL AND VOCATIONAL SCHOOL STUDENTS IN INDONESIA: A LITERATURE REVIEW

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ABSTRACT

Critical thinking skills are needed in students' lives, both for now and for the future. Therefore, the development of these skills should be carried out by teachers through students' learning at schools. This research was conducted with the aims of knowing: 1) the level of critical thinking skills possessed by senior high school and vocational high school students in Indonesia today, 2) the efforts made by teachers in developing the students' critical thinking skills in classroom learning; and 3) instruments to measure the students' critical thinking skills. This research method was content analysis, that was conducted by reviewing and analyzing 22 research articles about the measurement and development of critical thinking skills for senior high school and vocational high school students in Indonesia, which have been published in scientific journals from 2015 to 2020. The results showed that: 1) the level of students' critical thinking skills was still relatively low; 2) the learning strategy most used by teachers and effective for developing students' critical thinking skills in classroom learning was problem-based learning; and 3) the measurement (assessment) of students' thinking skills was generally carried out by tests (essays and multiple choices), some of which referred to aspects or rubrics measuring critical thinking skills that had been developed by experts.

KEYWORDS: Critical Thinking Skills, Students, Senior and Vocational High School

1. INTRODUCTION

Critical thinking skill is one of the skills needed in the 21st century. These skills are very important to develop, especially to prepare high school students to be able to take part in education at the next level and when they enter the world of work [1]. Therefore, educators in secondary schools should develop students' critical thinking skills through various subjects taught in schools. Learning should not only be centered on understanding the subject matter, but also allow time for students to develop a variety of necessary life skills.

Critical thinking skill is cognitive skill, including: interpretation, analysis, evaluation, inference, explanation, and self-regulation [2]. According to Ennis [3], critical thinking is logical reflective thinking that focuses on making decisions about what to believe or do. Onosko and Newman stated that critical thinking skill requires students to interpret, analyze or manipulate information. Therefore,

according to Ennis, critical thinking skills are needed when we are trying to understand some information that will be used to generate ideas. Critical thinking also requires students to use new information or manipulate existing knowledge and information in order to be able to provide reasonable responses to new situations [4].

According to McGregor, the goal of thinking skill development is to have outstanding thinking, as highly qualified thinking is essential both within and outside of the educational environment [4]. Paul and Elder [5] state that the quality of our life and what we produce, make or build really depends on the quality of our thinking. Critical thinking is present as one of the answers to improve the quality of thinking. According to Qing [5], a student who has critical thinking skills can ask appropriate questions, gather relevant information, efficiently and creatively sort through information, reason logically, and arrive at reliable conclusions and be trustworthy.

Thinking skills are related to students' ability to understand thinking processes when studying subject matter [4]. According to Paul and Elder [5], the only capacity that can be used for learning is the human ability to think. Effective learning depends on our ability to think well, and vice versa. Critical thinking is a high-level thinking skill that has the potential to increase students' critical analysis power. Increasing students' critical analysis power is closely related to increasing students' intellectual abilities. Therefore, developing students' critical thinking skills in learning is an effort to improve student learning outcomes [6].

Given the significance of critical thinking abilities in students' lives now and in the future, educators should be concerned with and responsible for developing these skills in their students through educational experiences. For this reason, this study will analyze the findings of research on skills in critical thinking that have been conducted in Indonesian high schools and vocational schools in order to find out: 1) how critical thinking skills students currently have in Indonesia? 2) how are the teacher's efforts in developing students' critical thinking skills in classroom learning? 3) how to measure students' critical thinking skills? In order to address these issues, this article will discuss and analyze studies on evaluating and developing students' critical thinking skills, particularly those in high school and vocational students.

Numerous studies have been conducted on the development of critical thinking skills in a variety of academic subjects and educational levels. However, articles that analyze various previous studies to gain new insights about the level of critical thinking skills generally possessed by high school students and the development of critical thinking skills more broadly are still rare. Likewise, articles that specifically analyze the results of research in Indonesia on this theme are also still very limited. This article intends to fill that void.

2. METHODOLOGY

This research was conducted through content analysis from 22 research articles on measuring and developing critical thinking skills of high school and vocational high school students in Indonesia, which have been published in scientific journals from 2015 to 2020. According to Creswell, content analysis is a method that studies the contents of written text, artifacts, images, and recordings. This method can carefully analyze and interpret various published articles. Content analysis is able to connect data related to each other and analyze certain themes so that readers can read them efficiently, and can be used by researchers as a reference for further research [7].

Content analysis is carried out by following certain steps. According to Kohlbacher [8], content analysis refers to analyzing material through a step-by-step process. The steps that must be taken are as follows: firstly, formulate the material to be analyzed based on theoretical studies and research questions. Secondly, select the journal articles from various fields of study that discuss the profile and development of critical thinking skills of high school and vocational school students in Indonesia which were published from 2015 to 2020. Thirdly, analyze the main material that has been determined, including the level of students' critical thinking skills, strategies used by teachers in developing students' critical thinking skills in learning, as well as measuring students' critical thinking skills. The results of the analysis are interpreted using descriptive analysis, percentage, and frequency to interpret the findings and get the most frequent categories used in the development of critical thinking skills. Fourth, the data is analyzed and reported systematically. Furthermore, conclusions are drawn and suggestions are formulated for further research that can be carried out to contribute to the literature on the development of critical thinking skills.

3. RESULT & DISCUSSION

All of the 22 journal articles that have been chosen for analysis are research articles, including experimental research (7 articles), survey (2 articles), qualitative descriptive (6 articles), development research (3 articles), research and development (1 article), action research (2 articles), and mix method (1 article). From these articles, an analysis was carried out regarding the level of students' critical thinking skills, teachers' strategies in developing critical thinking skills, and measuring critical thinking skills.

3.1 Critical Thinking Skills Level for High School and Vocational High School Students

Nine of the 22 papers evaluated indicated study findings on the level of students critical thinking skills. The outcomes showed that the students' critical thinking abilities remained mediocre. The majority of students still meet the low/weak and sufficient requirements for critical thinking skills. The following table displays the findings of each study's assessment of critical thinking skills in chronological order based on the year of publication.

Table 1. Results of Measurement of Critical Thinking Skills

No.	Sources: Author (Year), Subjects	Research Result	Location
1	Utami, Saputro, Ashadi, Masykuri, & Widoretno, (2017) Chemistry [9]	Students' critical thinking skills are included in the sufficient category	Boyolali, Karang-anyar, Sukoharjo, Surakarta
2	Mahanal, Tendrita, Ramadhan, Ismirawati, & Zubaidah (2018) Biology [10]	Students' critical thinking skills show that 71% of students belong into the "invisible or underdeveloped" category, and 29% of students belong into the "starting to develop or developing well" category.	Malang
3	Utami, Probosari, Saputro, Ashadi, Masykuri, & Sutanto (2018) Chemistry [11]	Most students have weak or low critical thinking skills, especially in analysis, evaluation, explanation, and self-regulation, while their interpretation and inference skills are moderate.	Surakarta
4	Saputri, Sajidan, & Rinanto (2018) Biology [12]	Students' critical thinking skills are included in the sufficient category	Surakarta
5	Elisanti, E., Sajidan, & Prayitno, B.A. (2018) N/A [13]	Students' critical thinking skills are included in the low category	Kediri
6	Sukardi, Putra, & Dharmono (2019) Biology [14]	Students' critical thinking skills are categorized as very high on interpretation indicators. However, on analysis, evaluation and inference indicators are categorized as high.	Banjarmasin
7	Setianingih, Marianti, & Ngabekti (2019) Biology [15]	Students' critical thinking skills are included in the sufficient category	Ungaran, Bergas, Ambarawa
8	Adinda & Hamka (2019) Math [16]	Students' critical thinking skills in solving mathematical problems are low	Malang

9	Miterianifa, Ashadi, Saputro, & Suciati (2020)	High school students' critical thinking skills regarding the colloid concept are still low	Surakarta
	Chemistry [17]		

Of the 9 research results, 4 (44.44%) researches showed that students' critical thinking skills were in the low category, and 4 (44.44%) researches were included in the medium or sufficient category. Meanwhile there was 1 (11.11%) article which showed that students' critical thinking skills were in the high category. Based on some of these research results, it can be concluded that in general, students' critical thinking skills in Indonesia are still relatively low. However, these conclusions are still limited to a few subjects, namely mathematics, chemistry, and biology. One study, by Elisanti et al. (2018), did not explain the types of subjects in which critical thinking skills were measured, it only stated that the respondents to this study were 234 class XI students at a public high school in Kediri. The results of this study are in line with the results of a survey of professional human resources by The Conference Board (2006) which found that 70 percent of employees with high school education lack critical thinking skills [5].

Students' low critical thinking skills cannot be separated from the learning practices they experience at school. According to Redhana, critical thinking is a required ability in learning at every level of school. However, the development of critical thinking skills still receives less attention from teachers. Generally, in Indonesia, the learning practice in schools is still theoretical and learning strategies still tend to be teacher-centered. During the learning process, students are not actively involved, so they do not have the opportunity to construct their knowledge through experience and do not develop the potential for empowering critical thinking skills. Even though these skills have become part of students' way of thinking, students still need to repeatedly practice their thinking skills. Routine practices carried out by students will have an impact on the efficiency and automation of their thinking skills [6], [13]. Initial research by Mundilarto and Ismoyo [3] at high schools in Yogyakarta revealed a number of issues with physics instruction, including: 1) teachers still used traditional methods so they did not give students enough time to participate in learning, 2) students tend to be passive so they only follow what the teacher says, 3) teachers tend to rarely discuss issues related to the material to be taught, 4) the learning process rarely starts with realistic problems, 5) students are only able to use existing abilities only to solve problems posed by teachers and are less able to apply them in everyday life, 6) teachers also infrequently train students to think critically in solving problems, 7) teachers more often use the teacher centered approach than the student centered method. Some of these problems are still found in other subjects and also in other schools in various regions in Indonesia, which have an impact on the underdevelopment of students' critical thinking skills.

Critical thinking is a skill that must be developed, practiced, and integrated into the school curriculum so that students are involved in active learning [10]. Critical thinking skills are needed in a learning process that emphasizes student-centered learning. Teachers play an important role in developing

students' critical thinking skills. Therefore, teachers should pay attention to the learning methods that can empower students' critical thinking skills. It is important for teachers to design learning processes that can help improve students' critical thinking skills in the classroom. Teachers can also apply various strategies, techniques, and methods to facilitate students' critical thinking skills and active participation [10].

3.2 Learning Strategies for the Development of Critical Thinking Skills

13 of the 22 articles include research results on the creation and use of models or learning methodologies for the development of critical thinking skills. The learning techniques each researcher employed are listed here, organized by the year of publication.

Table 2. Learning Strategies for Developing Critical Thinking Skills

No.	Sources: Author (Year), Subjects	Strategies/Learning Method	Location
1	Firdaus, Kailani, Bakar, & Bakry (2015) Math [4]	Problem-Based Learning	Bone, Sulawesi Selatan
2	Widyatiningtyas, Kusumah, Sumarmo, & Sabandar (2015) Math [18]	Problem-Based Learning	Bandung
3	Listiani (2016) Math [19]	Problem-Based Learning Model Contextual	Kendari
4	Apsari (2016) English [5]	Infusion approach	Bandung
5	Nugrahaeni, Redhana, & Kartawan (2017) Chemistry [20]	Discovery Learning	Singaraja Bali
6	Setiawati & Corebima (2017) Biology [6]	PQ4R -TPS: Preview, Questions, Read, Reflect, Recite, Review - Think, Pair, Share	Pare-Pare
7	Mundilarto & Ismoyo (2017) Physics [3]	Problem-Based Learning	Yogyakarta
8	Boleng, Lumowa, & Palenewen, (2017)	Problem-Based Learning	Samarinda

	Biology [21]		
9	Agnah, Rusdi, & Herlanti, (2018)	Peta Argumen	Jakarta
	Biology [22]		
10	Suarniati, Hidayah, & Handarini (2018)	Problem-Based Learning	Malang
	The Nation's Philosophy and Citizenship Education [23]		
11	Samani, Sunwinarti, Putra, Rahmadian, & Rohman (2019)	Contextual Project Based Learning (CPjBL)	Mojokerto
	Automotive Technology [24]		
12	Nuri, Sajidan, Oetomo, Prasetyanti, & Parmin (2019)	Science Integrated Learning Model	Surakarta
	Biology [25]		
13	Alvionita, Prabowo, & Supardi (2020)	Problem-Based Learning - Science, Environment, Technology, and Society method (PBL-SETS method)	Gresik
	Physics [26]		

The results of the review showed that as many as 8 (61.54%) researchers used the Problem-Based Learning (PBL) strategy, and 5 (38.46%) researchers used other strategies, which are argument maps, PQ4R -TPS, Science Integrated Learning Model, Infusion approach, and Discovery Learning. Through quasi-experimental research, it is known that the application of PBL is more effective in improving students' critical thinking skills in biology, mathematics, and physics subjects, compared to other learning strategies, which are demonstrations, direct learning, and conventional learning [3], [4], [18], [19], [21]. Similar to the argument map strategy, the PQ4R-TPS strategy is more effective than the discussion, PQ4R, and TPS methods for developing students' critical thinking skills in biology courses [22], [6].

In her development research, Suarniati et al. (2018) chose to develop a PBL strategy which was considered the right strategy for developing critical thinking skills for vocational high school students. Meanwhile, Samani et al. (2019) developed CPjBL to improve critical thinking skills in learning automotive technology. Alvionita et al. (2020) also developed PBL-SETS to develop students' critical thinking skills in learning physics. The results of implementing CPjBL and PBL-SETS can improve students' critical thinking skills.

Through classroom action research conducted by Nuri et al. [25] by applying the Science Integrated Learning Model in biology learning, and Nugrahaeni et al. [20] by applying Discovery Learning in

chemistry learning, showed that the two learning strategies can improve students' critical thinking skills. While Apsari [5] applied an infusion approach to improve critical thinking skills in learning English.

These different investigations have led to the conclusion that students' critical thinking abilities can be improved by applying a variety of engaging learning methods. Thinking skills are not inherent and do not belong to students by nature. The development of critical thinking skills requires supervised practice. These abilities will not be very useful if students have not mastered the understanding and application of them in their critical thinking study. Robbins states that critical thinking skills are skills that can be learned, so that these skills can be taught [6].

According to Rosnawati [6], students' critical thinking skills can be trained through problem solving in the form of various questions. Therefore, PBL has been chosen as a learning strategy to improve critical thinking skills. Ibrahim and Nur recommended PBL as a learning strategy that is used to stimulate students' high-order thinking in conditions that lead to real problems, including thinking about how to learn. In detail, the purpose of PBL is to guide students develop their thinking skills and problem-solving skills, to help them learn the various roles of adults through their involvement in real experiences and to support students become independent students. Meanwhile, Moffit also stated that PBL is a learning strategy that utilizes real problems as a context for students to practice critical thinking and problem-solving skills [18].

PBL is an ideal learning model to meet the goals of 21st century education, because it involves the 4C principles of critical thinking, communication, collaboration and creativity (critical thinking, communication, collaboration and creativity). In order for problem-based learning to work well, the teacher must design an activity plan that suits the interests and needs of students, and of course it is adapted to the curriculum [27].

3.3 Measurement of Students' Critical Thinking Skills

All reviewed articles mention the instruments used to measure students' critical thinking skills. The following is a list of instruments that researchers use to evaluate students' capacity for critical thinking in different types of research they conduct. The year of publishing determines the order of placement.

Table 3. The Measuring Instruments of Critical Thinking Skills

No.	Sources: Author (Year)	Types of Research	Measuring Instruments
1	Firdaus, Kailani, Bakar, & Bakry (2015) [4]	Quasi Experiment (one group pre-test- post-test)	The assessment test of critical thinking skills in solving non-routine mathematical problems includes three parts: identification and interpretation of information, analysis of

			information, and evaluation of evidence and arguments.
2	Widyatiningtyas, Kusumah, Sumarmo, & Sabandar (2015) [18]	Quasi Experiment (control group design)	Mathematical critical thinking skills test
3	Listiani (2016) [19]	Experiment (pre-test-post-test control group design)	Critical thinking ability test
4	Apsari (2016) [5]	Descriptive- qualitative (case study)	<p>Observation and interview.</p> <p>The instrument for observation was adapted from research by Thomas (1999) which was a replication of the Commission on Teacher Credentialing Study conducted by Paul, Elder, and Bartell (2007)</p> <p>The instrument for the interview was adapted from the study of Thomas (1999) which was used in his research at the secondary school level.</p>
5	Utami, Saputro, Ashadi, Masykuri, & Widoretno (2017) [9]	Descriptive method	Ten multiple-choice questions make up the test, which was created based on signs of critical thinking abilities. Each answer or choice gets a different score, ranging from one to four.
6	Nugrahaeni, Redhana, & Kartawan (2017) [20]	Classroom Action Research (CAR)	Observation sheet
7	Setiawati & Corebima (2017) [6]	Quasi Experiment	The cognitive learning test was in the form of an essay test consisting of 15 items which was developed by the researcher, using the cognitive learning outcomes rubric adapted from Hart (1994) which consists of 5 scales (0-5).
8	Mundilarto & Ismoyo (2017) [3]	Quasi Experiment (pre-test- post-test control group design)	Four questions essay test
9	Boleng, Lumowa, & Palenewen (2017) [21]	Quasi Experiment (non-equivalent pretest-posttest control group design)	Test with critical thinking skills rubric developed with reference to Hart (1994)

10	Mahanal, Tendrita, Ramadhan, Ismirawati, & Zubaidah, (2018) [10]	Survey	The essay test developed is based on the five items suggested by Finken & Ennis (1993).
11	Utami, Probosari, Saputro, Ashadi, Masykuri, & Sutanto (2018) [11]	Descriptive - Qualitative Method	Essay tests and questionnaires regarding everyday chemistry problems were developed based on Facione's critical thinking aspects, such as interpretation, analysis, evaluation, conclusion, explanation, and self-regulation.
12	Saputri, Sajidan, & Rinanto (2018) [12]	Descriptive	A test developed based on the core aspects of critical thinking skills according to Facione which includes interpretation, analysis, evaluation, explanation, conclusion, and self-regulation
13	Elisanti, Sajidan, & Prayitno (2018) [13]	Descriptive - Qualitative	Essay-based test. Items based on indications of critical thinking ability include features of interpretation, analysis, evaluation, inference, justification, and self-regulation, according to Facione (2011).
14	Agnah, Rusdi, & Herlanti, (2018) [22]	Quasi Experiment (Static Group Pretest-Posttest Design)	14 questions on the essay test using the Illinois Critical Thinking Essay Test which first passed validity and reliability tests.
15	Suarniati, Hidayah, & Handarini (2018) [23]	Development research	A critical thinking test based on the Watson-Glaser Critical Thinking Appraisal (WGCTA) with five dimensions: inference, recognition assumptions, deduction, interpretation and evaluation of arguments
16	Sukardi, Putra, & Dharmono (2019) [14]	Development research (Tessmer Model)	Students' answer sheet
17	Setianingih, Marianti, & Ngabekti (2019) [15]	Survey (quantitative descriptive)	Observation sheets, critical thinking skills tests, and critical thinking skills questionnaires
18	Adinda & Hamka (2019) [16]	Qualitative approach with descriptive method	Tests for critical thinking skills in aspects of strategy and tactics as well as interview guidelines

19	Samani, Sunwinarti, Putra, Rahmadian, & Rohman (2019) [24]	Development research Effectiveness test using experiments (pre-test-post-test control group design)	Observation sheets that have been validated and tested with inter-rater reliability by experts
20	Nuri, Sajidan, Oetomo, Prasetyanti, & Parmin (2019) [25]	Classroom Action Research (CAR)	Qualitative data in the form of information obtained through observation, interviews and documentation. Quantitative data which were obtained through cognitive tests which refer to six aspects of critical thinking according to Facione (2015), namely interpretation, analysis, evaluation, conclusions, explanations, and self-regulation, in the form of descriptions and multiple-choice tests with a maximum score of 7 on each indicator (adaptation from Facione).
21	Miterianifa, Ashadi, Saputro, & Suciati (2020) [17]	Mixed-method using explanatory sequential design (quantitative followed by qualitative)	Quantitative research using essay tests, and qualitative research analyzing students' critical thinking skills through student answer sheets.
22	Alvionita, Prabowo, & Supardi, (2020) [26]	Research & Development (R&D)	Critical thinking skills test

Based on Table 3, it can be concluded that many methods and instruments are used to test critical thinking abilities. 13 researchers (59.09%) said that they only applied test-related instruments; 5 researchers (22.73%) combined test-related and non-related instruments (interview instructions, questionnaires, observation sheets, documentation, and analysis of student answers); and 4 researchers (18.18%) used student worksheets, observation sheets, and interview guides.

Half of the 18 researchers (50%) who used the test questions in essay and multiple-choice formats explained that the tests used for evaluating students' critical thinking abilities made reference to aspects or rubrics for measuring these skills that had been developed by experts, including Facione, Hart, Finken, and Ennis, as well as the Watson-Glaser Critical Thinking Appraisal (WGCTA) and the Illinois Critical Thinking Essay Test. In contrast, the other 9 (50%) of the other researchers neglected to discuss the test source that was used to evaluate students' critical thinking skills.

Measuring students' critical thinking skills is an important thing to do, with the aim of knowing the level of students' critical thinking skills and to determine the success of developing these skills. Therefore, Ennis suggested that the measurement of critical thinking skills should be developed.

According to Ennis, there are two types of tests that are used to evaluate an individual's ability for critical thinking: 1) specific critical thinking tests, measuring only one topic or subject, and 2) general critical thinking tests (for all topics), using content from various fields or general nature [28].

In terms of form, tests that measure critical thinking abilities may take the shape of multiple-choice questions or essays. Ennis recommends an open ended tests to measure critical thinking skills rather than multiple choice tests. The open ended test is considered more comprehensive than the multiple choice test. According to Ennis, several forms of tests for measuring critical thinking skills with an open ended format are: 1) multiple choice tests with written explanations; 2) critical thinking essay test; and 3) performance test (performance assessment). Essay tests are chosen by many educational experts because these tests have the potential to measure students' abilities in expressing reasons, compiling, analyzing, synthesizing, and evaluating. Essay tests also have several advantages, including: 1) they can be used to assess higher-order thinking skills or critical thinking skills, 2) they can evaluate students' thinking and reasoning processes, and 3) they provide authentic experiences. According to Reiner et al., essay tests are an effective way to assess learning outcomes that are complex and cannot be measured by other forms of tests. Some complex thought processes can only be measured through essay tests [28].

4. CONCLUSIONS & RECOMMENDATIONS

Based on the findings of a review and analysis of 22 research articles on measuring and developing critical thinking skills in Indonesian high school and vocational school students, it can be pointed out that: 1) the level of students' critical thinking skills is still relatively low; 2) problem-based learning is the most popular and successful instructional strategy for developing students' critical thinking skills in the classroom; and 3) assessments (essays and multiple-choice questions) are typically used to measure (assess) students' thinking skills. Yet, some have pointed to elements or rubrics for testing critical thinking abilities that have been created by experts.

The development of critical thinking skills in Indonesia has actually been implemented in Kurikulum 2013 (Curriculum 2013). Based on the study's findings, it is important to reevaluate whether teachers prioritize student-oriented learning so that they can engage in active learning and develop their critical thinking skills. The majority of the articles under review were from studies done on MIPA (mathematics and natural sciences like biology, chemistry, and physics) subjects, and only 2 studies were conducted on non-MIPA subjects, which are on English and Pancasila dan Pendidikan Kewarganegaraan (Nation's Philosophy and Citizenship Education) subjects. Judging from the research area, 16 studies (72.73%) were conducted on the island of Java, and 6 studies (27.27%) were conducted outside Java. Therefore, it is suggested for future researchers to conduct research on the measurement and development of critical thinking skills of high school students, especially in subjects included in the social sciences group, and/or research in other cities outside Java.

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