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IMPROVING CRITICAL THINKING ABILITY AND MATHEMATICAL DISPOSITION OF HIGH SCHOOL STUDENTS THROUGH INTEGRATED SAINTIFIC APPROACH TO BRAIN BASED LEARNING Enen Nurbaeti1, Meida Sugiharti2, Rippi Maya3 1Graduate Student of Mathematics Education, IKIP Siliwangi, Cimahi, Indonesia 2Graduate Student of Mathematics Education, IKIP Siliwangi, Cimahi, Indonesia 3Mathematics Education, IKIP Siliwangi, Cimahi, Indonesia 1syifanurbaeti92@gmail.com, 2meidasugiharti@gmail.com, 3rippimaya@gmail.com Received: XXXXX X, XXXX; Accepted: XXXXX X, XXXX
Abstract. The purpose of this study was to examine the problem of achievement and improved critical thinking skills and dispositions mathematical high school students between those who use the scientific approach to integrating brain based learning with a scientific approach , examining the association between variablesand an overview of student performance. This study is an experimental study with a design pretest-posttest design. Sampling in this study using purposive sampling technique . The instruments used were tests and non-tests , the test instruments included tests of mathematical critical thinking skills while the non-test included attitude scale tests Student mathematical disposition . The results showed that the achievement and improvement of critical thinking skills (CTS) with a scientific approach to integrating Brain-based Learning (SAIBBL) better than class with scientific approach (SA). Mathematical Disposition (MD) student in the classroom with using learning (SAIBBL) better than students in class with SA. There is a strong association between CTS and MD . The overall picture of student performance with SAIBBL is superior and students are more active in learning. These results prove that the use of SAIBBL is better than SAI.

Keywords: Critical Thinking Skills, Mathematical Disposition, Scientific Approach to Integrating Brain Based Learning. How to Cite: Nubaeti, Enen., Sugiharti, Meida., &

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JIML, X (X), XX-XX _ _ INTRODUCTION Mathematics is the subject on a school where a student not only can solve a problem, but they also need high-level thinking . One of these capabilities is the ability to think critically mathematics. Students' critical thinking skills need to be improved, so that students are not only able to deal with mathematical problems at school only, but also able to deal with problems with confidence and have a variety of alternative solutions mastered instead of complaining and feeling unable to follow the mathematics learning process that he carried out so as not to have the motivation to produce positive things and make the results he gets worse .

According to O'daffer and Theonquist and Miller [1] states that the critical thinking skills of middle school students are not satisfactory and they tend to avoid non-routine questions.This explains that students' low critical thinking skills greatly influence the learning of mathematics . Mathematical disposition can also make someone easier and feel more able to work on the math problems they face, even more complex or specific math problems [2][3].

Ennis, Baron and Sternberg defines critical thinking as reflective thinking that is grounded and focused on establishing what to believe or what to do, while Langrehr stated that critical thinking is evaluative thinking involving the relevant criteria in accessing information along with accuracy, relevance, confidence , constancy, and bias[4].Another opinion, Glaser [5] states that Mathematical critical thinking contains abilities and dispositions combined with knowledge, mathematical reasoning abilities, and cognitive strategies that were previously used to generalize, prove, assess reflective mathematical situations'.

In line with that, [6] argues that critical thinking is reasonable and reflective thinking that is carried out systematically on all information or problems obtained so that it can make the right decisions. The purpose of critical thinking is to achieve deep understanding. Perkins and Murphy 2006 identified a critical thinking model consisting of four stages, namely clarification, assessment, inference and strategy. Whereas according to[7] Indicators of critical thinking skills are: (a) Providing simple explanations (elemntary clarification), (b) Building basic skills (basic support), (c) Making conclusions (inference), (d) Making further explanations (advance clarification) , (e) Determine strategies and tactics to solve problems.

Kilpatrick, Swafford and Finder suggest mathematical dispositions are positive attitudes and habits of seeing mathematics as logical and useful. Bandura added that

mathematical dispositions involve three interrelated processes, namely self-observation, self-evaluation and self-reaction. These three processes are part of metacognition of goal setting in mathematical dispositions[8].

[3] Mathematical disposition is one of the factors supporting the success of student mathematics learning. Students need a mathematical disposition to survive in the face of problems, take responsibility and familiarize good work in mathematics, attitude and good thinking habits in essence will form and foster mathematical dispositions.

Sumarmo [9] argues that mathematical dispositions are desires, awareness, tendencies, and strong dedication to students to think and do mathematically. Polking [4] suggests indicators of mathematical disposition, namely: 1) confidence in using mathematics, solving problems, giving reasons and communicating ideas, 2) flexibility in investigating mathematical ideas and trying to find alternative methods in solving problems, 3) diligently working on mathematical assignments 4) interest, curiosity and meeting power in performing mathematical tasks, 5) tend to monitor, reflect on their own performance and reasoning, 6) assess the application of mathematics to other situations in mathematics and everyday experience, 7) appreciation of the role of mathematics in value culture, mathematics as a tool and as a language.

Based on the description above, a learning approach is needed that can optimize students 'ability to improve their critical and creative thinking skills and foster students' mathematical dispositions. Learning approaches that match the characteristics of these students are approaches Scientific Brain-based learning integration , the reason researchers try to contribute to a scientific approach that must be applied in schools with regard to school curriculum rules that require using a scientific approach, this approach is integrated with brain-based learning that is aligned with students' abilities in dealing with mathematical problems.

Scientific approaches include component 1) observing, 2) questioning, 3) associating, 4) experimenting, 5) networking) [10]. In line with that [11] suggests scientific learning is learning that adopts scientific steps in building knowledge through scientific methods. In the learning process touches three domains, namely attitudes, knowledge and skills. The scientific approach makes learning more active and not boring. Students can construct their knowledge and skills through the facts found in investigations in the field for learning. In mathematics learning for example, students can be invited to see events directly, observe events, phenomena [12].

The scientific approach that is integrated with brain based learning is according to [13][14] Brain Based Learning is an alternative learning strategy that can be used by

teachers to develop students' critical and creative thinking skills, because Brain-Based Learning is a strategy that facilitates learning activities that involve the power of both hemispheres.

According to Gulpinar [15] what distinguishes BBL from other learning models is that BBL has the characteristics of relaxed learning, constructive learning, learning that emphasizes inter-student collaboration, there is enough time for students to reflect on the material they have received, meaningful and contextual learning. The Scientific approach to integrating brain based learning is a learning approach whose implementation process is based on the steps of the scientific approach but is integrated with activities in brain based learning where the results are expected to make learning meaningful so as to improve critical and creative thinking skills and mathematical dispositions.

METHOD This study was an experimental design pretest-posttest aimed at analyzing the role of the brain based learning integrated approach to the criticaL thinking ability and mathematical disposition of students. This study involved 72 eleventh grade students, mathematical critical thinking tests, mathematical disposition scales.

The mathematical critical thinking ability test consisted of 4 items, and by using[8], and [4] as references it was obtained charactristic CTS test as follow: reliability test was r= .77; item validity were .54 (IV (.83; discriminat power were .22 (DP (.49, and difficulty index were .21 (DI (.62 . While MD scale contained 30 items, reliabilty of MD was .87, and item validity were .33 (IV (.66; perception on SAIBBL scale contained 22 items, reliability scale was .94, item validity .35 (IV (.86; In the following, we attached sample items of mathematical critical thinking test, sample of mathematical disposition scale, and sample of perception on SAIBBL scale.

Sample 1. Item of mathematical critical thinking test ability indicator : Provide a simple explanation related to the arithmetic sequence A company in the first year produced 5,000 units of goods. In the following years, production fell by 80 units per year.

Determine the number of years in which the company produces 3,000 units of goods and explain the reasons underlying your answer! Sample 2. Item of mathematical critical thinking test ability indicator : Develop strategies and tactics to solve problems in geometric series A ball is dropped on the floor. The first reflection was as high as 9 m, the second reflection was as high as 3 m, the third reflection was as high as 1 m, and so on with the ball fixed.

Develop a strategy for calculating the reflection height of the ball after bouncing 6 times

and finishing! Sample 3. Item of Mathematical Disposition Scale Table.2.1 Grains of Test Items Mathematical Disposition Scale _ _ _ _Statement Form _ _Indicator _Activity / Feeling / Opinion _ (+) _ (-) _ _ Confident _I was pessimistic about learning mathematics about sequences and sequences _ _ v _ _ _I am sure I can solve the sequence and sequence questions correctly _v _ _ _ Flexibility _I work on math problems using one method that I really understand _ _v _ _ _I wrote new ways that my friends found to increase my knowledge _v _ _ _Note : SA (Strongly agree) , A : (Agree), D : (Disagree), SD : (Strongly Disagree) _ _ Table.2.2 Item of Perception on SAIBBL Scale _ _No. _Statement _SA _A _D _SD _ _1.

_Mathematics problem on student work sheet insufficient with prior student's knowledge. _ _ _ _ _ _2. _Mathematics task on student's work sheet reqiured student to solve it accurately. _ _ _ _ _ _3. _This new learning approach motivate student to solve mathematics problem by various strategies. _ _ _ _ _ _4.

_Student was afraid for presenting work-group solution in front of the class. _ _ _ _ _ _5. _Learning process in this new teaching approach caused students less appreciate the beauty of mathematics rules and principles. _ _ _ _ _ _6 _Mathematics task in student's work sheet allow student to solve by own strategy _ _ _ _ _ _ RESULTS AND DISCUSSION Description of CTS, MD and perception toward SAIBBL of students is attached in Table 1. From Table 3.1, in pre-test it found that there was no difference of CTS of students in both teaching approaches, and the grades were at very low level (20.39 % and 18.77% out of ideal score).

Nevertheles, after learning process, on ([13] [10] [14] [11] [12]) CTS and its gain (N<G>), students taught by SAIBBL attained better grades (45.16% out of ideal score, N<G> .29) than the grades of students taught by conventional teaching (35.22% out of ideal score, N<G> .18). The findings on CTS of this study are similar to the previous studies, that students taught by SAIBB; obtain better grades than students taught by conventional teaching.

Table 3.1 Description of Mathematical Critical Thinking Ability, Mathematical Disposition And Perception on SAIBBL _ _Variables _Stat _SAIBBL _SA _ _ _ _Pre-Test _Post-Test _N Gain _n _Pre-Test _Post-Test _N Gain _N _ _CTS __ _11.08 _26.65 _.29 _36 _12.03 _20.78 _.18 _36 _ _ _% _18.77 _45.16 _ _ _20.39 _35.22 _ _ _ _ _S _3.17 _3.18 _.08 _ _3.83 _4.36 _.09 _ _ _ MD __ _ _73.43 _ _36 _ _77.96 _ _36 _ _ _% _ _60.18 _ _ _ _63.90 _ _ _ _ _S _ _10.97 _ _ _ _7.76 _ _ _ _ SAIBBL __ _ _69.65 _- _36 _ - _ _ _% _ _72.56 _ _ _ _ _Note: CTS : Ideal score: 59 MD : Ideal score: 122 SAIBBL : Ideal score: 96 But, in this study students' grades on mathematical critical thinking ability are at low level. Moreover, on MD there is no difference student's grades in both teaching approaches, and those grades were at

medium level.

The testing hypothesis of those data was attached in Tabel 2. Table 3.2 Testing Hypothesis of Mean Difference of Mathematical Critical Thinking Skill, and Mathematical Disposition on Both Teaching Approaches _ _Variables _Teaching Approach _ ?? _SD _N _Sig (2-tailed). _Sig(1-tailed). _Interpretation _ _ CTS _SAIBBL _26.65 _3.18 _36 _. 000 _.000< .05 _CTSSAIBBL > CTS SAI _ _ _SAI _11.08 _3.17 _36 _ _ _ _ _N-Gain CTS _SAIBBL _.29 _.08 _36 _.000 _.000 < .05 _N-Gain CTS SAIBBL > N-Gain CTS SAI _ _ _SAI _.18 _.09 _36 _ _ _ _ _ MD _SAIBBL _73.43 _10.96 _36 _ . 617 _.308 > .05 _No difference of MDSAIBBL and MD SAI _ _ _SAI _77.96 _7.76 _36 _ _ _ _ _ Note: CTS Ideal score: 59 Ideal score MD :122 Concerning perception on SAIBBL, the study found students' opinion is at fairly good level (72,56 % out of ideal score). These findings are similar to [10] findings.

Some student difficulties in completing Critical mathematical thinking tasks are illustrated in Table 3.2. The study found that students received treatment with SAIBBL, achieving low scores (less than 60% of ideal scores) on two items of the CTS test. In fact, students who received treatment with SAI were aware of the difficulties in all CTS test questions.

Apparently, CTS problems are a very difficult task for most high school students. Table 3.3 Mean Score of Each Item of CTS Test of Students In Both Teaching Approaches _ _Teaching Approach _Stat.Desc _No.1 _No 2. _No.3 _No.4 _No.5 _Entirely _ _ _Ideal score _8 _12 _15 _12 _12 _59 _ _SAIBBL _ X _5.12 _8.21 _7.22 _3.54 _2.92 _27.01 _ _ _% of IS _64.00 _45.62 _48.13 _29.50 _24.33 _45.78 _ _SAI _ X _2.32 _5.16 _2.56 _2.89 _7.67 _20.60 _ _ _% of IS _29.00 _43.00 _17.06 _24.08 _64.00 _34.91 _ _ Further analysis, is concerning association between CTS and MD.

That association is analyzed by using contigency table such as in Table 4 and by using (2 testing . The analysis obtain value (2 = 4,368a and sig.(2 tailed-.113 > .005). This is meant that there is no association between CTS and MD. Table 3.4 Contigency Table of CTS and MD in SAIBBL Class _ _ MSE MCTA _High _Medium _Low _Total _ _Medium _1 _0 _0 _1 _ _Low _4 _8 _13 _25 _ _Total _5 _8 _13 _26 _ _ Besides that, the students' grade on MD is at medium level.

This finding is in line with [13] that MD or other affective behavior cannot be taught directly such as taught a certain mathematical content. Improving better MD or other soft-skill in mathematics need a long period of time, and through four ways namely: Be sure student to understand the meaning of mathematical disposition and the important of owning MD attitudes in learning; Teacher should performed behavior that wished in mathematical MD attitudes; Familiarize students to behave the wished in MD attitudes;

Carry out integrated and continous mathematics teaching-learning process.

Besides those findings, this study also find that students perform more active learning during SAIBBL compare to students during conventional teaching. At the first lesson, actualy students still confuse to learn mathematical task on students work sheet (Figure 1). / Eventhough, on further lessons students accustomed to work passionately in small group discussion, to ask to teacher, and to present their work in front of the class (Figure 2). While, in the conventional teaching student less active learning and they more paid attention on teacher's explantion.

/ Student's perception on SAIBBL is accquired through limited interview to some selected students representation of high group, medium group, and low group students as well. Entirely, students peformed positive opnion on SAIBBL. High group and medium group students proposed that problems on student work sheet difficult indeed, but they are challenging, relates to daily life problem and can be applied in other dicipline; learning material help students to learn earlier; discussion atmosphere some time is tighten but it can be overcomed through working together.

Low group students express that problems on student work sheet are difficult, can't be imagined, and sometimes can't be understood; but student work sheet and learning material help students to learn, SAIBBL is worthwhile in daily life, and learning in smal group is better than learning individually. Those positive students' opinion on SAIBBL was similar to the findings of [14] which report students performed positive opnion on SAIBBL CONCLUSION Based on the findings and discussion, this research concludes as follows. SAIBBL takes a better role than SAI about student CTS and its benefits, but not at MD students.

However, CTS students are still at a low level and at MD grades students at the middle level. Treatment of students on both approaches to realize the difficulties in solving problems of mathematical critical thinking skills. Another conclusion is that, students form positive opinions about SAIBBL and they show active learning in the five phases of the SAIBBL phase.

In addition, there is no relationship between CTS ability and MD ACKNOWLEDGMENTS The researcher thanked all parties involved in this research, especially to the headmaster of SMA 2 Karawang who had given permission to the researchers to take action on students who were used as research samples. to supervisors who always direct, support, and assist during the research process from beginning to end.

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