# EFFORT IMPROVE OF STUDENT'S ABILITY TO CRITICALS THINK THROUGH OF LEARNING STRATEGY OF PROBLEM SOLVING ON ADVANCED CALCULUS COURSES

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**Abstract**
These research aims to increase of student's ability to criticals think. Research Desain is Classroom Action Research with one cycle. Collected data is data about lecturing execution with observation technic and data about ability of student to criticals think with written tes technique. From three session of lecturing executed, is observed that student work in finishing problems have walked better. During execution three sessions lecturing becoming resistance is prepare result of group discussion to presentation. Skill of student use laptop in preparing report result of team-work still weakens. Obtained conclusion that "If the learning strategy of Problem Solving used in lecturing betterly can improve student's ability to criticals think in items of partial defferential application of function two variables on Advanced Calculus Courses.

**Key word:** ability of student to criticals thinks, Strategy of Problem Solving, Classroom Action Research,

# Introduction

Advanced Calculus Courses is representing to more general from differential calculus and integral function one variable into differential calculus concept and integral function some variable on real variable. Differential calculus and integral of function one variable represent lecturing of Calculus 1 and Calculus 2. Equally, Advanced Calculus Courses is represents continuation courses from Calculus 1 to Calculus 2, and it is prerequisite courses of Real Analysis and Complex Analysis. Thereby courses of Advanced Calculus represent one of courses owning place strategic at Study Program of Mathematics Education in FKIP University Riau.

By paying attention on strategic of Advanced Calculus courses hence efficacy of student to lecturing especially at courses Real Analysis and Complex Analysis very depend on efficacy

of student in lecturing on courses of Advanced Calculus. Therefore, student have to ability to criticals think into solve of problem related to items lecturing on courses of Advanced Calculus in such a way till they get final value very goodness.

Fact is not that way. Still the student's owning on Advanced Calculus Courses enough and less. At anomalous semester of academic year 2011/2012, from 47 student there are 11 student (23,04%) is valuable of C,  22 student (46,81%) is valuable of D, and 3 student (6,38%) is valuable of E.

Efficacy of Student follow Advanced Calculus Courses is not quit of some factor, for example the ability of itself student and lecturer. Lecturer as which play a part in effort learn while student as becoming lecturing target (Suhermi, 2000). Lecturing that was designed in such a way till by a lecturer have strategic in activity to be centrals on lecturing (Hasan, 1997). Thereby, the students failed in following Advanced Calculus Courses is very determined by lecturing process that executed during the time.

Lecturing that researcher execute during the time especially on items of partial differential application of function two variable is remind about items of partial differential of function two variable.  Then give the problem that related to partial differential of function two variables without facility to student by steps to solve that problem.  This matter, the researcher conduct with assumption that is the student has owned skill and knowledge in solving problem.  As result the student don't have ability of criticals think in solve problem that was given. Therefore,  researcher have  to repair  lecturing  specially on items of partial differential application of function two variable in such a way till the student have ability of criticals think.

Ability of criticals think in mathematics is disposition and ability to entangle previous knowledge, mathematics reasoning, and used cognitive strategy into generalization, proving, or evaluating mathematics situation which less recognized as reflective (Glazer, 2001). Ability of criticals think in mathematics in this research is focused at ability of reactions on mathematics problem that covering ability of problem solving. In learning, emphasized to ability of social interaction that will train the student to be think convergent and divergen. Think divergen is an ability to yield many comments, idea, alternative or choice answers on an open question or challenge. While thinking convergent is an ability to yield single comments, passing certain guide (Gardner, 1999).  Think convergent and divergen represent a condition to be someone has ability of think creative and critical.

The formulas in this research are "Do strategy of learning of Problem Solving can improve ability of think critical of student at Study Program of Mathematics Education at FKIP University Riau on advanced Calculus Courses?"

This research have objective to increase ability think critical of Students of Study Program of Mathematics Education of FKIP University Riau on Advenced Calculus Courses.

This research is useful as follows;

1. This Research aim to be increase ability of think critical of the student at Study Program of Mathematics Education of FKIP University Riau on Advanced Calculus Courses.

2. Strategy of learning of Problem Solving can be made one of the alternatives learn of inovatif by lecturer of Study Program of Mathematics Education at FKIP University Riau especially on Advanced Calculus Courses.

3. Result of this research can be made one of the base tread on to develop learning inovatif at Study Program of Mathematics Education at FKIP University Riau especially on Advanced Calculus Courses

## Literature Review

Think is an ability bounce is one can differentiated to be some type, that is: think logical, analytical, systematic, and creative and criticals. Think critical none simply as thinking logical. Think critical have to have confidence in values, rationale, and trust before got by logical reason (cited Schafersman by Murwani, 2006). Thinking critical represent to clear and direction process which used activity bounce, like to problem solving, taking decision, persuading, analysing assumption, and conduct erudite research (Johnson, 2009).

Thereby think critical is thinking process by using Strategy of Problem Solving. process and logic which consist of activity analyse idea or idea up at more specific, differentiating of it incisively, chosening, identifying, studying, and developing it up at more perfect to solve problem in mathematics.

Ability of think critical in this research is ability of student in problem understanding, making in plan of problem solving, execution of plan of problem solving, and check again from a problem that related to partial derivatif application on Advanced Calculus Courses.

The problem in Mathematics is a problem which is at least loading two matter, that is the problem that challange of mind and the problem don't automatically known of solved that problem ( Lenchner, 1983).

Problem Solving represent efforts obtain problem solution by applying knowledge of mathematics and entangle skill of student to think and have reason (Schoenfeld, 1992). Thereby, problem in mathematics oblige student as billows problem to be more from

translating problem and procedure use which have been known. Therefore, need a used strategy to solve problem.

In the field of education, strategy can be interpreted as planning that containing of activity network that disined to reach specific-purpose (Sanjaya, 2010). Strategy represent from activity sequence, way of organization about lecturing and student, and also used time of lecturing to reach the target of lecturing (Suparman, 1997). Strategy of Problem Solving represent one of the lecturing strategy bases on problem with lecturer was guide to student to learn to solve problem to passing experience of lecturing (Jacobsen, dkk. 2009).

Learning Strategy of Problem Solving loading systematic stages to be problem solving on mathematics. Steps of Problem Solving is problem understanding, making in solution plan of problem, executing in solution plan of problem, and review to the execution plan of problem solving and check solution (Polya, 1957).

In comprehending of problem the student looks for question and any data that exist in given problems (Sumardiyono, 2011). In making in solution plan of problem needed a specials strategy to be problem solving among other of strategy write equation (Holmes, 1995). In executing the solution plan of problem needed with calculation, algebra manipulation, making argument and clarification (Sumardiyono, 2011). After solution obtained, require being review to the execution plan of problem solving with checking again and also check argument in each step which have been conducted (Wardhani, 2010).

Pursuant to description above problem solving strategy, hence strategy of problem solving is a process lecturing of partial differential application of function two variable on Advanced Calculus Courses by following steps: (1) problem understanding, (2) making in solution plan of problem solving, (3) execution to solution plan of problem solving, and (4) review to the solution obtained with checking in each step of execution.

Implementation of strategy learning of problem solving in lecturing on Advanced Calculus Courses as follows.

***Introduction***; The activity of introduction, researcher raise question about partial derivatif of function two variable as perception. Then continued by raising problems to be studied by student as motivation having the character of challenge for the student. Before this activity, researcher gives LKM (student activity sheet) and explains the breakdown of activity of lecturing.

***Activity of Core;*** At this activity, student thinks critical by executing problem solving strategy of which problem decanted at student activity sheet. Student work by teaming, preparing report results of team-work, and presentation of result of team-work. During this

activity take place, researcher as lecturer to do perceiving, observing, and facility and also motivate student in such a way till every group can finish academic duty.

*Ending;* At this activity, student facility researcher in making conclusion, conducting assessment and reflection, and give house duty as follow-up, and also inform student about course items next week.

Pursuant to description of ability think critical and strategy of learn of problem solving, hence researcher can formulate action hypothesis at this research. Hypothesis action formula at this research is if strategy of learn of problem solving used in lecturing with better hence can improve ability think critical of student in course items of partial derivatif application of function two variable on Advanced Calculus Courses.

## Research Method

This Research executed at anomalous semester of academic year 2012/2013 have place at Study Program of Mathematics Education of FKIP University Riau Pekanbaru. Subjek in this research is student of semester III at Study Program of Mathematics Education of FKIP University Riau academic year 2012/2013 counted 20 people.

This Research is Classroom Action Research. At this research the researcher in same time become lecturer as curator on Advanced Calculus Courses. Action repair of lecturing at this research by learning strategy of problem solving in topic about partial derivatif application.
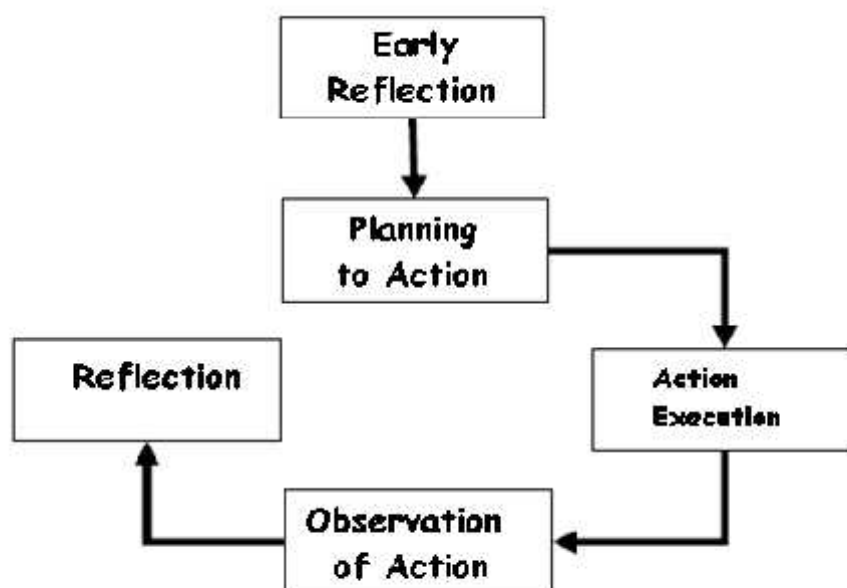


Map : cycle of lecturing execution

Research Desain is Classroom Action Research with one cycle. Research cycle consist of some phase that is; reflection early, planning to action, action execution, observation of action, and reflection. This research executed only one cycle by Map: cycle of lecturing execution.

***Early Reflection;*** At this phase, researcher analyse problem about result learn student at items lecturing of limit and continuity of function some variable. Activity which is researcher conduct is analysing of data about result of quiz 1 on Advanced Calculus Courses.

***Planning to Action;*** At this phase, researcher work along with researcher member to be design instruments of lecturing and data compiler.

***Action execution;*** At this phase, researcher executes lecturing for the course items of partial derivatif application.

***Observation of Action;*** At this phase, researcher member execute observation to lecturing executed by researcher.

***Reflection;*** At this phase, researcher member and researcher to be analysis of result of observation of lecturing and result of learn of student at items of partial derivatif application.

Developed Research instrument at this research is a set lecturing and data compiler instrument. Developed a set Lecturing is unit of lecturing for the items of extreme value and Lagrangian meftod. Developed Compiler data instrument at this research is observation sheet of lecturing execution and tes result of learning. Tes result of learning is a set semester middle test of loading items of partial differential and partial derivatif application (in items extreme value and Lagrangian meftod).

The collected data in this research is data about lecturing execution and data about ability of think critical of student at Study Program of Mathematics Education of FKIP University Riau. Data about lecturing execution collected by using observations technique. Data about ability of think critical collected by using test technique of written

1. Observation Technique

    To collect data about lecturing execution used observation sheet by observer that give sign check list ($\sqrt{}$) when lecturer activity and student activity that included at observation sheet during lecturing.

2. Test Technique of Written

    To collect data about ability of think critical of student in topic of partial derivatif application in items Lagrangian meftod used test of semester middle. Collected data about ability of think critical passing follow stages ( 1) researcher and researcher member

arrange students seat in such a way till don't enable to cooperate in replying of problem, ( 2) researcher allot copy of problem sheet, ( 3) researcher say the word to be started of test (during student doing solution of problem, the researcher member and researcher do observing such a way till there no student cooperate or open note or of a kind), ( 4) researcher say the word of test have ended and at the same time collect problem sheet and answer sheet.

To analyse data about lecturing execution and ability of think critical of student in this research is used descriptive analysis technique

1. Technique analyse data of lecturing execution
   Data result of observation of lecturing execution analysed to follow stages (1) summarize result of observation of lecturing execution, (2) presenting data summarize result of observation of lecturing execution, and (3) interpreting data summarize result of observation of lecturing execution.

2. Technique analyse data of ability of think critical
   Data result of semester middle test analysed to know ability of think critical of student follow stages (1) grouping student answer pursuant to problem solving stages, (2) analysing mistake of student each problem solving steps, (3) calculating acquirement score each problem solving steps, and (4) calculating final score of acquirement of student to the overall of problem.

3. Efficacy of Action
   Criterion Efficacy of action applying of strategy of learning of problem solving told can improve ability of think critical of student if final score mean of semester middle test about exstrim value and Lagrangian meftod higher than final score mean of semester middle test about partial derivatif on Advanced Calculus Courses.

## Result of Research and Discussion

Lecturing Executed in this research by three session that is; items of local extreme value, items of Lagrange method, and items of absolute extreme value.
Lecturing with items of local extreme value, researcher early activity of lecturing by raising question about partial derivatif of function two variables and continued to raise problems 1 which is decanted at Student Activity Sheet with code LKM 7_1. Problems 1 cannot be answered by all students. At that moment, researcher submit the target of lecturing " on this day you'd study how to look for maximum value and local minimum value a function two variable by using partial derivatif concept of function two variable" passing LKM 7_1. Through group discussion, they earn to finish problems 1. Each group to be presents the result of discussion by using LCD projector.

Lecturing with items of Lagrangian meftod, researcher early activity of lecturing by raising question about partial derivatif of function two variables and continued to raise problems 5 which are decanted at Student Activity Sheet with code LKM 7_5. Problems 5 cannot be replied by all students. At that moment, researcher submit the target of lecturing " on this day you'd study how to look for maximum value and minimum value a function two variable if any an other as constraint by using partial derivatif concept of function two variable" passing LKM 7_5. Through group discussion, they earn to finish problems 6. Every group to be presents the result of discussion by using LCD projector.

Lecturing with items of absolute extreme value, researcher early activity of lecturing by raising question about partial derivatif of function two variables and continued to raise problems 3 which are decanted at Student Activity Sheet with code LKM 7_3. Problems 1 cannot be replied by all students. At that moment, researcher submit the target of lecturing " on this day You'D study how to look for maximum value and local minimum value a function two variable by using partial derivatif concept of function two variable" passing LKM 7_3. Through group discussion, they earn to finish problems 3. Every group to be presents the result of discussion by using LCD projector.

From thrice session of executed action at this research, is perceived that cooperation student in finishing problems that raised passing LKM (Student Activity Sheet) walk better. During execution three sessions lecturing becoming resistance is to prepare result of discussion to be presented. This is Matter is less skill of student use laptop prepare report result of team-work.

Result of tes before and after repair action presented at table 1.  From tables 1 the expressed that 10 people (50%) can finish Task 1 related to local extreme value a function two variable, 20 people (100%) student cannot finish Task 2 related to Lagrangian meftod. And so do in finishing Task 3 related to absolute extreme value a function two variable.

Whether into finishing of Task 1 and Task 3, the students find difficulties to look for given function critical point. Function two passed to variable both the problem is trig function. While in finishing Task 2, student fined difficulties in planning to problem solving.

From tables 1 is also expressed that mean result of tes after action is 41,3 and mean result of tes before action 31,5. This means repair action can improve result learn of student in Advanced Calculus Courses. Even though that way, still there are 6 student (30%) student experience of degradation result of learning after action.
From analysis data of ability of think critical above, obtained that result of tes after action is higher than result of tes before action. This indicates that learning strategy of problem solving can improve ability think critical of student on Advanced Calculus Courses at Study Program of Mathematics Education of FKIP University Riau.

**TABLE 1**
**SCORE OF RESULT TEST BEFORE**
**AND AFTER LECTURING EXECUTION**

| NO | ID STUDENT | EARLY SCORE | SCORE AFTER LECTURING EXECUTION | | | |
|---|---|---|---|---|---|---|
| | | | TASK 1 | TASK 2 | TASK 3 | TOTAL |
| 1 | 1105111519 | 51.4 | 38.7 | 9.7 | 3.2 | 51.6 |
| 2 | 1105111583 | 45.7 | 38.7 | 16.1 | 19.4 | 74.5 |
| 3 | 1105113499 | 37.2 | 29.0 | 9.7 | 25.8 | 64.5 |
| 4 | 1105113527 | 56.5 | 0.0 | 9.7 | 6.5 | 16.2 |
| 5 | 1105113605 | 28.6 | 0.0 | 2.3 | 0.0 | 2.3 |
| 6 | 1105113611 | 17.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | 1105113650 | 11.4 | 38.7 | 9.7 | 12.9 | 61.3 |
| 8 | 1105113660 | 45.6 | 22.6 | 6.5 | 19.4 | 48.5 |
| 9 | 1105113661 | 30.0 | 38.7 | 9.7 | 0.0 | 48.4 |
| 10 | 1105113715 | 22.8 | 38.7 | 9.7 | 16.1 | 64.5 |
| 11 | 1105113776 | 0.0 | 38.7 | 9.7 | 19.4 | 67.8 |
| 12 | 1105113795 | 31.5 | 3.2 | 6.5 | 9.7 | 19.4 |
| 13 | 1105120029 | 14.3 | 38.7 | 0.0 | 12.9 | 51.3 |
| 14 | 1105120080 | 48.3 | 3.2 | 0.0 | 3.2 | 6.4 |
| 15 | 1105120767 | 14.0 | 6.5 | 9.7 | 12.9 | 29.1 |
| 16 | 1105120771 | 20.0 | 29.0 | 9.7 | 19.4 | 58.1 |
| 17 | 1105121112 | 37.2 | 38.7 | 9.7 | 0.0 | 48.4 |
| 18 | 1105121126 | 51.5 | 38.7 | 6.5 | 9.7 | 54.9 |
| 19 | 1105121190 | 31.4 | 0.0 | 3.2 | 0.0 | 3.2 |
| 20 | 1105122264 | 34.3 | 38.7 | 9.7 | 6.4 | 54.8 |
| AVARAGE | | 31.5 | 24.0 | 7.39 | 9.8 | 41.3 |

Thereby result of research support action hypothesis formula "If learning strategy of problem solving used in lecturing better hence can improve ability of think critical of student in topic of partial derivatif application of function two variables on Advanced Calculus Courses".

Even though that way, lecturing execution passing learning strategy of this problem solving still have weakness
First, this lecturing execution is only executed one cycle in such a way till researcher cannot see efficacy for the course items of problem solving in related to double integral and triple integral. This matter because research time don't synchronize with course execution at Study Program of Mathematics Education of FKIP University Riau.
Both, this lecturing execution to be observed by using observation sheet as less detail in such a way till result of research cannot lay open more detailed about lecturing process. To overcome especially for the weakness to be combine of learning strategy of problem solving with cooperative learning model.

## Conclusion and Suggestion

Pursuant to result of above research analysis, hence researcher can conclude that strategy of learning of problem solving can improve ability of think critical of Student at Study Program of Mathematics Education of FKIP University Riau on Advanced Calculus Courses.

Pursuant to above solution, hence researcher suggests to enthusiastic researcher of follow up to result of this research to be combining strategy of learning of problem solving with cooperative learning model.

## References

Ennis, R. H. (1996). *Critical Thinking*. United States of America: Precentice_ Hall Inc.

Holmes, Emma E., (1995). *New Directions in Elementary School Mathematics –Interactive Teaching and Learning*, A Simon and Schuster Company, New Jersey.

Johnson, E. B. (2009). *Contextual Teaching and Learning: waht it is and why it's here to stay* (terjemahan oleh Ibnu Setiawan). Bandung: MLC. Buku asli diterbitkan tahun 2002

Lenchner, George. (1983), *Creative Problem Solving in School Mathematics*, Glenwood Publication Inc, New York

Murwani, E. D., (2006). Peran Guru dalam Membangun Kesadaran Kritis Siswa,"*Jurnal Pendidikan Penabur* (No. 06/Th.V/Juni 2006) SMAK BPK PENABUR Jakarta.

Polya G., (1957), *How to Solve It*, Princeton University Press, New Jersey Schoenfeld, 1992, Learning to Think Mathematically: Problem solving, metacognition, and sense making in mathematics. Dalam Grouws,

Douglas A (Eds.), *Handbook of Research on Mathematics Teaching and Learning* (pp. 334-366) New York: Macmillan Publishing Company.

Sumardyono, (2011), *Tahapan dan Strategi Memecahkan Masalah Matematika.* http://p4tkmatematika.org/file/problemsolving/TahapanMemecahkanMasalah.pdf. (5 Oktober 2011)

Suparman, (1997), *Desain Instructional,* PAU-PPAI Universitas Terbuka, Jakarta.

Wardhani, dkk., (2010). *Pembelajaran Kemampuan Pemecahan Masalah di SMP*, P4TK Matematika, Yogyakarta.