# Proceeding ICeMATH 2011

## The International Conference on Numerical Analysis & Optimization

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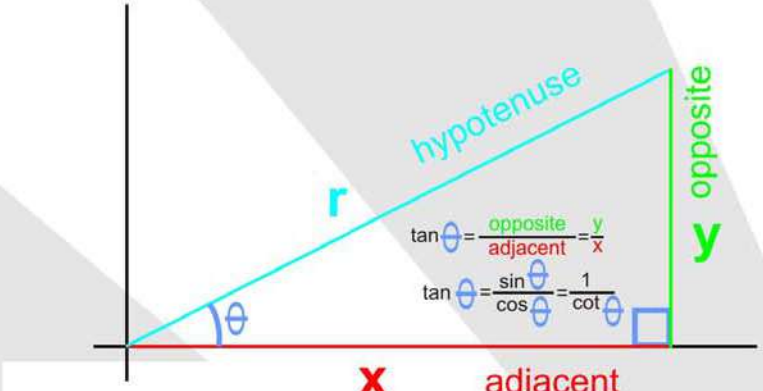


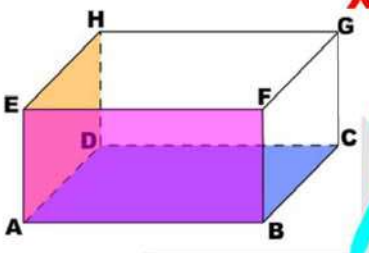


June 6 - 8, 2011


*Hosted by :*

**Departement of Mathematics**
**Faculty of Mathematics and Natural Sciences**

# The International Conference on Numerical Analysis and Optimization (ICeMATH2011)

The field of numerical analysis predates the invention of modern computers by many centuries. Numerical analysis is the area of mathematics and computer science that creates, analyzes, and implements algorithms for solving numerically the problems of continuous mathematics. Such problems originate generally from real-world applications of algebra, geometry, and calculus, and they involve variables which vary continuously.

On the other hand, Numerical Optimization is defined as a scientific approach in finding the finest solution of a particular problem that is interpreted in mathematical models. Hence, the combination of numerical analysis with numerical optimization is highly important for scientific efforts in the areas of developmental work as well as humanity in general.

Therefore, on the occasion of the 50th anniversary of its founding celebration, Universitas Ahmad Dahlan (UAD) with the collaboration of Journal KALAM has initiated **The International Conference on Numerical Analysis and Optimization (ICeMATH 2011)** to be held at Yogyakarta, Indonesia.

**Objectives:**

- Provide a platform for researchers, professionals, and academicians to exchange ideas and discuss their research findings.
- Encourage future collaborations between participants.
- Provide room for researchers to discuss their thoughts and views on the development of this field that can contribute towards future works as well as being a very beneficial program for all participants.

**Topic of Discussions:**

Numerical Analysis, Numerical Methods, Operations Research, Mathematics, Statistics, Numerical Optimization, Differential Equation, Applied Mathematics and Statistics, Interval Mathematics, Fuzzy, Computational Mathematics, Combinatory, Algebra, Engineering Mathematics, Mathematics Education

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**Proceedings of The International Conference on Numerical Analysis and Optimization (ICeMATH 2011)**

**$6^{TH}$ – $8^{TH}$ JUNE 2011**

**UNIVERSITAS AHMAD DAHLAN, YOGYAKARTA, INDONESIA**

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**Part VIII - Statistics**

# LEARNING ALGEBRA IN JUNIOR HIGH SCHOOL WITH PROBLEM-CENTERED LEARNING (PCL) APPROACH

***Tedy Machmud***

**Abstract.** One of the students' competency to be mastered when learning mathematics in junior high school, operating mastery of algebra, equations, inequalities, the system of equations and the ability to apply it in everyday life. Facts on the field shows that learning algebra in junior high school, not develop optimally. Optimization can be achieved if in student learning "experience" yourself what would learn, not "know" it. One alternative for optimizing learning algebra, among others, by applying the approach Problem-Centered Learning (PCL). PCL is a learning approach with the potential to improve the situation of learning that allows students to learn productively. This approach focuses on building students' mathematical ability through presentation of problems, so that students become a learning center always trained to understand and construct concepts through problem, and ultimately to solve mathematical problems it faces with the language or understanding of their own. Problem-Centered Learning (PCL) is one approach to learning that focuses on the activities of the intensity of negotiations between student-student and student-teacher, which consists of three main components, namely giving the task, grouping, and class discussions (sharing.)

***Keywords***: *Constructivism, Problem-Centered Learning*

## 1. INTRODUCTION

Learning algebra in junior high school, not to develop optimally. This was painted from a survey conducted by TIMSS (the Trends in International Mathematics and Science Study) which was followed by junior high school students (grade 8) in 2007 shows from 48 countries who participated in a competition, Indonesia rank 37th in math (Mullis, et. al., [5]). When viewed from the mathematics content domain average percent correct of Indonesian students to conten of algebra only 29%, compared with the average percent correct for international students which is 40%. In fact given problem in TIMSS 2007 were 29% are questions concerning the algebra (the problem of the Numbers 30%, Geometry 21%, Data and Chance 20%). When viewed from the cognitive domain average percent correct of Indonesian students compared with the average percent correct for international students on the domain knowing mathematics is 34% (international average percent of 46%), the domain applying mathematics is 28% (international average percent of 39%), and the domain reasoning mathematics is 17% (international average percent of 28%). The percentage of the number of domain knowing mathematics, applying mathematics and reasoning mathematics respectively is 35%, 41%, and 24%.

The data show that Indonesia is still weak sample of students in Algebra content, especially in solving problems in the form of applying mathematics and reasoning mathematics. If only focused on aspects of learning, the authors expect that this may be caused by a learning approach that is less "meaningful" for students. Learning will be more meaningful if students "experience" itself what would learn, not “know” it. Target-oriented learning mastery of the material proven to be successful in the competition 'remember' short term, but failed to equip students to solve problems in the long term life.

Learning activities are conducted as usual, the teacher began by discussing the previous questions, provide explanations of new concepts directly, giving the example problems and their solution procedures, provides routine questions for practice, and concludes by giving homework. Routines such learning is often done by teachers in everyday so that can be tedious, dangerous and damage the interests of students (Sobel and Maletsky [8]). In this case it was realized that there are math teachers who embrace the paradigm of the transfer of knowledge, which assumes that the student is an object of study and teacher centered learning that focuses solely teacher as the main actor of learning.

In both paradigms the teacher dominates the learning process so that an atmosphere of learning more emphasis on routine exercises work on the problems with repeat procedures and more use of specific formula or algorithm that failed to give students the opportunity to do mathematical problem solving. It's time needs to be developed in a more widespread and intensive paradigm of student-centered learning. The new paradigm of education is more emphasis on learners as human beings who have the potential to learn and develop. This paradigm is the paradigm of constructivism.

## 2. PARADIGM OF CONSTRUCTIVISM IN MATHEMATICS EDUCATION

Constructivism is a theory of cognitive development which emphasizes the active role of students in building their own understanding of the knowledge learned. According to Steffe & Kieren [9] constructivism is rooted in cognitive developmental psychology and epistemology of Piaget has influenced mathematics educators around the year 1960. Slavin [7] revealed that constructivism in educational history is born from the ideas of Piaget and Vigotzky. Both stressed that cognitive development occurs only if the conceptions which had understood previously processed through a process imbalance in the effort to understand the new information. The construction or development knowledge according to Piaget's theory Equilibrated (Sutawidjaja [10]) took place through two processes namely: the process of assimilation, and accommodation process. Referring to the theory of Piaget equilibrated earlier, learning is an active process to develop schemata.

While learning mathematics in constructivist view according Hudoyo [2] is to help students develop the concepts and principles of mathematics with their own abilities through a process of internalization and transformation of the concepts and principles so that awoke back into the concept / new principle. Therefore, learning mathematics is an active process in an effort to help students build understanding.

Good & Brophy (Kauchack & Eggen [4]) mentions the general characteristics of constructivist learning as follows:

- Students build their own understanding;
- The new study relies on previous understanding;
- Learning is facilitated by social interaction;
- Learning occurs in meaningful learning tasks independently.

While Alexander & Murphy (Kauchack & Eggen [4]) propose five general questions about learning and teaching in line with the opinions of Good & Grophy, namely:

- Knowledge of beginning students affect their learning;
- Students need to think about learning strategies;
- Motivation has a strong influence on learning;
- Development and individual differences affect learning;
- The context of social in the classroom affect learning.

Based on the characteristics of constructivism and general statements about teaching and learning mentioned, there is a peculiar appropriateness in learning mathematics for organizing and structuring knowledge. First, is the characteristic which says that new learning depends on prior understanding. This is regarding the preconditions knowledge to learn that can not be separated from the nature of the mathematical structure itself. In the study of mathematics, a person who studies the concept of B before understanding the concept of a concept A or higher level can only be understood through the concept of a lower level. Second, is a statement about the progress and individual differences. Students at the stage of concrete thinking will be difficult if the math is presented in

abstract form. Therefore, require adjustment of learning that serves as a form of representation of mathematical concepts to help students to facilitate learning.

## 3. APPROACH PROBLEM-CENTERED LEARNING (PCL) IN MATHEMA-TICS EDUCATION

Nickson (Grows [1]) states that constructivist view of learning mathematics is to help students to develop the concepts/ principles of mathematics with their own abilities through the internalization of that concept/ principle was awakened again, the transformation of information obtained by the concept/ new principle. The transformation occurs when understanding occurs easily because of the formation of schemata in the minds of students. Thus, learning mathematics is nothing but understanding, not just a mere acquisition of learning outcomes.

Learning mathematics can provide the opportunity for students to be able to perform learning activities so that students can build their own understanding and participating in the learning process, among others, are learning to approach the PCL. This approach was originally introduced by Cobb (Wood [12]) in Primary Schools with a Problem-Centered Mathematics or Problem-Centered Classroom. Then Wheatley [11] develop this approach in the Middle School as the PCL.

Wheatley [11] PCL component divides into three components, namely task, the activities of the group, and sharing. This approach begins by preparing the classroom by giving the assignment of tasks problem solving to the students to work on that task. The next activity is to group students in small working groups and encourage them to collaborate. After discussion in each group stated quite, followed by class discussion activities. In this discussion each group presents the material that has been discussed in the discussion group. It is expected that through this class discussions happening sharing opinions so as to produce a solution to solving the problem you're working.

According to Wheatley (Jakubowski [3]) PCL approach is designed to provide opportunities for students to engage actively in the learning process by encouraging them:

- To invent their own ways of attacking and working out problems;
- To exchange point of rather than reinforce correct answers and correct wrong owns;
- To think rather than to compute with paper and pemcil.

Posamentier [6] explains that sometimes requires the preparation of a mathematical problem-solving are not unusual and requires a unique solution. In the context of the PCL students faced with real problems that students might initially find it difficult to understand the concepts involved in solving the problem, so to solve this problem required a high creative power of students. On the other hand the teacher's role is helping to facilitate the students so that they can and will succeed in problem solving activities. The presence of teachers in problem-solving activities, in addition will be a figure which is used as a role model, it will also help the development of attitudes and cognitive development of students in understanding mathematics. Students as individuals who have the potential can not develop well without any help from the teacher.

## 4. EXAMPLE IMPLEMENTATION OF PCL IN LEARNING

In general, the implementation of the PCL can be described as this description. At the beginning of the meeting, the teacher informs the form and mechanisms of learning activities that will be followed by students, subject matter and learning objectives to be achieved. It is expected that students first have to learn and discuss subject matter related to the presentation of issues contained in the Student Book. In apersepsi activity and motivation, teachers discuss with students the important concepts associated with a dish issue contained in the Students Book. In this session teachers ensure through questioning, whether students have grasped the important concepts related to the presentation of issues that will be given. This session is also used teachers to motivate students on the importance of material that will be discussed. This session is expected to last for 25 minutes.

### 4.1 Activities Giving Task Problem Solving

Teachers provide opportunities for students to do the following tasks for 10 minutes.

Determine the amount of:

$$\frac{1}{2}+\frac{1}{6}+\frac{1}{12}+\frac{1}{20}+\frac{1}{30}+\frac{1}{42}+\frac{1}{56}$$

At first, students work individually, after 10 minutes took place, followed by a discussion with friends the bench for 5 minutes to confirm and correct answers respectively. Teachers monitor directly, while providing assistance and guidance.

### 4.2 Activity Groups

After that phase of activity followed by group discussion (4-5 students) for 25 minutes to discuss the task of solving the above problems. Teachers conduct a careful observation (noticing) on student cognitive situation developing at the time, and provides key directions for example:

*Teacher:* Try to note the denominator of the fraction above, state the denominator as the product of two numbers that the difference is 1.

*Teacher:* The next state above the numerator of the fraction as a result of the difference between two successive numbers.

*Teacher:* Exploring the phenomenon of what happened.

*Teacher:* Determine determine its addition result.

*Teacher:* Expand your exploration and find the pattern to determine the amount of:

$$\frac{1}{2}+\frac{1}{6}+\frac{1}{12}+\frac{1}{20}+\frac{1}{30}+\frac{1}{42}+\frac{1}{56}+\frac{1}{72}+\frac{1}{90}$$

*Teacher:* Do symbolization to number the numerator and denominator, expand your exploration and find the pattern in general to determine the number of specific fractions.

Teachers in these activities to monitor and fishing as well as inviting students to participate actively in learning through teachers' efforts to provoke student participation.

### 4.3 Activity Sharing

After the group discussions, followed by class discussion for 25 minutes in the form of presentation of each group of problem-solving task given above. Each group reported the results of their discussion on the group. Teachers monitor and if necessary, engage in discussions. Teachers invite students to participate actively in learning through the efforts of teachers to lure student participation, verification of the understanding that emerged from the students. Class discussion is expected to become an arena of negotiation, both among the students-teachers. In this negotiation process is expected to occur in a class sharing in taking the deal.

## 5. CONCLUSION

Mathematics learning is an active process in efforts to help students build understanding. The management of mathematics instruction that focuses on students' active involvement also requires a constructive learning environment. PCL is one of the instructional models that can be presented in

class to actively involve students in constructing understanding of the material he was examined. In this situation the role of PCL as a facilitator and teacher dynamist become very important for optimum continuity of the process of meaningful construction in the structure of students' minds.

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