

# The Analysis of Critical Thinking Ability Differences between Cognitive Field Independent and Cognitive Field Dependent Students on the Topic of Atmosphere Dynamics for Grade X Students

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**Abstract**— *This study aims to analyze differences in field independent and field dependent students on their critical skill in Atmosphere Dynamics topic for grade X students at senior high school. The design of this study is quantitative research by using data instrument in the form of basic geography ability test, GEFT test, and critical thinking skill test. Data are analyzed by using T-Test. The results showed that the average score of field-independent students on their critical thinking ability is 78.71, better than field-dependent students which is 68.12.*

**Keywords**—*Field Independent, Field Dependent, Critical Thinking*

## I. INTRODUCTION

The development of science and technology in education changed and remained dynamics very quickly. This made the role of teachers important in the learning activity in the classroom. due to increasingly complex challenges, learning today should also be at the stage of developing higher order thinking skills (higher order thinking skills). The 2013 curriculum emphasized the aspects of learning based on critical thinking, analytical, evaluative and decision-making skills. According to the ministry of national education and culture regulation Number 65 Year 2013, learning process in education should be interactive, inspiration, fun, challenging, motivate learners to participate actively, and able to give enough space for the initiative, creativity, and independence according to students' talent, interest, and physical and psychological development.

Thus, the whole learning process established a personal quality that reflected whole mastery of attitudes, knowledge, and skills. Knowledge was owned through activities of knowing, understanding, applying, analyzing, evaluating, and creating. The characteristic of learning

activities in this knowledge domain had differences and similarities to learning activities to the skill domain. Education was functioned to build a better life of the present and the future of the past with various intellectual abilities, communication skills, social attitudes, concerns, and participation to build better society and society (experimentalism and social reconstructivism).

Furthermore, it was recommended to implement discovery or inquiry learning to strengthen the scientific, thematic, integrated and thematic approach. Project-based learning was recommended to encourage learners to produce creative and contextual work, both individually and in groups. The concepts of learning in the 2013 curriculum were actually aimed to improve the ability to think critically. Paul and Elder (in Shaarawy, 2014) defined critical thinking as "the art of analyzing and evaluating thought with a view to improving it." In some definitions of critical thinking, critical thinking means thinking with logical thinking [1].

A preliminary study was conducted by writers at SMAN 4 Sidoarjo on the analysis of material difficulty in geography subjects, especially on Atmosphere Dynamics. Students were difficult to analyze atmospheric phenomena or conduct measurements related to temperature and altitude differences. the learning difficulties were considered by some teachers because the background of students was from social science class who tended not to think high level especially critical thinking. According to Duron, implementing critical learning did not require commitment and hard work to be active, because at first it might not be convenient for students and teachers [2]. Thus, it was necessary to conduct scientific research related to the cognitive style of students in social science class which tended to have field independent or field dependent. Cognitive style described a relatively stagnant habit of thinking within a person in receiving, thinking, solving problems and storing information. The position of cognitive

style in the learning process was very important and need the attention of teachers. In addition to other student characteristics such as motivation, attitude, talent, interest, thinking ability and others. According to Woolfolk, the implementation of cognitive style in learning was crucial to the learning success [3]. After writers knew the students' cognitive style in tenth of social science class, then they measured differences of students' critical thinking skill between Field Independent students and Field Dependent students through Critical Thinking Skills test on Atmosphere Dynamics material. Critical thinking had several elements such as focusing on issues, analyzing discussions, asking clear and challenging questions and answering questions, questioning the validity of information sources, assessing data accuracy and reaching conclusions, evaluating predictions and communicating with others [4]. The development of learning and teaching depended on the development of critical thinking skills of teachers and students. today's, the characteristics emphasized by teachers did no get higher scores than standardized tests. The more important things for students were to have skills such as mathematical thinking, finding scientific solutions to problems, reasoning based on historical and geographic information, seeing things from an aesthetic point of view, reading critically, writing effectively, and conducting understandable dialogue. Based on the background, this study was aimed to determine the differences in critical thinking skills of FI and FD students in learning Atmosphere Dynamics material in the tenth class of senior high school.

**II. RESEARCH METHODS**

This study aimed to determine differences in higher order thinking skills of the independent and field dependent students in Atmosphere Dynamics learning in tenth class at SMAN 4 Sidoarjo. This study used the quantitative method. Subjects were students of tenth class at SMAN 4 Sidoarjo on Atmosphere Dynamics materials categorized as difficult. The criteria for determining the subjects were students with medium cognitive skills consisting of 2 groups, consisting of 1 (one) field dependent group and 1 (one) field independent group.

The Criteria used to select subjects were as follows:

a) giving the test of geography ability especially on Atmosphere Dynamics material. Students whose score was 60-80 would be the subject of this study, meaning that students were in moderate cognitive ability category, b) then GEFT test was given to divide the cognitive style of the students into 2 groups consisting of field dependent and field independent, c ) the two groups of dependent fields and field independent were tested to measure critical thinking skill validated by expert. If the previous questionnaire test (geographic ability test) was not obtained the expected criteria, then to determine subjects (students with moderate skill) based on geography teacher in school or based on the previous test scores [5].

Data were collected using: a). Geographic Ability Test. This test was used to explore students with medium ability, given prior to determining the subject. b). GEFT Test to determine the subject with field Independent and

dependent category. The GEFT instrument used a question developed by Witkin, Oltman, and Karp [6]. This test was a perceptual psychological test in which the student's task was to find a simple image that was seen earlier in a complex or even more complex image arranged to blur the simple image. The test consisted of 3 parts: the first part with 7 items as an exercise, the second and third parts with 9 items for each test. The total score was determined by the subject's ability to correctly answer the image in the second and third sections of the test. the range between 0-18, with grouping score 0-9 was field dependent group and 10-18 was field independent group. c). Critical Thinking Tests. The question was not tested statistically because principally the test used to measure knowledge, so expert validator was more suitable than test validity and test reliability statistically.

The research flow was explained and described in the following Stages at the diagram below.

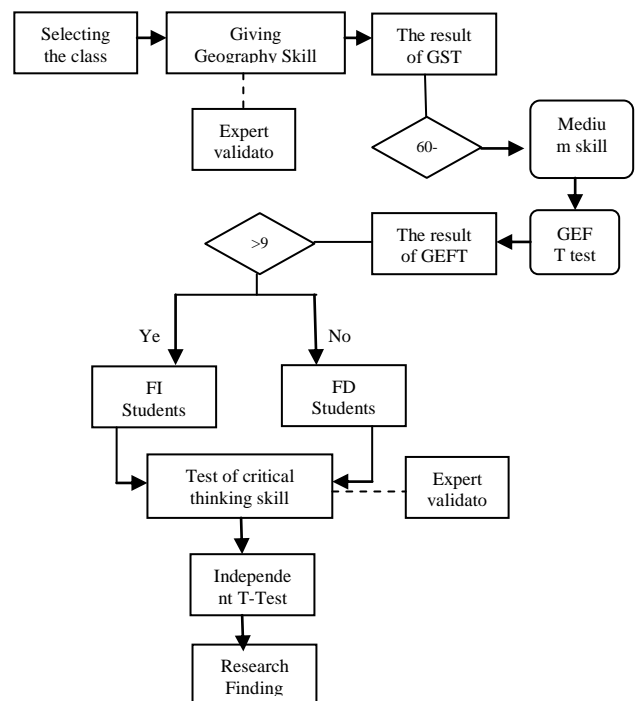


Figure 1 Diagram of the Research Flow

Data were analyzed using parametric inferential statistic with Independent T-Test. The independent T-test was performed with the following steps.

- a. Ho = there is no difference of students' average score in critical thinking skill between FI and FD groups
- b. H1 = there is a difference in students' average score in critical thinking skill among FI and FD groups
- c. Testing Equipment: Independent T-Test
- d. Significance Level of 5%
- e. Decision Rules:

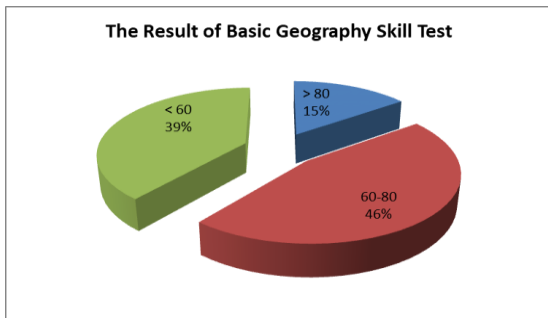
If Sig Observed > 0.05 then H0 is accepted

If Sig Observed < 0.05 then H1 is accepted

**III. RESULTS AND DISCUSSION**

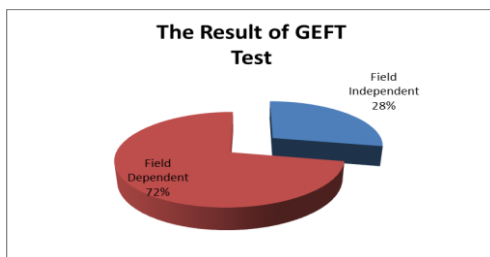
The results showed that:

The result of the test on basic geography skills showed that there were 74 students of 160 students who got between 60-80 categorized as moderate skill or 46.25%. it can be seen in the following figure!



**Figure 2 Basic Geography skill**

The results of GEFT test showed that 74 students with moderate skill, consisting of 21 students or 28,38% who had Field Independent (FI) Cognitive style and 53 students or 71,62% with Field Dependent cognitive style (FD). No student was neutral in cognitive distribution in this study. Here is a figure of cognitive distribution based on GEFT test.



**Figure 3 Distribution of Cognitive Styles**

The results of the Critical Thinking skill Test showed that difference between Field Independent and Field Dependent students can generally be found in the following table 3.1.

**Table 1 Mean Difference of FI and FD Students' Critical Thinking Skills**

| Students Group | N  | Mean    | Std. Deviation | Std. Error Mean |
|----------------|----|---------|----------------|-----------------|
| Group FI       | 21 | 78.7143 | 3.00238        | .65517          |
| Group FD       | 53 | 68.1698 | 11.15233       | 1.53189         |

From the above statistical test results, it was known that Sig observed  $0.000 < 0.05$  meaning  $H_A$  was accepted. It indicated that there was a difference of mean score in critical thinking ability between Independent Field (FI) and Field Dependent (FD) students. The mean score of the FI group was 78.71 higher than FD group of 68.12.

The following table described critical thinking skills between Field Independent and Field Dependent students in tenth grade of social science class.

**Table 2 The ability to clarify Question**

| Group             | Pre test | Post test | Gain Score | N-Gain |
|-------------------|----------|-----------|------------|--------|
| Field Independent | 7.1      | 8.93      | 1.83       | 0.27   |
| Field Dependent   | 6.2      | 7.28      | 1.08       | 0.23   |

Based on the above table, the mean score of the ability to clarify questions between FI students was 0.27 greater than FD students of 0.23. but, both groups of students had a change in their ability to clarify questions.

**Table 3 The ability to assess source**

| Group             | Pre test | Post test | Gain Score | N-Gain |
|-------------------|----------|-----------|------------|--------|
| Field Independent | 7.4      | 8.73      | 1.33       | 0.21   |
| Field Dependent   | 6.8      | 8.15      | 1.35       | 0.25   |

Based on the above table, the ability to assess the source credibility showed that FD students were 0.25 greater than FI students of 0.21. but in post-test, the capabilities of FI students was still superior to FD students.

**Table 4 The ability to define terms**

| Group             | Pre test | Post test | Gain Score | N-Gain |
|-------------------|----------|-----------|------------|--------|
| Field Independent | 7.1      | 9.3       | 2.2        | 0.31   |
| Field Dependent   | 6.5      | 8.1       | 1.6        | 0.29   |

Based on results, the mean score of the ability to define terms for FI students was 0.31 greater than FD students of 0.29. Similarly, in post-test FI students were still superior to FD students. However, both students showed positive changes or increased learning outcomes.

In general, the FI students' critical thinking skills in this study showed better results compared with FD students. According to [6] someone with field-dependent cognitive style are people who think globally, receive structure or update existing ones, have a social orientation, choose a profession that is both social skills, tend to follow the objectives and the information that already exists, and tend to promote motivation external, while people who have an independent field cognitive style had characteristics of being able to analyze objects separated from their environment, capable of organizing objects, having an impersonal orientation, choosing a profession that is individual, and prioritizing motivation from within oneself.

Critical thinking skill had several elements like focusing on issues, analyzing discussions, asking clear and challenging questions and answering questions, questioning the validity of information sources, assessing the accuracy of data and reaching conclusions, evaluating predictions and communicating with others. The development of learning and teaching depended on developing the critical thinking skills of teachers and students. Today's, the characteristics emphasized by teachers do not get higher scores than standardized tests. The more important things for students were to have skills such as mathematical thinking, finding scientific solutions to problems, reasoning based on historical and geographic information, seeing things from an aesthetic point of view, reading critically, writing effectively, and conducting understandable dialogue. Facione (2010) states that critical thinking is a self-regulation in deciding on something that produces interpretation, analysis, evaluation, and inference, as well as exposure using a proof, concept, methodology, criterion, or contextual considerations on which decisions are made.

According to Wade, there are eight characteristics of critical thinking: 1) formulating questions, 2) limiting problems, 3) testing the data, 4) analyzing opinions and bias, 5) avoiding very emotional considerations, 6) avoiding over-simplification, 7) considering to various interpretations, and 8) being tolerated to the ambiguity [6]. Fisher (2011) emphasized on important critical thinking skills indicators that included: (1) telling the truth of questions or statements; (2) analyzing questions or statements; (3) thinking logically; (4) sorting things in order temporally, logically, causally; (5) classifying, for example, ideas, objects; (6) making decision, for example, whether there is sufficient evidence or not; (7) predicting (justify prediction); (8) theorizing; and (9) understanding others and himself [7].

Hatcher and Spencer states that critical thinking is an essential ability needed in the workplace, and can help people answer mental and spiritual questions, and assess people, policies, institutions and also avoid social problems [8]. According to Bart (2010) the importance of critical thinking, among others were: 1) critical thinking ability is one of the abilities of the 21st

century, 2) critical thinking is one of the main goals in education and 3) critical thinking is the main result of 21st-century learning [9]. Paul stated optimizing students' critical thinking skills on the subject matter, using language, using logical thinking logic structures, testing the truth of science, and experience from various aspects will make students become self-sufficient. The intellectual independence was important, along with courage, modesty, and faith, which would bring the students being moral and responsible adults in social life [10]. According to Marzano, the trained critical thinking skills are important because they can develop attitudes and perceptions that support the creation of positive class conditions, acquire and integrate capabilities, broaden knowledge horizons, actualize the meaningfulness of knowledge, and develop profitable thinking behaviors [11].

The results of this study also show that not all FI students have better critical ability compared to FD students. This can be seen from the ability to assess the source credibility that shows FD students are still better than the FI students.

#### IV. CONCLUSIONS

Critical thinking is a basic requirement in learning geography, especially on Atmosphere Dynamics material in tenth grade of social science class at senior high school. In the curriculum 13 critical thinking skills become an important part in Higher Order Thinking Skills (HOTS). The mean score of FD students in Critical thinking skills of tenth graders at the high school, in general, is still under FI students. However, it does not mean that FD students are less than FI students, because both students have improved learning outcomes, where it can be seen from the average score of assessing source credibility in which FD students are still superior to FI students.

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