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Increasing Indicators of Mathematics Competency in Integral Concept Through Debate Scientific Strategy

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Abstract — **This research aim is to analyze the differences of the enhancement of the mathematical competence between the students whose Integral Calculus learning with Scientific Debate strategy and conventional class. The study design was quasi-experiment that involved 200 students. Data of the mathematical competence enhancement is analyzed by using test of gain normalized and data of pretest and posttest are analyzed by Test-t and Mann-Whitney U. The research results show that average value of the mathematical competence enhancement is the middle category. The average value of the mathematical competence in the scientific debate class has either category or B. The average value of mathematical competence in the conventional class has sufficient category or C. In the scientific debate class proves that: (1) the conceptual understanding average value and productive disposition have either category or B; (2) The average value of strategic competence and adaptive reasoning have the sufficient category or C; (3) The procedure fluency has privileged category or A. In the conventional class indicates that the average value of concept understanding, strategic competence, adaptive reasoning, and productive disposition have category sufficient or C, and the mean value of procedure fluency has category good or B. Students who follow the Integral Calculus learning with scientific debate strategy are significantly better than conventional class. There is no difference in the competence of the mathematical understanding, strategic competence, and productive disposition between scientific debate class and conventional class. Students' competence in fluency procedures and adaptive reasoning in the scientific debate class is better than conventional class.**

Keywords — **Scientific Debate, Integral, Mathematical Competence, Test-t, Mann-Whitney U.**

I. Introduction

In Indonesia, the developed curriculum was based on a principle that the students have a central position to develop their competence to become a man of faith obedient at Almighty God, noble, healthy, knowledgeable, capable, creative, independent, democratic and responsible citizens. This objective must be supported by the ability and the development of students' competence that adapted according to students' needs, interests, and demands of the environment. The students have a central position. It means that learning activities were centered on the students. The student competence must be reflected through the students' ability to find and communicate the knowledge to solve the problems in real life. School curricula must be designed to ensure that students can use the skills of scientific inquiry to solve problems in the real world and communicate these solutions to others [1].

Education is a systematic process to enhance human dignity in a holistic manner that allows self-potential (affective, cognitive, and psychomotor) to develop optimally. Correspondingly, the curriculum was drawn up with pay attention to potential, development level, interesting, intellectual, emotional, social, spiritual, and kinesthetic students. Education should create self-regulated both in individual and the nation. It was very important when the world was driven by the free market. Learning model that can enhance self-regulated is Scientific Debate Strategy that has the characteristics. They can create an interactivity nuance, expect to bring up collaborative learning and encourage activate students through opportunities to express opinions, to ask questions, to comment on the teacher or his friend, to argue, to discuss, to learn themselves and others.

Scientific Debate Strategy will be implemented in learning of Calculus of Integral. The integral concept is the difficult concept to be understood, constructed, and applied by students. The difficulties level of the students includes using relevant graphics for presentation. In general, students can calculate the integral of the polynomial function correctly and successfully in questions form in determining or calculating. But for the question that shaped or applied application, they have difficulties to establish mathematical models. Students have a minimal ability in understanding the used symbols [2].

The students who have low ability show that average value of the evaluation results of integral concept has the lowest value, namely 1,895 for the schooling level and 1,685 for the college level on a scale of 0 to 4 compare to the other Calculus ingredients such as line, concept of limit, and derivative [3]. The students' understanding of integral concept has not reached a limit of mastery learning of the group with an average value of 59.20 [4]. Many college students in a conventional classroom have a shallow understanding and incomplete about the basic calculus concepts [5].

The cause of students' low ability was that they rarely challenge themselves to solve mathematical problems that can develop their ability in the high mathematics level [6]. Students only asked to complete, describe in graphic form, find, evaluate, determine, and calculate in a model that is clear. The students' view of mathematics as a collection of concepts and techniques that static to be solved step by step [7]. The pilot project results of the national exam in 2010 which was given to 879 high school students in Bandung city only 30.22% of students were able to answer correctly to the concept of integral [2]. The national exam trial results in 2011 which was given to 1578 high school students in the Bandung city, demonstrated that the ability had decreased, only 6.7% students were able to answer correctly to the concept of integral. In general, the calculus instructional process in conventional class is still presented in the form of the problem-solving exercises, explanation of concepts and techniques through examples, concepts and techniques form [4].

The above condition needs the learning strategies to optimize the mathematical competence. Scientific Debate strategy can deliver the students in achieving these objectives. It was supported by [8], the Scientific Debate strategies application can enhance the students' understanding of the integral concept during the final exam. The applied Scientific Debate exposes that the majority of the students reaches the mastery learning to understand the integral concept and they can explore the knowledge without using algorithm [9]. Scientific Debate application can enhance the mathematical communication and connection ability compared to conventional [2]. Scientific Debate strategy can develop students' mathematical creative thinking abilities better than conventional [10]. This condition is recommended by [1] that, teachers should encourage students to undergo a cognitive process as scientists do, including present a question, form a hypothesis, design an exploration, acquire data, draw conclusions, redesign explorations, and form or revise theories [1].

II. Review of the Literature

A. The Importance of Integral Concept

Integral is an important concept in mathematics and has widespread applications in science and industry, such as: the using of oil droplets rate from the tank to determine the leakage amount during a particular time interval, the use of the Endeavour space shuttle speed to determine the reached height in a certain time, the using of consumption energy knowledge to determine the used energy somewhere one day. In some fields, the integral is used to solve the volume related problems, the curve length, the estimated population, cardiac output, dam style, business, consumer surplus, baseball, and others.

The integral concept is the main concept in mathematics and science. The mastering mathematics is crucial as a strong base to study in a range of disciplines, including engineering, business, and finance [11]. Additionally, mathematical skills and knowledge have been considered to be essential to learn at university in health science [12], [13]. Economic and industry expert predicts that all new economic will be built on the base of mathematics and science [14].

B. Learning Design in Scientific Debate Enhancement of Mathematical Competence

There is five interrelated mathematics competency (intertwine), namely: the understanding of concepts, operations, and relationships [15]. Procedure fluency is capable of applying the procedures flexibly, accurately, efficiently, and right. Strategic competency is the ability to formulate, to present, and to solve the mathematical problem. The adaptive reasoning is the capacity to think logically, reflect, explain and give the justification. Productive disposition is the ability to see mathematics as the knowledge that is useful and meaningful. The mathematical competence that developed in the Scientific Debate strategy is suitable with the raised mathematical competence [16]. They are abilities in reason of mathematical, mathematical argumentation, mathematical communication, modeling, problem-posing and problem-solving, representation, the using of the symbol, the using of tools and technology. The ability in mathematical competency subsequently will lead to the ability to solve mathematical problems in other fields and their real life.

The Scientific Debate strategy uses the informative teaching in presenting materials [10]. It means that teaching materials are given directly without processing. The non-informative teaching materials are packaged in the problem form to think and to solve so that it can optimally develop mathematical competence. The non-informative teaching materials are directed toward procedure ability in finding mathematical concepts use that associated with the integral completion. It can solve non-routine problems based on the finding procedures, submit justification for the conclusion. So that, students can apply the mathematical competence that they have already learned to solve their real-life problems.

Teaching materials must be studied and implemented in debate for strengthening understanding concept. Uncertainty is created by the Lecturer through writing different solutions that it has to be validated and concluded. Building knowledge in the implementation of Scientific Debate strategies was based on some habits that they can be created such as creating uncertainty completion. In mathematical knowledge, uncertainty was expressed in the conjecture form. The different result was developed and validated. Students were trained to generate and validate the relevant conjecture. This habit supporter was a fundamental principle to solve the problem. It proves that the new knowledge can obtain to students by discovering the uncertainty of mathematical propositions. This uncertainty was created by the lecturer with the following steps: the Lecturer initiates and organizes all differences of student solutions without evaluating the truth. This solution was given back to the students to be considered and discussed. Each solution that is produced must be supported by giving the arguments that can to be proven. The proof which was not right it must be supported by counter-examples, and others. The statement was justified by showing theorem or the applicable rules. Some false statement was presented as a "false statement" and justified with counter-examples. To provide the modification of statement, the Lecturer needs to determine the counter-example, conduct the observation, produce a new conjecture and an argument, and perform validation that students are given by validating the argument.

The following example was created by using the didactic situation in Scientific Debate strategies to enhance students' mathematical competence in the learning of Integral Calculus:

The Lecturer gave the statement to be debated by students:

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If f was a continuous function in the interval $a \le x \le b$, we divide the $[a,b]$ interval into n partition that has the same width was

$$\Delta x = (b - a)/n.$$

We assume

$$x_0 (= a), x_1, x_2, \ldots, x_n (= b)$$

was in the partition points and we select the $x_1^*, x_2^*, \ldots, x_n^*$ sample point in this partition, so that x_i^* lied in the partition-i, $[x_{i-1}, x_i]$. So That, definition of boundary integral in $[a, b]$ interval was

$$\int_a^b f(x)\,dx = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_i^*)\,\Delta x$$

And then, Lecturer gave the question:

Can you make some conjectures form of

$$\int_a^b f(x)\,dx$$

While students learned about this concept, the teaching stages were observed as follow:

1. Counter-example: a student stated that the function F was said the derivative inverse of the function f on the interval $a \le x \le b$ if $F'(x) = f(x)$ for all x in $a \le x \le b$. The other student stated

$$\int_a^b f(x)\,dx$$

this was a contradiction of the statement:

$$\frac{df}{dx} = f'(x)$$

And then, the entire students concluded whether his statement was true or not.

2. Statement modification: a student suggested a statement, if f was a continuous function in the interval [a, b] then:

$$\int_a^b f(x)\,dx$$

can be defined as the total area under the curve f which it has the form:

$$A = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_i)\,\Delta x;$$

$$A = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_{i-1})\,\Delta x$$

$$A = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_i^*)\,\Delta x$$

3. Counter-example: the some students claim the example opponents of

$$\int_a^b f(x)\,dx$$

Was

$$A = \sum_{i=1}^{n} f(x_i)\,\Delta x$$

$$A = \sum_{i=1}^{n} f(x_{i-1})\,\Delta x$$

$$A = \sum_{i=1}^{n} f(x_i^*)\,\Delta x$$

The same function was used in number two, but it was not defined as a limit form. It was contradicted the modified statements.

4. Observation: All students considered the mentioned counter-example.
5. A New Conjecture: a student suggested,

$$A = \sum_{i=1}^{n} f(x_i^*)\,\Delta x$$

(Student think that this statement was incorrect) it was not the broad of the curve under area, but it was a Riemann amount that is defined as

$$R_n = \sum_{i=1}^{n} f(x_i^*)\,\Delta x.$$

While

$$\int_a^b f(x)dx$$

was the Riemann integral at the interval [a, b].

6. An Argument: from number five, students obtain an explanation about Riemann sum that it forms:

$$R_n = \sum_{i=1}^{n} f(x_i^*)\,\Delta x,$$

the form of

$$A = \int_a^b f(x)\,dx$$

was the Riemann integral on the interval [a, b], and

$$\int_a^b f(x)dx \ne \sum_{i=1}^{n} f(x_i)\,\Delta x.$$

Some students did not believe that it was always right. This stepping debate revealed that the teacher shows some results and definition that were discussed to determine and conduct a lack of understanding in some students. In particular, they have not understood correctly. It proves that:

$$\int_a^b f(x)dx$$

was a Riemann integral on the segment [a, b] if $b > a$ and the integral decreased if $b < a$. to analyze this phenomenon, we can say that it was a repetition of what it has been learned. A stable knowledge in integral has been learned in the previous year.

7. Validation: students know the curve broad validation concept under area $y = f(x)$ with

$$\int_a^b f(x)\,dx$$

integral concept. It can be defined as the limit of Riemann sum, and it has the form

$$\int_a^b f(x)\,dx = \lim_{n\to\infty} R_n = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_i^*)\,\Delta x$$

This debate needs two hours. The above example illustrates the debated proposition during the learning.

III. Aims

This research conducts the mathematics competency by measuring five of mathematical competence that it is interrelated with each other. Specifically, the part of verification is investigated by analyzing differences enhancement of mathematical competence (mathematical understanding, adaptive reasoning, strategic competence, procedure fluency, and productive disposition) between the group of student with Scientific Debate Strategy and conventional learning in Calculus of Integral.

IV. Methods

A. Participant

The subject in this study is students of Mathematics and Statistics Department Bandung Islamic University (Unisba). The subjects of the study were two-level students (N = 200). It consists 106 students. They are groups of scientific debate strategy as the experimental class and 94 students as a group of conventional learning in the control class.

B. Data Analysis

Data analysis was performed by using Statistical Package for Social Science (SPSS) software version 18 (IBM Corporation). Increased category of mathematical competence among the group of students of Scientific Debate strategy and the group of the conventional used test of normalized gain according to Meltzer (2002) with the formula:

$$\text{Normalized gains (g)} = \frac{\text{Postes Score} - \text{Pretes Score}}{\text{Ideal Score} - \text{Pretes Score}}$$

With the category (g) of normalized gain is: $g < 0.3$ is low; $0.3 \le g < 0.7$ is moderate, and $0.7 \le g$ is high. The category level of value is $80 \le N < 100$ is A, $70 \le N < 79$ is B, $60 \le N < 69$ is C, $50 \le N < 59$ is D and $N < 50$ is E. The difference of enhancement of mathematical competence indicator between Scientific Debate and conventional learning is used t-test and Mann-Whitney U with p-value = 0.05.

V. Results

A. Category of Enhancement of Mathematical Competency

Based on the results of data calculations of mathematical competency indicators are X_1 (Understanding the concept), X_2 (Procedure fluency), X_3 (Strategic competence), X_4 (Adaptive reasoning), and X_5 (A productive disposition) it is obtained that the enhancement of mathematical competence for the experiment and control class is g = 0.47 and g = 0.44 including the moderate category.

Table1. Enhancement of Mathematical Competency for Each Indicator

Class	Indicator of Competency	Average of Gain Normalized	Category
Experiment	X_1	0.494	Medium
	X_2	0.743	High
	X_3	0.404	Medium
	X_4	0.342	Medium
	X_5	0.538	Medium
Control	X_1	0.387	Medium
	X_2	0.849	High
	X_3	0.291	Low
	X_4	0.489	Medium
	X_5	0.468	Medium

B. Enhancement of Mathematical Competence Indicator

Description of enhancement indicator statistic data of mathematics competence

Table 2. Data Description of Indicator OF Mathematical Competency

Class		X_1	X_2	X_3	X_4	X_5
Control	Mean	65.80	70.51	56.59	64.92	63.93
	Std. Deviation	16.62	15.04	12.36	14.49	11.92
Experiment	Mean	71.47	85.59	66.18	67.02	71.35
	Std. Deviation	19.13	16.70	15.36	17.14	12.19
Total	Mean	68.81	78.50	61.67	66.03	67.86
	Std. Deviation	18.17	17.60	14.80	15.94	12.59

The calculation results show that average value of the mathematical competence enhancement is the medium category. The average value of the mathematical competence in the scientific debate class is good category or B. The average value of mathematical competence in the conventional class is sufficient category or C. In the scientific debate class shows that: (1) the average value of understanding conceptual and productive disposition are good category or B; (2) The average value of strategic competence and adaptive reasoning are in the sufficient category or C; (3) The average value of the procedure fluency is privileged category or A. In the conventional class show that the average value of understanding concept, strategic competence, adaptive reasoning, and productive disposition are sufficient category or C. The mean value of procedure fluency is good category or B.

Furthermore, to analysis the influence of learning factors on the enhancement of mathematical competence indicator conducted the prerequisite test, i.e., normality test of data and homogeneity of data variance; Respectively with Shapiro-Wilk test and Levene test (F test). The test one was tested at significance level α = 0.05 with the t-test.

Table 3. Independent Samples Test of Concept Understanding

Variable		t-test for Equality of Means		
		T	df	Sig. (2-tailed)
X_1	Equal variances assumed	-1.875	198	0.062
	Equal variances not assumed	-1.870	192.698	0.063

From Table 3 is known that there is no the difference of the enhancement of mathematical understanding between the class of scientific debate strategy and conventional class. But the average score of mathematical understanding at the class of scientific debate is higher than conventional class. The indicator of mathematical competence of X2, X3, X4, and X5 was tested at a significance level of α = 0.05 with Mann-Whitney U. The results of the calculations are presented in Table 4.

Table 4. Statistics Test of Procedure Fluency, Strategic Competence, Adaptive Reasoning, and Productive Disposition

Statistic Test	X_2	X_3	X_4	X_5
Mann-Whitney U	4657.000	4606.000	4101.500	3471.500
Wilcoxon W	9122.000	9071.000	9772.500	7936.500
Z	-0.796	-0.920	-2.155	-3.698
Asymp. Sig. (2-tailed)	0.426	0.357	0.031	0.000

a. Grouping Variable: Class

From Table 4 it is known that: (1) enhancement of the procedure fluency with scientific debate strategy is not different from conventional learning. (2) There is no difference in enhancement of strategic competency of students who follow Integral Calculus learning with scientific debate strategy compared to conventional learning. (3) The enhancement of students' adaptive reasoning that follows Integral Calculus learning with scientific debate strategy better than conventional learning. (4) There is a difference in enhancement of students' productive disposition who follow Integral Calculus learning with scientific debate strategy to conventional.

VI. Discussion

Overall, the strategy of scientific debate can enhance students' mathematical competence better than conventional learning. At the scientific debate strategy, students with active learning will have a positive correlation in their learning achievement. In everyday life requires activeness. Learning and working actively is more fun. Learning actively will broaden the horizons and so on. Learning actively is very important to help the youngster in the future need [17].

Scientific debate is implemented at the integral calculus class. The integral problem that students must solve is mathematics application problem. This condition can broaden student insight so that students can interpret mathematics not only mathematics itself but also its role in other fields. Mathematics is not a set of separate topics, but it is a network of closed related ideas [18]. The students can get a picture of concepts and ideas about relationships between mathematics and science, and students gain more experience from problem of mathematics application [19]. The contextual learning can enhance the ability of creative thinking, the ability of critical thinking and self-regulated learning [20]. Students are trained to do good interrelations in mathematics in other fields so that students realize the importance of mathematical connection capability. The carrying capacity to improve mathematical competence can include context, place, situation, climate, or social factors [21]. There are several characteristics of problem-based learning. These characteristics are student-centered learning [22]. Learning occurs in small groups. The teacher acts as a facilitator or mentor. The problem is focused and given stimulus for the learning process. Problems as a vehicle for the development of problem-solving ability, and new information or concepts can be obtained through self-directed learning activities.

Other strategies that can be used in problem-based learning are SSCS strategies (Search, Solve, Create, and Share) [23]. Search refers to brainstorming activities to identify problems and generate ideas to explore. The solving refers to activities that generate and implement plans to find solutions, develop critical and creative thinking skills, propose hypotheses, choose appropriate methods for solving problems, collect data, and analyze them. The benefits of problem-based learning are put forward by [24], which can shape positive attitudes and creativity, enhance deep understanding, and develop problem-solving skills or investigative skills that can be applied in various areas of life. Related to problem-based learning weaknesses, Vernon and Blake (Xiuping, 2002) suggest that the focus of problem-based learning on specific goals, problem-based learning does not necessarily imply an increase in student academic achievement as measured by general tests that often focus more on mechanistic skills.

The ability of adaptive reasoning also appears to be able to develop optimally. Students are challenged to use their reason to solve problems. To develop conceptual understanding, fluency in the procedure, and strategic competence, students are required to solve problems in writing, and they are also required to account for their answers through debate as a means of communicating their knowledge. The students who are trained in mathematical communication skills, their learning needs to be conditioned to give an argument for each answer and respond to the answers given by others so that what is being learned becomes more meaningful to them [25]. To improve mathematical conceptual understanding, students can do it by expressing their mathematical ideas to others [26].

Mathematical learning model with the scientific debate is used in the current era of information, where knowledge can be obtained easily, cheaply and quickly by students through the internet and lecturers are not the only source of knowledge information. Students can actively equip themselves with the knowledge which will be accepted before college, and they can discuss and argue with other students or with lecturers about the knowledge that they seek for themselves.

From the characteristics of the scientific debate strategy, it appears that every student is required to be able to construct and understand knowledge independently. Thus, students have an enormous role in understanding concepts, representing problems, developing procedures, finding principles, and applying those concepts, procedures, and principles in solving problems. One of the keys to success in solving problems is to represent the problem appropriately [27]. In line with that [28] also reveals that one component of problem-solving is the representation which represents mathematical ideas related to the problem in a pure and simple, so it is easy to be processed, operated and sought the solution. Meanwhile, the main role of lecturers is more as a facilitator who must always facilitate every development that occurs to students during the learning process taken place. This is in line with Piaget's statement "Knowledge is actively constructed by the learner, not passively received from the environment" [29]. Piaget's statement implies that every student is not passively accepting the knowledge of his surroundings but it must be active to rediscover knowledge independently. The role of the lecturer only leads the students to seek and understand the knowledge meaningfully. Science is needed by humans when it has benefits for life. Learning and teaching are reflective phenomena based on inter-connections between lecturers and students who are co-leaders in finding and understanding the meaning [30]. Constructivism assumes that students must construct their knowledge. Knowledge as a habit allows students to develop their mathematical compositions [31].

'Gains' and 'participation' in learning are interrelated and interacted synergistically [32]. There are three types of identifiable relationships: individual learning can be better or less good than socially mediated learning. People can participate in collective learning, sometimes with what is learned to be distributed through the collective, rather than in the minds of individuals. The individual and social aspects of learning can interact with mutual reinforcement in a 'reciprocal spiral relationship.

Scientific debate strategy is one of the learning models that can enable students in learning. Each student is given the opportunity to express opinions, ask questions, comment on the lecturer and his friends, argue, discuss, learn on their own, etc., then students can learn actively. To create such conditions, lecturers should be able to invite the participation of students in learning to teach, that is by providing many opportunities for students to learn actively, especially through the debate. This practice will support improving mathematical competence. The use of Mathematical Habits of Mind (MHM) strategy can improve student performance in solving problems [33]. We are what we repeatedly do. Individual success is largely determined by the habits that it performs [34].

In the implementation of scientific debate learning model, students are challenged to express and reflect on their thoughts related to the material being studied. Students should also be able to ask things that they are not known or still in doubt either to other students or lecturers. Formulating questions or problems is often more essential than the solution of the problem itself [35]. Asking new questions and seeing new possibilities from old problems require creative imagination. The ability to argue about how the problem-solving process is done, why certain problem-solving strategies are used, and why the solution obtained is correct or appropriate are an important aspect in addressing problem-solving skills [36]. One form of mathematical communication is speaking; it is identical with arguing or discussion [26]. Advantages of the discussion, among others: can accelerate the understanding of learning materials and skills using the strategy [37]. Helping students construct a mathematical understanding. Mathematicians usually do not solve individual problems, but they build ideas with other experts in a team. To help students in analyzing and solving problems wisely, [38] states that there is a significant relationship between the ability of mathematical creative thinking with the capacity to ask questions. Also, understanding problems, developing problem-solving strategies, and reflecting on conformity or correctness of solutions are also components of Szetela and Nicol's problem-solving capabilities (Chicago Public Schools Bureau of Student Assessment, 2000).

In the context of mathematics, [33] identify some of the habits of mathematical thinking are: explore mathematical ideas; reflect on the truth of the answer (reflect on their response to see whether they have made an error); Identify problem-solving strategies that can be applied to solve problems on a wider scale (identify problem-solving approaches that are useful for large classes of problems); ask yourself if there is "something more" than the mathematical activity that has been done (generalization); formulate question and construct the example [33]. These creative thinking habits above as components of a learning strategy, the Mathematical Habit of the Mind (MHM) strategy [33]. MHM strategies are used to develop mathematical competence, such as the ability to think creatively and capacity to solve mathematical problems through the development of mathematical thinking habits. Brainstorming is an idea development strategy that is used in groups so that each group member freely expresses his ideas [21].

Implementation of scientific debate, lecturers, coordinate different answers. The evaluation of the replies was handed back to the students. The lecturer directs the student toward the correct answer. These principles are delaying evaluation, taking account of quantity, and giving freedom of thought [39]. The principle of delaying evaluation emphasizes that lecturers do not immediately evaluate or assess the truth or appropriateness of an idea that put forward by students. Evaluating student ideas earlier is at risk of blocking the flow of subsequent ideas.

The principle of caring for quantity emphasizes the importance of developing as many ideas as possible. If there are ideas that are in sufficient quantity, then the opportunity to obtain a quality idea is greater. The principle of freedom of thought emphasizes the giving of freedom to the students to generate unusual ideas.

Stages of reflection or looking back according to [33] can consolidate student knowledge and develop their ability to solve problems [33]. A reflection stage to help students to organize their thought. In general, reflection has not become a student habit [33]. In fact, the students often do not realize what they think and do [40].

VII. Conclusion

Quantitative calculations show that the enhancement of the average mathematical competence is in the medium category. Students who follow Integral Calculus learning with scientific debate strategy are significantly better than traditional learning. There is no difference enhancement of mathematical understanding between conventional and scientific debate strategies class. But the average score of mathematical understanding with scientific debate strategy class is greater than the conventional class. The enhancement of students' procedure fluency that follows the Integral Calculus learning with scientific debate strategy better than conventional class. There is no difference in the enhancement of students' strategic competency who follow Integral Calculus learning with scientific debate strategy compared to traditional learning. But the average score of strategic competence with scientific debate strategy class is greater than the traditional class. Improvement of students' adaptive reasoning who follow Integral Calculus learning with scientific debate strategy is better than traditional learning. There is no difference in the increase of students' productive disposition following Integral Calculus learning with scientific debate strategy compared to traditional learning. But the average score of students' increased mathematical disposition with scientific debate strategy is greater than the conventional class.

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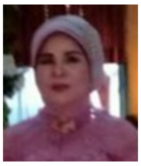

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