

# The Development of Mathematics learning Tool Oriented on Problem Based Learning to Enhance Mathematics Problem Solving Ability and Self Efficacy

Solawati Nainggolan  
State University of Medan  
Medan, Indonesia  
solawatinainggolan@gmail.com

Mulyono  
State University of Medan  
Medan, Indonesia

Hasratuddin  
State University of Medan  
Medan, Indonesia

**Abstract**— problem-solving skills are essential to improving math skills. It can increase logical, systematic, and creative skill and thinking". In high school most problem solving skill are still low, its because learning model used not exactly and the teacher haven't preparation while teaching, so mathematics learning not interesting. it is necessary to develop learning tools to make learning effective. researchers do development of learning tools that its student book, teacher book, Learning program plan, student worksheet and problem-solving test with the learning model used problem based learning. Expected that students problem solving ability can be increased and students are interested and love learning math, so that the learning becomes effective. This research use research improvement Thiagarajan, Semmel and Semmel by 4D model. There are 4 step development processing: define, design, develop and disseminate. Population in this research is all of student class X high school Yayasan Pendidikan Keluarga (YPK) medan school year 2016/2017 taking samples from 2 class room which totally there are 64 students and material is trigonometry. learning tools that have been declared valid by validator. In the trial 2 stages in two different classes, the second test new results obtained that the learning tools can and easy to use can be said practical so that effectively improve the ability of problem solving and self efficacy students.

**Keywords**— learning tools, problem based learning, mathematical problems solving ability, self efficacy

## I. INTRODUCTION

Mathematics courses need given to all learners from elementary school, to equip learners with logical, analytical, systematic, The students ability to have the ability acquire,

manage, and utilize information to live better in ever-changing circumstances, not sure, and highly competitive, Dahlia (2016) further in her research says "Mathematics learning has an important role in developing logical, systematic, and creative skill and thinking".

Principles NCTM explains: "Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well"

Teachers should focus their activities and preparing tasks interesting enough to stimulate students to engage naturally. The teacher makes the students responsible for their learning process, with extensive and profound material mastery, the teacher is more likely to ask questions that require students to involved naturally. then Dahar (2006) explained that it can be done by teachers rich in knowledge through approaches and methods of teaching and able to apply in accordance with teaching materials . So it is clear that learning can produce maximum results if the teacher can implement a truly effective teaching, ideally a teacher should be able to map the strategies he will use in approaching, designing, managing the learning process for students.

A teacher should have professional skills that support a teacher's performance. "The implementation of a competency-based curriculum is largely determined by the ability of teachers in developing learning tools, namely the development of syllabus, textbooks, learning resources and media, instructional models, assessment instruments, and implementation plans of learning" (Wasriono, 2015) Development of instructional tools need to be implemented in the practice of daily learning in educational units. However,

the daily practice of teaching in schools is still experiencing various problems with regard to the learning devices used to operate the learning path. Problems teachers in using learning tools are also found in high school Yayasan Pendidikan Keluarga (YPK) Medan.

The ability to develop learning tools is part of efforts to improve the quality of education. In addition, other points that can support the learning process is the ability possessed by the students themselves. The low math skills of students in Indonesia is a classic problem that is still a dilemma in the world of education to date. Similarly research Ayu Aji et al (2015) said that "the success of students who are less than optimal in achieving learning outcomes is possible because of learning difficulties in students. Students with learning difficulties tend to have difficulties in solving problems both in the classroom and in life issues".

One of the math skills that needs to be developed is the problem-solving ability. This is because mathematics can not be separated from challenges and mathematical problems. As Silver and Marshal (1990) says, "when solving mathematical problems, students adapt and broaden their existing understanding by linking new information with knowledge their current knowledge and building new relationships within their knowledge structures" (Ida kadarsih, 2015).

Problem solving is seen as a process to determine the combination of a number of rules that can be applied in an effort to cope with the new situation. Problem-solving skills are very important for students and their future, their previous knowledge is the basis for information retrieval. Furthermore, Hasratuddin said (2015: 69) that "the problem of the real world is a non-routine problem. Through the use of non-routine problems, students are not only focused on solving problems with existing strategies, but also realizing the power and usefulness of mathematics around the world and practicing the investigation and application of various mathematical concepts he has learned in the classroom.

Student's weakness in applying mathematical concept due to low ability of problem solving of student mathematical problem. As long as the researcher did observation, the researcher observed that the students tend to be passive in following the process of learning mathematics in the classroom. Students tend to feel fearful and anxious when expressing their opinions, even the students are afraid to ask questions about the less understood.

The number of studies that try to improve problem solving ability, it is clear that the ability of problem solving mathematics students is still low, so the need for efforts or ways to further improve it. Based on some of the above opinions, the ability to solve mathematical problems must be possessed by students to train to be accustomed to facing various problems, whether problems in mathematics, problems in other fields of study, or problems in everyday life are more complex. Therefore, the ability of students to solve mathematical problems need to be continuously trained so that students can solve problems encountered.

In addition to students' mathematical problem-solving abilities, self-efficacy also influences students' knowledge and understanding of mathematics. Self Efficacy is a psychological aspect that contributes to the success of a student in completing the task well. Having a strong confidence will make a person has the motivation, courage, perseverance in carrying out the given task, and vice versa. Having a low self-esteem will shy away from difficult tasks, quickly give up when faced with problems or math challenges.

Marlina et al (2014) says that "the successes and failures experienced by students can be viewed as a learning experience. This learning experience will produce self-efficacy of students in solving problems so that their learning ability will increase, it needs positive self-efficacy in learning so that students can achieve their learning objectives and achieve maximum learning achievement".

From the observation of the researchers, students in SMK YPK Medan have self efficacy students who are low. From the result of observation and interview can be seen from: (1) students who are generally passive waiting for answers from their friends or from teachers, (2) Students are not confident to express their opinions and generally will only answer when appointed by the teacher. When the researchers asked directly to some students, they admitted they were afraid of being wrong and some admitted that they did not like mathematics.

Teachers should really be able to choose the right model of spreading, which can shape students' understanding with meaningfulness that they can. Driver (1988) says "Significant construction can take place through interaction with meaning, text, through interpersonal negotiation or internal reflection" (Dahar, 2006: 166).

The use of learning models that are not in accordance with the development of students will impact terhadap stage of student learning development. Learning that is always focused on the teacher will cause the students' knowledge is less developed. The demands of the K-13 curriculum are to activate the students, as stated in Permendikbud no 60 annex III (2014) says "one of the models discussed and developed is Problem Based Learning".

Furthermore, Hasratuddin (2015: 137) says that "the vision of contemporary education is the mastery of concepts in mathematics learning used to solve problems". Meanwhile, according to Suyatno (2009) in permendikbud no 60 said that "The problem-based learning model is the learning process that the starting point of learning begins based on the problem in real life students are stimulated to learn the problems based on knowledge and experience they have previously (prior knowledge) to form knowledge and new experience".

Teachers should be able to develop tools tailored to the right model, so as to enable students to be active and develop existing knowledge to gain new knowledge and be able to understand the meaningfulness of learning mathematics itself.

From the description of the above problems, researchers interested in conducting research related to the mathematical ability of the students and its relation to the existence of learning tools mathematics. The title of the research is:

"Development of Learning Device through problem based learning to improve problem solving ability and Self Efficacy of grade X students of SMK YPK Medan"

## II. LITERATURE

### A. Quality of Mathematics Learning Tool

Criteria of a high quality learning according to Nieveen (2007) "for product quality consisting of the following three criteria: validity, practicality and effectiveness". That is to determine the quality of instructional device development results required several criteria including: validity, practicality and effectiveness.

### B. Basic concepts Problem Based Learning

Arends (in permendikbud, 2014) says that: "The problem-based learning model is a learning approach in which students work on authentic issues with the intent to develop their own knowledge, develop inquiry and higher-order thinking, develop self-reliance and self-confidence."

Problem Based Learning is not developed based on learning theory or psychological theory although the PBL process involves the use of metacognition and self-regulation. PBL is known as progressive active learning and is a teacher-centered learning approach but should be student-centered, and use unstructured problems as the beginning and beginning of learning (Minarni, 2013). Problem Based Learning Syntax is student orientation on problem, mengorganisasi student to learn, guide individual or group investigation, develop and present the work, Analyze and evaluate problem solving process (Trianto, 2010: 98)

### C. Problem Solving

Schroeder and Lester (in Hasratuddin, 2015: 70) describes three ways of interpreting classroom mathematical problem solving, teaching for problem solving, teaching about problem solving, and teaching through problem solving via problem solving). Further explained the purpose of teaching for problem solving is to inculcate mathematical concepts so that students can apply their knowledge to solve problems. therefore, students are given ways to solve routine or non routine problems. Teaching about problem solving is teaching strategy, or heuristics, in order to solve problems. the way used is to teach the 4 steps developed in Polya (1985), namely: understanding the problem, devise a plan, Carrying out the plan, and Looking Back

### D. Self Efficacy

According to Bandura (1999: 2) that self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations. Efficacy beliefs influence how people think, feel, motivate them selves, and act ". The point is that self-efficacy refers to a belief in one's ability to organize and implement a set of actions needed to manage a prospective situation. Such beliefs

affect how people think, feel, motivate themselves, and act. Bandura is a social psychology student whose writings are mostly about self-efficacy, giving the understanding of self-efficacy still general. The phrase 'particular situation' is broad-ranging, since self-efficacy is needed in all fields, including in mathematics learning, and more specifically in the situations students encounter and solve math problems. Huda (2013: 59) says "what teachers should do is develop a learning environment where all students can develop their own progress and motivation to move. Self-efficacy that is formed will affect and provide functionality on individual activities

## III. METHOD

This research was conducted at SMK YPK Medan. The subjects of this study were the students of class X AP-1 and X AP-3 academic year 2016/2017. This research type is research of learning device development which developed is teacher book, student book, lesson plan (RPP), Student Worksheet (LKS), instrument of problem solving test and Self-Efficacy questionnaire. This research research using Thiagarajan, Semmel and Semmel. The Thiagarajan model consists of four stages known as the 4-D model. These are the defining stages of define, design, develop, and disseminate. Learning tools are assessed based on the criteria of Nieveen (2007). The criteria assess the quality of learning tools based on three aspects: (1) Validity (Validity); (2) Practical; and (3) Effectiveness. Data analysis techniques used in This research is Content validation based on the opinion of five experts in the field of mathematics education. The criteria for the validity of Subjects as follows:

Table 1. Validitas Category

No	Va or average value	Criterion validity
1	$1 \leq Va < 2$	Invalid
2	$2 \leq Va < 3$	less valid
3	$3 \leq Va < 4$	enough Valid
4	$4 \leq Va < 5$	Valid
5	Va	very Valid

Note: Va is the value of determination level validity Subjects trigonometri.

The criteria stated teaching materials have a good degree of validity, if the validity of the minimum level reached is valid ( $4 \leq Va < 5$ ).

Practical analysis of learning tools can be determined by validator assessment consisting of experts and practitioners stating that the learning device components developed can be used and also the level of active student activity can be seen from the percentage of students who absorb information and percentage of interference from other students during the learning process. The level of student activity is also determined by comparing the allocation of learning time used with the ideal time percentage used for each student activity.

Analysis of the effectiveness of learning device data can be determined by Analysis of students' learning mastery data and student response analysis. The criterion states that students are said to have mathematical problem solving abilities when 80% of the students who take the test have the ability to solve the mathematical problems at least obtain values greater than or equal to 2.66 or at least B - (Rick, 2015) with the following table.

Table 2. Interval value

Nilai	Predikat
0,00 < Nilai ≤ 1,00	D
1,00 < Nilai ≤ 1,33	D <sup>+</sup>
1,33 < Nilai ≤ 1,66	C-
1,66 < Nilai ≤ 2,00	C
2,00 < Nilai ≤ 2,33	C <sup>+</sup>
2,33 < Nilai ≤ 2,66	B-
2,66 < Nilai ≤ 3,00	B
3,00 < Nilai ≤ 3,33	B <sup>+</sup>
3,33 < Nilai ≤ 3,66	A-
3,66 < Nilai ≤ 4,00	A

Analysis of the answers questionnaire responses of students to the teaching material is used as a reference that students are able to use teaching materials. To analyze the data are responding students use the formula:

$$RS = \frac{f}{n} \times 100\%$$

Note:

RS : The percentage of students with specific criteria

f : Total Score

n : maximum score

Determine the average score of the positive response of students, and then determine which categories of response or the response of students to a criterion by matching the results with the percentage of positive criteria.

The student's response is said to be positive if 80% or more of the students respond in a positive category (happy, new, interested, clear, and interested) to every aspect that is responded.

The data analysis of mathematical problem solving and Self Efficacy can be determined by N-gain formula:

$$N\text{-Gain} = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum possible score} - \text{pretest score}}$$

Gain index criteria are :

$g > 0,7$  : High

$0,3 < g$  : Medium

$g \leq 0,3$  : Low (Hake, 1999)

#### IV. RESULT AND DISCUSSION

##### A. Define

Stage definition with 5 steps is the beginning-end analysis, student analysis, concept analysis, task analysis, and specification of learning objectives. Indicators generated in

the objectives of the learning objectives are used as a basis in the preparation of the design of learning tools with the trigonometric material. analysis start from interview with teachers, analyze mathematic syllabus, analyze and meriview reference books that can be used to teach the subjects of mathematics, as well as studying the characteristics of the students.

##### B. Design

In this study the learning tools developed are teacher book, student book, RPP, LKS, instrument problem solving test and Self Efficacy questionnaire Instrument.

###### a. Learning Implementation Plan

Learning implementation plan arranged for 4 meetings each contains. Identification of subjects, standards of competence, basic competence, indicators, learning objectives, teaching materials, fittings, learning models, learning scenarios and assessment of learning outcomes. The material at determines the trigonometric ratio of an angle to a right triangle, a special angle, and a related angle, resolving a problem related to the ratio of trigonometry.

###### b. Book

Based on the analysis of front-end, designed a trigonometry teaching materials based on student-based learning. The book contains material developed problems related to the comparison of trigonometry to be solved by the students in groups and independently. Teaching materials in the book using the concept of questions and explanations that support the process of problem solving. Trigonometry Teaching materials problem based learning is focused on improving students mathematical problem solving abilities.

###### c. Student Worksheet

Student worksheet arranged for four meetings about trigonometric issues. Student worksheet is designed for problem Solving

###### d. Mathematical problem solving ability test and self efficacy

Problem solving is based on the trigonometric material indicator, which is a problem in everyday life to improve the problem solving abilities of mathematics which amounted to 5 questions, while the self-efficacy questionnaire of students as much as 24 items.

##### C. Develop

###### a. Validation

Validation of implementation plan, books, worksheets and problem solving tests conducted by experts and practitioners. Validation of experts made to produce equipment and instruments eligible. The expert in this case is the validator competent covering Lecturer Mathematics Education courses Unimed, teacher in SMK YPK

Based on the results of expert assessment then made revisions to devices and instruments. Advice from validator is used for the improvement of devices and instruments. Following the assessment of validators:

Table.3 Validation results

No	Devices is rated	Average	Criterion validation Result
1	Learning Implementation Plan	4,38	Valid
2.	Student Book	4,36	Valid
3	Teacher Book	4,39	Valid
4	Student Workseet	4,44	Valid

Based on the validation results of the implementation of the plan, books, worksheets and tests of validation problems that the valid developed, while problem-solving and self efficacy questionnaires can be used with little revision.

#### b. Practically Test

The first criterion, from the experts / validators and practitioners (teachers) is that on the basis of the criteria of practicality first been filled which can be used with little revision. If learning with a time-developed device is less than ordinary learning and the device is easy to use, then it can be said to be practical

#### c. Effectiveness test

The effectiveness of teaching materials in terms of:

##### 1. Mastery Learning

##### a. Analysis of problem-solving abilities

In the first test, the students' mathematical problem solving ability is  $g = 0.39$  or in the medium category. While in trial II, obtained by mathematical problem of student equal to  $g = 0.51$  or is in medium category.

##### b. Data Analysis Enhancement Self Efficacy students

In the first experiment I obtained an increase in student self efficacy of  $g = 0.57$  or are in the category of being. While in trial II obtained improvement of student self efficacy equal to 0,68 or in high category.

From the result of students' learning mastery analysis on mathematical problem solving ability in trial I, there were 22 complete students (68,7%) from 32 people, and in trial II there were 28 complete people (87,5%) from 32 students. It was concluded that this criterion was achieved.

##### c. Student Response

The result of student response analysis is positive if more than or equal to 80% student response is in positive kateori. In trial I and II trial more than 80% of students were in positive category on every aspect of learning device response.

From this means learning devices meet the effective criteria

#### D.Desseminate

After the field trial, and obtained an effective learning tool and improving students' math problem solving skills, the next step is to socialize learning tools that have been tested, this activity is done in a limited way on the subject teacher consultation forum, the result of this stage is recommending to all teachers to use this device as one of the alternative learning on Trigonometry students of SMK Class X

A study tool "How validity of Trigonometry teaching materials based problem to improve mathematical problem

solving students in class X SMK Yayasan Pendidikan Keluarga Medan ? " Has been answered based on the validation of the validator, the learning device of Trigonometry problem solving measure as, Sugiyono, (2008: 173) argues that the instrument is valid means of measuring instruments used to obtain data (measures) were valid, Valid means the instrument can be used to measure what should be measured.

The results of validation of teaching materials for materials are formulated as valid. This means that the material presented on teaching materials is loading indicator of the ability of understanding the problem, devising a plan, carrying out the plan, looking back. Problems can encourage students to improve the ability of mathematical problem solving students, want to measure

The second criterion is the activity of students during the learning activity has met the criteria of tolerance of the ideal time set. In trial I there are two categories of activities whose percentage is not in the ideal time tolerance interval set ie category of attention / listening explanation of teacher / friend and Reading, understanding of contextual problem in student book and LKS. While in trial II all student activities have been at the ideal time tolerance interval set so that concluded this criterion has been reached. When linked to student activities in the process of applying the problem-based learning model with piaget theory, it is stated that social interaction in learning activities with friends or groups or outside the group has a great influence in children's thinking. In another section jhon Dewey (Trianto: 2009) describes learning based on the problem is the interaction between the stimulus and the response is the relationship between the two directions of learning and the environment. Given the conditions and processes and learning activities are expected to make students as independent learners.

Ability to solve mathematical problems is understanding the problem, devising a plan, carrying out the plan, looking back. After learning using learning-oriented learning model based on the problem, obtained post result of 32 students there are 22 students (67.5%) who obtained value greater than or equal to 2.66 or at least B-). The most improved indicator in test I is the indicator to understand the problem. This is because the nature of problem-based learning is learning that always raises problems or questions to students. Therefore, the students will be familiar with the mathematical problems consequently the students will be able to understand the mathematical problems.

Based on the results of data analysis of student responses on test I and II obtained the CONCLUSION that students have a positive response to the components and learning activities. Positive responses of students can not be separated from the conditioning of learning with the model of learning based on the problem, among others: the problems posed on students derived from contextual problems that are close to the real world students or can be reached by the imagination of students to show the use of mathematics in the life of students through solution to problem. Student responses on

trial I and trial II always meet the specified criteria. This indicates that the application of learning tools developed oriented learning model based on problems can foster motivation and interest learning students in carrying out learning.

Furthermore, from the results of the research on trial II after the learning was obtained that of 32 students who followed the postes there were 28 students (87.5%) who got the value of more than or equal to 2.66 or at least B-). Besides the indicators understand the problem, the ability to solve the problem also experienced enhancement. This is because teachers help students understand the problem by providing scaffolding. scaffolding as a process of assisted learners to address a particular problem that is beyond its developmental capacity with the help of a teacher or a more capable person. From the results of research on the test I obtained improvements in student self efficacy by using learning tools using learning based on the problem. The increase in gain of self efficacy in test I is 0.57. The highest increase in the self efficacy indicator is the Magnitude or level indicator. The increase in self efficacy gain in trial II is 0.68. The highest increase in self efficacy indicators is also the Magnitude or level indicator.

This is because the problem-based learning model always confronts or poses a problem to the student. As a result students will get used to facing problems and also solve problems. This is also in line with students' ability to understand problems in mathematical problem solving indicators. Students will be accustomed to solve problems, so students' confidence in solving problems will increase.

Increased self efficacy of students will have an impact on students' mathematical problem solving skills in general. Students who have high self efficacy will be confident and better able to solve math problems. It can be concluded that the higher the students' self efficacy, the mathematical problem solving ability will also be higher. Problem-based learning is student-centered learning. Therefore, learning based on the problem of designing students' curiosity as well as motivating students to become independent learners. Therefore, the self-confidence or self efficacy of students will increase

## V. CONCLUSION

Based on the development and testing that has been done, the conclusion as follows:

### a. Valid

Based on the validator's assessment, learning tools are developed in the form of RPP with validity score 4.38, Student Activity Sheet (LKS) with validity score 4.36, Book of Teacher (BG) validity score 4.39, and Student Book (BS) score validity 4.44. From the results it is concluded that the average validator gives a good level of validity value, this means learning tools valid / fit to use. As for mathematical problem solving test and self efficacy validator questionnaire that mathematical problem solving test and self efficacy questionnaire can be used.

### b. Practical

The first criterion, from the experts / validators and practitioners (teachers) is that on the basis of the criteria of practicality and if learning with a time-developed device is less than ordinary learning and the device is easy to use, then it can be said to be practical.

### c. Effective

Effective learning tools measured from: (1) achievement of learning objectives or learning completeness in the classical 80% of students who follow the learning is able to achieve a minimum value of 2.66 or B-; (2) at least 80% of the many subjects studied provide a positive response to the device and learning activities. Completeness of learning conducted on the pilot activity I reached 67.5%, and II test activities reached 87.5%. Student responses from the results of questionnaire responses of students on trial I and trial II obtained the result that more than 80% of students give a positive response on each aspect of the response. There is an improvement in students' mathematical problem solving skills using the device. problem-based learning on trigonometric topics with gain = 0.39 and trial gain gain = 0,51. And also increase the ability of self efficacy at trial I gain = 0,57 and trial gain gain = 0,68

## REFERENCE

- [1] Arikunto, Suharsimi. 2002. *Dasar-Dasar Evaluasi Pendidikan (Edisi Revisi)*. Jakarta: Bumi Aksara
- [2] Bandura. 199. A. *Self Efficacy in Changing Societies*. Newyork : Cambrige University
- [3] Depdiknas. 2006. Permendiknas nomor 22 tahun 2006 Tentang Standar Isi Sekolah Menengah Atas. Jakarta : Depdiknas
- [4] Depdiknas. 2014. Permendikbud no 60 lampiran III tentang kurikulum SMK. Jakarta : Depdiknas
- [5] Hasratuddin, 2015. *Mengapa Harus Belajar Matematika..* Medan : Perdana Publishing
- [6] NCTM. 2000. Principles and Standars for school Mathematics. Reston : NCTM
- [7] Nieveen, N & Plomp, T. 2007. *Educational Design Research*. Netherlands : Enschede
- [8] Permendikbud RI. 2013. Salinan LampiranPermendikbud No. 65 Tahun 2013 tentang Standar Proses
- [9] Rahmadani, Rahmi. 2005. Pengembangan Perangkat Pembelajaran Matematika Berorientasi pada Problem Based Learning untuk meningkatkan kemampuan pemecahan masalah metamatika siswa kls XI SMK YPK Medan. Tesis tidak diterbitkan. Medan : Program Pasca Sarjana UNIMED
- [10] Salinan LampiranPermendikbud No. 81A Tahun 2013 tentangStandar Penilaian
- [11] Sinaga, Bornok. 2007. Pengembangan Model Pembelajaran Matematika Berdasarkan Masalah Berbasis Budaya Batak (PBM-B3). Surabaya: Program Pascasarjana Universitas Negeri Surabaya
- [12] Simanungkalit, Rick Hunter. 2015. Pengembangan Perangkat Pembelajaran untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis dan *Self Efficacy* Siswa, *Jurnal Pendidikan Dan Terapan*. Vol 1. No.2. Hal 1-14
- [13] Slavin, Robert E. 2011. Psikologi Pendidikan: Teori dan Praktiknya. Jakarta: Indeks
- [14] Trianto. 2010. Mendesain Model Pembelajaran Inovatif Progresif. Jakarta : Kencana
- [15] Wasriono. 2015. Pengembangan Perangkat Pembelajaran Berbantuan Autograph untuk Meningkatkan Pemahaman Konsep Matematik Siswa melalui Model Penemuan Terbimbing. *Jurnal Paradikma*, Vol. 8, Nomor 3, Desember 2015, hal 52-61