Analysis of Mathematics Critical Thinking Students in Junior High School Based on Cognitive Style

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Abstract. The purpose of this research was to determine the critical thinking ability of mathematics from junior high school students based on FI and FD cognitive style. Data of this research were taken from students grade VIII at SMPN 2 Ambarawa. The research method used a descriptive qualitative approach. Data was taken with a testing method; the critical thinking was measuredwith WGCTA which is modified with mathematical problems, thecognitive style was measured with GEFT. The student's test result was analysed, then four students were selected, the two of them are FI cognitive style, and the others are FD cognitive style, forqualitative analysis. The result showed that the ability of mathematics critical thinking students with FI cognitive style is better than FD cognitive style on the ability of inference, assumption, deduction,and interpretation. While on the aspect of argument evaluation, mathematics critical thinking ability of students with FD cognitive style is a littlebetter than students with FI cognitive style.

1. Introduction

In mathematics learning, students not only learn mathematics material but also learn to deal with problems and challenges in social life.One of theprovisions which should be owned by the students when facing problems and challenges in social life is critical thinking. Critical thinking has become one of the important things in daily life to survive [1]. This skillsshould be owned by each student to be able to face the problems.

The main purpose of education today is to provide students with a key competencies knowledge, which will create the basis for further learning and actby the demands of social and professional [2]. Critical thinking is one of the things used in everyday life to solve some problems. This case proves the importance of equipping students to learn mathematics not only learn the theorybut also equip them with critical thinking skills.

When teaching mathematics in schools, we need to integrate and emphasise critical thinking in the curriculum.So the students could learn the skills and applied them to improve the performance and capabilities of reasoning [1]. The critical thinking should be developed.So the students can overcome their future and useful for companies where students work [3]. The students are not enoughto only hasknowledge or information.To be effective at work or in life, students should be able to think critically [4]. A man who can think critically bring up the vital questions and problems and formulate it clearly and precisely [5]. It means that the ability of think critically needs to be developed in learning.

There are several measuring instruments used to assess critical thinking such that Watson-Glaser Critical Thinking Appraisal (WGCTA) [6]. The WGCTA is a way to measure the ability of think critically. This instrument is a written test that mostly used in the education fields and professional

occupations [7]. The WGCTA consists of the composition of issues, statements, arguments, and interpretation to assess critical thinking someone tested.

In developing the critical thinking, everyone has their ways are preferred in preparing what is seen, remembered, and thought. The differences in eachare how to prepare, and process information and experiences are known as a cognitive style. Cognitive style is a consistent way a person does in capturing stimulus or information, how to remember, think, and solve problems, respond to a task or various types of environmental situations. Cognitive style is an important variable that influences studentschoices in the academic field, the continuing development of academic, how students learn, and how students and teachers interact in the classroom.

There is some cognitive styles, which is field-dependent or field-independent developed by Witkin and Goodenough; global or analytic developed Dwyer and Moore; concrete or abstract developed Jonassen and Grabowski; sequential or random developed Summerville; risk-taking or cautions developed Jonassen [8]. Cognitive style field dependent and independent field has been extensively studied and has wide applications in education issues [9].Thus,this study used thecognitive style of field dependent and field independent.

Cognitive style is very influential on the choice of learning strategies learners [10]. People who have independent cognitive style field prefer to separate the parts of some patterns and analyse patterns based on its components and objectives can be achieved by strengthening its own [11]. Meanwhile, people who have field-dependent cognitive styles tend to look at a pattern as a whole, not separated into their parts and rely on information from the outside to reach the goal. Thus, by knowing the cognitive style of the students,appropriate learning strategies will be selected to get optimal student learning outcomes.

Based on the explanationabove, theproblem in this research is how the critical thinking skills of mathematical students, especially students of SMP N 2 Ambarawaregarding cognitive style. Critical thinking skills include the ability to mathematically studied drawing inference, assumptions, deduction, interpretation and evaluation of arguments.

2. Research Methods

Research conducted a qualitative descriptive study. Descriptive qualitative meaning describes events that became the centre of attention that is characteristic of students 'critical thinking mathematically seen from cognitive style quantitative data were analysed descriptively only as supporting data that the average ratio of students' critical thinking skills in two cognitive styles. Sources of data in this study were students class VIII SMP Negeri 2 Ambarawa. Results of tests of Mathematic critical thinking analysed to determine the characteristics of students' critical thinking skills regarding cognitive style. Tests critical thinking based on the mathematical WGCTA modified with a mathematical question, especially algebra. To determine the cognitive styles of students used the Group Embedded Figure Test (GEFT) developed by Witkin.

In this research, atriangulation that is comparing the data written test results of students with data from interviews, as well as comparing and checking data from different subjects in the cognitive style. To meet the credibility of data is done by persistent observation. Researchers also held triangulation to validate the data.

3. Results and Discussion

3.1. Critical thinking mathematically junior high school students field-independent cognitive style (FI) and field-dependent cognitive style (FD)

From the results of tests, critical thinking skills of students in general mathematical field-independent cognitive style (FI) students obtained a score of 51.41,andfield-dependent cognitive style (FD) obtained a score of 45.35 with a maximum score of 100. It demonstrates the ability of critical thinking mathematically junior high school students still being. Critical thinking skills test results mathematically Students with first FI cognitive style (SFI-1) and the student with the second FI cognitive style (SFI-2) each scored 72 and 58, while students with a first FD cognitive style (SFD-1) and the student with the second FD cognitive style (SFI-2) each scored 45 and 39. These results are triangulated with interviews obtained results are still appropriate written test, so the critical thinking skills of students with cognitive style mathematical FI and FD in the medium category.

Seen from the cognitive style of critical thinking skills mathematically of junior high school students with FI cognitive style is higher than students with FD cognitive style. These results support the findings of [8] which showed that the students' mathematics achievement FI cognitive styles significantly higher than the FD cognitive style. It is also corroborated by the findings[12] which show that students with FI cognitive styles understand the problem better when compared with students with FD cognitive style, where as the ability to understand the problem is the initial capabilities required incritical thinking. Similarly with[13] which states FI students have better cognitive performance than students FD.

3.2. Critical thinking mathematically Aspects inference junior high school students field-independent cognitive style (FI) and field-dependent cognitive style (FD)

The ability to think critically about the inference FI students is higher than the FD. The inference is a conclusion that made the students to illustrate the observed fact. Measure the student's ability to draw conclusions given some questions. Each question begins with a statement of facts which are true. Furthermore, was given the proposed conclusion. Student task is to determine whether the conclusions are made true, probably true, additional information wasneeded, it may be wrong, and wrong.

From interviewing, students SFI-1 and SFI-2 still wrong in working on inference due fooled by the conclusions put forward by a statement about, so trying to validate the proposed conclusion, regardless of the statement. Also, the two subjects are still wrong in formulating the sentencing statement in mathematics, is not rigorous in calculating the final result although the previous steps are correct.

From the interview, students SFD-1 and SFD-2showed some difficulties in working on inference due to its origin in choosing an answer. They do not know how to solve problems, not thorough in scrutinising the matter of the request, do not understand the statements and conclusions presented in a matter that is not can formulate mathematical statements and conclusions in a sentence correctly.Also, less skilled in the conversion unit so that the results of the calculation to be wrong.

Differences in students' ability to draw inference SFI and other SFD, SFD which students have not been able to develop a comprehensive comparison of the rectangle beginning and end, while the SFI students have been able to construct a rectangular area ratio beginning and end correctly so that proper inferences were drawn.

3.3. Characteristics of critical thinking mathematical assumptions junior high school students field-independent cognitive style (FI) and field-dependent cognitive style (FD)

The ability to think critically about the capability assumptions FI students is higher than the FD. From interviewing, students SFI-1 and SFI-2 still wrong in working on the assumption because one of the two subtraction operations algebraic form, understand the meaning of the sign is equal to zero, do not try to resolve the matter of the proposed assumptions to prove the worth of the calculation results of the statement.From interview, students SFD-1 and SFD-2 still wrong in working on the assumption because one of the elaborations of the algebra multiplication, subtraction on two forms of algebra, understanding the meaning of the sign is equal to zero, do not try to resolve the matter of the proposed assumptions for proving the worth of the calculation results of the statement. Student SFD also was not thorough in number operation.

Differences in student's ability to make the assumption that students SFI and SFD has not been able to make assumptions in showing that the general formula proposed in the matter in accordance with the sequence of numbers, while the SFI students have been able to prove that the general formula proposed in the matter in accordance with the sequence of numbers, namely by entering a value of n in the general formula. Student SFD was wrong in the reduction operation two forms of algebra, and also not thorough in number operation.

3.4. Characteristics of critical thinking aspect mathematical deduction junior high school students field-independent cognitive style (FI) and field-dependent cognitive style (FD)

The ability to think critically on the ability aspect deductions FI higher than the FD. From interviewing, students SFI-1 and SFI-2 still wrong in working on deduction due after trying to prove the truth of the statement directly choose the answer that is not necessarily the conclusion of the proposed deduction is true. SFI also one error in the number operation due to forgetting the concept, if

all numbers are divided 0 then the results are undefined. It resulted in SFI wrong in formulating conclusions.

From interviewing, students SFD-1 and SFD-2 still wrong in working on deduction due to not understanding the statements and conclusions presented in the matter so as to prove the statement, originally in selecting answers without validating the proposed conclusions. Also, one in operating numbers that $\frac{2}{0} = 0$, misunderstand 4a, lazy in the count because his number was not unanimous.

Differences in student's abilities of deduction, namely SFI and SFD students have not been able to understand the statements and conclusions presented in the matter, while the SFI students have been able to understand and try to prove the truth of the statements and conclusions presented on the matter. Student FD is less resilient when faced with problems involving non-integer number comparing with the others.

3.5. Critical thinking mathematically interpretation junior high school students field-independent cognitive style (FI) and field-dependent cognitive style (FD)

The ability to think critically on the ability to interpret aspects of interpretation FI students is higher than the FD. From interviewing, students SFI-1 and SFI-2 are still wrong in working on interpreting the interpretation because only able to find a relationship between the number of a sequence of numbers or geometrical patterns and can continue next parts in geometric patterns, but can not formulate common form tribestonne. Also, the origin of the answer as confused how to solve them. Another cause is the inaccuracy in the algebraic operation so that the results of the settlement system of linear equations into one.

From interviewing, students SFD-1 and SFD-2 are still wrong in working on interpreting the interpretation because only able to determine the relationship between the numbers of rows of numbers, yet can continue to the next rate in geometric patterns. In completing the system of linear equations, is still one of the algebraic operation so that the settlement be incorrect. In using algebra to solve the problem of the invention, SFD students only take their number by themselves and the variable was not included so wrong in formulating conclusions.

SFD studentshave not been able to prove the conclusion proposed in the matter, but can only pass on the next number of the sequence of numbers, while the SFI students have been able to prove the conclusion proposed in the matter. SFI students have been able to involve variable in the calculation, but students SFD has not been able to involve variable in the calculation.

3.6. Critical thinking mathematically argument evaluation junior high school students field-independent cognitive style (FI) and field-dependent cognitive style (FD)

The ability to think criticallyto analyse aspects of the argument evaluation FI students is lower than the FD students, although the difference is not great. From student, interviews provide results that students SFI-1 and SFI-2 are still wrong in working on argument evaluation because after proving that the statement is false matter, direct students chose the answer 'weak argument', despite the fact that the arguments put forward are not necessarily weak. In addition to completing the quadratic form of algebra, students still make mistakes in algebra and number operations.

From interviewing, students SFD-1 and SFD-2 are still wrong in working on argument evaluation because there is no accurate in number operations, originally in answering because confused how to solve them. Students SFD are wrong in solving aquadratic form of algebra, students still make mistakes in the operation of algebra and multiplication of numbers that describe two forms of algebra and operate tribes that are not similar.SFD students have not been able to understand the problem and one of the number operations, while the SFI students have been able to understand and able to complete but less thorough.

Seen from the critical thinking skills of all students have the ability to think critically mathematical being, it needs to get the attention of teachers to facilitate better students in learning to develop critical thinking mathematically because with the critical thinking students' understanding of mathematical concepts will also increase. According to [1] critical thinking skills is an effective way to improve students' understanding of mathematical concepts.

From interviews found most students with FD cognitive style more wrong than students with FI cognitive styles in the following points. Misunderstood the problem, one sentence in formulating

statements in mathematics is not rigorous in calculating the final result, and one to operate the algebra, compared. It is consistent with findings [14] showed cognitive styles FI students with better understanding compared with the FD. In [15] also reported better FI students in the writing test.Good writing skillsrequire understandingandgood accuracy; it is abasic ability tothink criticallymathematically.

Results also show that both the students' cognitive style FI and FD highest ability to analyse arguments than the ability to draw conclusions, assumptions, deductions, and interpreting information. While the ability to draw conclusions showed the lowest results. It also needs attention because the teacher drew the conclusion is a very important thing and the end of the process of critical thinking or problem-solving.

From the aspect of student's critical thinking aspects with FI cognitive style is better than the FD on the viability inference, assumptions, deduction, interpretation, whereas argument evaluation of students with FD cognitive style is a little better than the FI. This is consistent with the nature of field-independent cognitive style (FI) that tend to be able to use the analogy approach in solving problems. Usually, they are more independent in organisingknowledge; it is easier to analyse a problem and rearrange the parts and more diligent in finding its solution. While students who have a field-dependent cognitive style is easy to remember information associated with social relationships, but it is difficult to process unstructured learning materials.

Critical thinking is a way of thinking that is tested, connect, and evaluate all aspects of a problem situation, including the ability to gather information, remember, analyse thesituation, to read and understand and identify the things that were necessary, so that critical thinking is analytical thinking. FI cognitive style characteristics that tend analytical thinking, therefore in mathematics students who have cognitive style independent field will show the level of achievement of the critical thinking skills that are higher than the FD.

Critical thinkingis notan innate abilitystudentsince birth. According toHemmingin[4],students are notborn with the abilityto think critically, andpreviouslearningexperienceoftendoes not require themtothink critically. Therefore,in the classroomteachershave to understandthe student's model of behaviourfirstly beforeintegratingthe thinking skills. Students withFDcognitivestyleprefer to workin groupsandrequireextrinsic motivation [11]. Thus tofoster FD student's mathematics critical thinking skills,teachers shouldgivea morestructuredstrengtheningandactivatingstudentwork group. It isin the opinion of[16]which statesthroughcollaborative learningFDstudentsgetgreat benefits.

4. Conclusions

Conclusions of this study are(1) the ability to think critically mathematical junior high school students are still; (2) in terms of cognitive styles critical thinking skills mathematical junior high school students with a higher FI cognitive styles of the students FD; (3) From the aspect of student's critical thinking aspect with FI cognitive style is better than the FD on the viability inference, assumptions, deduction, and argument evaluation

Therefore, (1) the ability to think critically mathematical see junior high school students are still being, the teacher needs to facilitate students in learning that develops critical thinking, (2) the need for special assistance for students with dependent cognitive style in developing the critical thinking aspect of inference, assumptions, deduction, interpretation.

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