The development of self-perception instrument of students’ critical thinking skills

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Abstract. Critical thinking skill is one of important skills in the 21st century. With critical thinking skills, people can observe a phenomenon from different perspectives. Therefore, it will lead individuals to think more critically in responding to information received. This study aimed to product self-perception instrument of students’ critical thinking skill that valid and reliable. This research used a modification from 6 steps of research by Borg and Gall. The credibility of instrument is observed from its validity, reliability, exploratory factor analysis, and validation result by the experts. To examine validity and reliability of this instrument, researchers adopted SPSS 23. Results showed that there were 13 items in self-perception instrument of critical thinking skills with a valid and reliable category. Exploratory factor analysis test results show that the 13 items that have been developed form 3 critical thinking skills factors, namely analysis, evaluation, and synthesis. In addition, results showed that the self-perception instrument of critical thinking skills which has been implicated is in the category of “very good” and it is highly valid to measure the levels of self-perception of critical thinking skills. For example in natural science learning activities.

Keywords: Self-perception, Critical thinking skills, validity, reliability

1. Introduction

Critical thinking skills is one of the aspects that play an important role in someone’s life and education field [1], in order to solve the problems [2], be able to contribute as a part of society [3], and take a decision [4]. In the learning activities, critical thinking supports individuals to select relevant and useful information, evaluate the information received, and make better a decision [5]. Critical thinking skill protects individual from claims and thoughts not verified [6]. Therefore, the environment of education must pay attention on how to improve students’ critical thinking skills [7]. As in natural science learning activities. Natural science learning should improve critical thinking skills in students.

To stimulate and develop critical thinking skills, it can be done through education processes and activities by improving social interaction of students in the learning process and including leaning experience in the curriculum. Besides, it is to encourage the learning participants to have practical experience in critical thinking skills [8]. Moreover, to develop critical thinking skills, it can be also done in other ways, such as by using questions in class, using learning based on problems, using concept mapping, and applying cooperative learning [9].

Various experts have conducted research related to critical thinking skills, including research related to critical thinking skills that focuses on aspects of improving critical thinking skills through the use of media and learning models, for example research that has been conducted by (Ismail, Harun, Zakaria, and Salleh, 2018) [10]. Assessment of critical thinking skills in students, for example research that has
been conducted by (Castle, 2006) [11]. Factors related to critical thinking skills, for example research conducted by (Mahapoonyanont, 2010) [1]. Research related to the design and application of tests to measure critical thinking skills, for example research that has been conducted by (Gelerstein, Río, Nussbaum, Chiuminatto, and López, 2016) [12]. Related research shows that critical thinking skills are of paramount importance. So that research activities must be increased, especially in developing instruments.

The observation was conducted toward students of Elementary School Teacher Education Study Program At Yogyakarta State University during learning activities. The result of the observation showed that critical thinking skills of the students seem variant. In learning activities, some students could perform critical thinking skills well. However, others have low critical thinking skills. The results of observation also pointed out that students are not active in expressing an opinion critically in the learning process.

Therefore, an instrument of critical thinking skill is really necessary for the lecturers in order to identify the level of students’ critical thinking skills. By understanding the level of critical thinking skills, it will be easier for the lecturers to increase critical thinking skills to the students. One of the instruments that can be used to measure critical thinking skills is through the self-perception instrument of critical thinking. Self-perception is a self-assessment of the learning outcomes that have been obtained [24]. Self-perception relies on personal behavior as a basis for inferring their own attitudes [25].

Thus, in this research, researchers are interested to develop an instrument to measure students’ self-perception of critical thinking skills. The purpose of this study was to develop self-perception instruments and measure self-perception of students’ critical thinking skills. Researchers hope that educators can use the results of this study to measure the level of self-perception of students’ critical thinking skills.

2. Methods

2.1 Research Model

This research uses a research and development approach. Researchers use the research and development (RandD) type which aims to produce an self-perception instrument of students’ critical thinking skills. The researchers conduct research and development by using 6 steps of research and development which are the results of the development model by Borg and Gall [13].

2.2 Participant

Participants in this research are 140 students of elementary school teacher education study program at Yogyakarta State University in Indonesia. Students were divided into 2 groups, specifically 8 students in the preliminary field testing and 132 participants in the main field testing. This research also involved 1 expert of language and 1 expert of learning evaluation to validate the instrument.

2.3 Data Analysis

Data analysis in this research is separated into 3 steps, which are analysis data of product validation results by the expert, analysis data of product trial results in the preliminary field testing, and data analysis of product trial results of in the main field testing.

2.3.1 Product analysis of validation result by the expert

Self-perception instruments that have been developed, then validated by linguists and learning evaluation experts. The results of the instrument validation by the experts were analyzed to determine the feasibility of the instrument. The interpretation of assessment data by the experts to observe the credibility that has been developed is adopted from Widoyoko [14].

2.3.2 Data analysis of product trial result on preliminary field testing

Self-perception instruments of critical thinking skills that have been developed, then trial run on preliminary field testing. The aim of this product trial run on a preliminary field testing is to observe the
validity and reliability of the instrument. In this research, validity and reliability testing of self-perception Instrument uses SPSS 23.

2.3.3 Exploratory factor analysis
Exploratory factor analysis was carried out using several stages, including the test stage of Kaisyer Meisyer Olkin (KMO) Measure of Sampling Adequacy and Barlett Test of sphericity, the Anti-image Matrices test stage, the Communalities test stage, the Total Variance Explained test, and the Rotated Component test Matrix. In this study, Exploratory factor analysis was carried out using SPSS 23 App.

2.3.4 Data analysis of product trial result on the main field testing
Self-perception data about critical thinking skills is seen from the scores / grades obtained by students, then the percentage is calculated to measure the level of self-perception of critical thinking skills. The final score gained by students is as mentioned below.

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\text{Student score} = \frac{\text{Total number gained}}{\text{Maximum score}} \times 100\% 
\]

Self-perception data of students' critical thinking skills were analyzed to determine the category of the level of self-perception of critical thinking skills. The level category of self-perception of critical thinking skills determined as on the table 1 below, the following category adopted from Darmawati [15].

| Student score | Levels of critical thinking skills |
|---------------|-----------------------------------|
| 80 < score ≤ 100 | Excellent                         |
| 60 < score ≤ 80  | Good                              |
| 40 < score ≤ 60  | Fair                              |
| 20 < score ≤ 40  | Poor                              |
| 0 < score ≤ 20   | Very Poor                         |

2.4 Procedure
The procedure used in this study is an adaptation of Borg and Gall's research and development steps [13]. This research uses 6 steps of research, namely, the first step is preliminary study as well as collecting data, including literature study and create the research framework. The second step is planning, including formulating the purpose of research and planning procedure of the research framework. The third step is developing the first product of the self-perception instrument of students’ critical thinking skills. The fourth step is the credibility test of the product that consists of the product validation test by the experts and product trial on preliminary field testing. Product validation test run to identify the assessment of the product by the experts. Meanwhile, the product trial on the preliminary field testing that is testing the product in the area and subject limited. Product trial on the preliminary field testing run to identify the validity and reliability of the product of self-perception instrument of critical thinking skills. The fifth step is revising the product based on the results of the research. The sixth step is product trial on the main field testing. Product trial of self-perception instrument on the main field run at Yogyakarta State University. Participants are 132 students of elementary school teacher education program. The diagram of stages of research procedures is presented in figure 1.
3. Result and Discussion

Product of self-perception instrument of critical thinking skills has been completed to develop. The following is a description of the results of the research that has been done.

3.1 Result of the first-product development

The product developed in this research is the self-perception instrument of critical thinking skills. Self-perception instrument of critical thinking skills is developed based on 3 aspects of critical thinking skills according to Cargas, et al [16]; Pieterse, et al [17]; Crain, et al [18] including analysis aspect, evaluation, and synthesis. Here are the results of developing the first-product of critical thinking skills.

The results of first-product development of instrument, can be found that in developing the first product, the researchers use 20 items of self-perception, in details, 6 items toward aspect “analysis”, 5 items toward aspect “evaluation”, and 9 items toward aspect “synthesis”.

3.2 Analysis result of validation instrument by the expert

Based on the result of the product validation test by the experts identified that the product has a total score of 23.5 of the maximum score, 25. The average product validation test results by experts obtained a value of 4.7 from a scale of 5. As a result, it can be concluded that the product of self-perception instrument that has been developed is a “very good” category.

3.3 Analysis result of product trial on a preliminary field testing

The purpose of testing the product on a preliminary field testing is to determine the validity and reliability of the instrument. Based on product trial on a preliminary field testing, then the result of the validity and reliability of the instrument is found as follows.

3.3.1 Analysis result of validity and reliability test

The type of validity test used in this study is the Pearson product moment. Based on the result of the validity test which has been run, then identified that of 20 items in the instrument trial, it can be obtained 13 items are “valid” categories. Then the remaining 7 other items in the instrument is “invalid” categories. In the instrument item with “valid” category on number 3, 4, 6, 7, 8, 9, 12, 14, 15, 16, 17, 18 and 19. Then 7 items of instrument with “invalid” category are on number 1, 2, 5, 10, 11, 13, and 20. The total of items in instrument with a “valid” category has represented all outline aspects of critical thinking skills instrument. Then, based on the results of the reliability test that has been done, the instrument reliability value is 0.966. Therefore, it can be concluded that self-perception instrument in
this research is “reliable” category.

3.4 Exploratory Factor Analysis Test Results
Exploratory factor analysis test is conducted on 13 questions that have been proven valid and reliable. Based on the results of the exploratory factor analysis test on the critical thinking skills questionnaire instrument, values were obtained Kaisyer-Meisyer-Olkin (KMO) Measure of Sampling Adequacy amounted to 0.889. Whereas at Bartlett's Test of Sphericity a significance value of 0.000 was obtained. After testing KMO and Bartlett's Test, then the next step is Anti-image Matrices test. Anti-image Matrices test results obtained the value of Measure of Sampling Adequacy (MSA) on each question item with a greater value (> 0.8).

Next is the Communalities test with the Principal Component Analysis method, the test shows that all questions have an Extraction value of more than (> 0.5). Then the results of the Total Variance Explained test obtained 3 factors. Based on the table rotated component matrix, it can be seen that all questions form 3 factors, namely: first factor is synthesis consisting of 5 questions, second factor is evaluation consisting of 5 questions, and third factor is analysis consisting of 3 questions.

3.5 Product Revision
The self-perception instrument was revised based on the results of product trials on a preliminary field testing. The results of the preliminary field testing trial showed that there were 7 invalid items. So that 7 items were removed from the instrument. So, the final result of this product revision is an instrument consisting of 13 items with valid and reliable categories.

3.6 Result of last-product development
Table 2 shows the last result of developing the product in the form of critical thinking skills questionnaire instrument.

| Table 2. Last-Result Development the Product of Self-perception Instrument of Students’ Critical Thinking Skills |
|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|
| Aspect | Question | 1 Strongly agree | 2 Agree | 3 Neutral | 4 Disagree | 5 Strongly disagree |
|--------|----------|-------------------|----------|-----------|------------|-------------------|
| Analysis | 1. I can make a recommendation about daily life’s problems happened. | | | | | |
| | 2. I can compare the similarity and difference of many varieties of information sources I obtain. | | | | | |
| | 3. I can assess information from many various of resources. | | | | | |
| | 4. I can use the ability of critical thinking to evaluate many various of issues in daily life. | | | | | |
| | 5. I can adapt to many existing and new issues. | | | | | |
| | 6. I can compare problems in many kinds of perspectives and evaluate its truth. | | | | | |
| | 7. I can understand how opinion is incorrect. | | | | | |
| | 8. I can accomplish many varieties of opinion/ information resources contradicting. | | | | | |
| Evaluation | 9. I can formulate my opinion from many varieties of resources. | | | | | |
| | 10. I can defend my opinion with various supporting strong evidence | | | | | |
| Synthesis | | | | | | |

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Table 2 above depicts the last result of developing the product in the form of self-perception instrument of students’ critical thinking skills. The self-perception instrument above has passed the validity and reliability test as well as the validation test by the experts. Consequently, self-perception instrument above is a “valid” and “reliable” category. The self-perception instrument above consists of 13 question items. Aspects of self-perception instrument through analysis, evaluation, and synthesis. On the aspect of “analysis” represented by 3 questions, aspect “evaluation” represented by 5 questions, and aspect “synthesis represented by 5 questions. The self-perception instrument uses Likert scale 1-5.

3. 7 Data analysis result of product trial on main field testing
Product trial of self-perception instrument on the main field run at Yogyakarta State University. Participants are 132 students of elementary school teacher education study program. Based on the results of product trial on main field testing, figure 2 shows the results obtained.

![Graph 1. Percentage of self-perception Levels of Students' Critical Thinking Skills](image)

**Figure 2.** Percentage of self-perception of critical thinking skills

Based on figure 2, it can be seen that of 132 students that have taken part in test self-perception of critical thinking skills on the main field, 15 students (11%) think they have self-perception of critical thinking skills with “excellent” category.” There are 95 students (72%) who have self-perception of critical thinking skills with “good” category, 21 students (16%) have self-perception of critical thinking skills with “fair” category, and 1 student (1%) has self-perception of critical thinking skills with “poor” category. In addition, it also shows that the critical thinking skills of students has been improved. This is showed by the fact that only a small number of students who have the capability self-perception to think critically with a “excellent” category. To improve students’ skills to think critically, it can be through ways, for instance, requesting students to make the review, making the summary, and running the presentation program. Through that program, they learn to be more objective and sensitive; they also develop their desire and ability to elaborate on their ideas [19]. Moreover, to improve their skills to think critically, the student can use teaching based on the problems [20]. Teaching based on problem functions to reactivate the knowledge that has been previously owned by students [21]. Teaching by implementing
the approach of Problem Based Learning (PBL) empowers student’s ability to think critically [22]. Stages of the problem based learning model makes students think critical [23].

By reviewing the previous studies, critical thinking skill is one of the aspects that must be owned by someone in the learning of 21st century. In addition to critical thinking skills, there are still many other skills that must be owned by students in the 21st century learning such as the ability to solve problems. Therefore, other researchers can develop instruments to measure critical thinking skills in students. Developing an instrument to measure the level of critical thinking skills is very important. This is because it will facilitate educator/lecture to identify how high the level of critical thinking skills each student has.

4. Conclusions
Based on the results, it can be concluded that this study develops and produces a self-perception instrument of critical thinking skills. This instrument can be used to measure the perception of critical thinking skills in students, for example in natural science learning activities. The number of items in this instrument consists of 13 items with a Likert scale of 1-5. The results of the product validation by the experts show that the product of self-perception instrument has a “very good” category. It means that the product developed is highly feasible to use to measure levels of self-perception of critical thinking skills. Then, the results of limited-scale product trials show that the product of the self-perception instrument of critical thinking skills has good validity and reliability. Meanwhile, based on the results of the exploration factor analysis test, it was found that 13 items formed 3 factors. These factors are analysis consisting of 3 items, evaluation consisting of 5 items, and synthesis consisting of 5 items. Then, the results of product trials in the main field showed that of the 132 students who had taken the self-perception test of critical thinking skills, 15 students (11%) have self perception of critical thinking skills with “excellent” category, 95 students (72%) have self-perception of critical thinking skills with “good” category, 21 students (16%) have self-perception of critical thinking skills with “fair” category, and 1 student (1%) has self-perception of critical thinking skills with “poor” category. Based on this result, it is important to help students develop their positive perceptions on their critical thinking skills by actually train them to use critical thinking on their daily tasks and use learning approaches that promote critical thinking skills.

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