ANALYSIS OF STUDENTS' LOGICAL THINKING SKILLS IN COMPUTER PROGRAMMING LEARNING

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Abstract

This study aims to describe students' logical thinking skills in computer programming learning on algorithmic and programming subjects. The purpose of learning computer programming is to make a program that can do a calculation or "work" in according to the programmer desire. Programming requires some skill, namely; logic, algorithms and programming. Logic in programming is one of the supporters of success in making computer programs. For this reason, it is necessary to have indicators or measuring instruments to see whether students understand the making of a program, namely by: 1) Harmony of thinking, 2) Ability to argue, and 3) Drawing conclusions. This research is quantitative descriptive. The subjects used in this study were students of the PGRI Palembang 2017/2018 academic year. The data collection technique used is a test. Data is analyzed through data reduction, data presentation, and conclusion drawing. The results of the study show that: 1) In the indicator of thinking harmony, students can determine the steps taken regularly in solving problems given from the beginning of planning to obtain a conclusion, 2) On indicators of argumentation ability, students can give logical arguments according to facts or existing information related to the problem planning step and solving the problem taken, 3) On the indicators of drawing conclusions, students can draw a conclusion from an existing problem based on the steps that have been taken

INTRODUCTION

Algorithm and Programming is one of the subjects that must be taken by students, especially the University of PGRI Palembang. The aim of this course is to make students understand and have skills in making computer programs using programming languages to solve several problems, especially in the field of mathematics. Computer programming is a process for implementing algorithms using programming languages [1]

Algorithm according to Rinaldi [6] is the sequence of steps to solve the problem. Whereas according to Levitin in Rinaldi [6], an algorithm is a series of clear instructions for solving problems, namely to obtain the desired output from a input in a limited number. In simple programming, an algorithm is the first step that must be written before writing the program. Problems that can be solved by computer programming are problems related to mathematical calculations [7]. The relationship between mathematics and computers is in two ways: 1) Mathematics can look for rational logic equations that can be translated into computers through programming languages, 2) Computers can do mathematical rational logic calculations quickly and precisely. The limitations of computers can be overcome by mathematical logic, whereas mathematical problems can

be computerized just like counting the amount of sand in a scale. Whereas according to Barakbah [2], the notion of algorithms is very closely related to the word logic, namely the ability of a human to think with reason about a problem producing a truth, proven and acceptable to reason, logic often associated with intelligence, someone who is able to logic well is often called as a smart person. Therefore, the ability to think logically is one of the supporting abilities in understanding computer learning programming.

Logical thinking can be interpreted as the ability of students to draw legitimate conclusions according to the rules of logic and can prove that conclusions are true (valid) in accordance with previously known knowledge [9].

The description above shows a very close relationship between algorithms and logical thinking. Thus the logical thinking of students can be trained and seen by their ability to write or make algorithms in learning programming. According to Casnadi's research [3] there are still many students who ignore the making of algorithms, resulting in many unexpected errors and excessive coding changes. Therefore, it is difficult for students to understand the concept of logic programming. This is often done by some students of Mathematics Education Study Program, University of PGRI Palembang.

Based on this, the purpose of this study is to examine more deeply the students' logical thinking skills in computer learning programming.

METHODS

This study uses descriptive quantitative research by providing an overview of students' logical thinking skills in computer programming learning. The subject of this study was mathematics education students held at the PGRI University of Palembang in the academic year 2017/2018 Mathematics Education Study Program. Data is collected by using a logical thinking ability test. The data analysis technique used in this study is the Miles & Huberman model which presents three activities in data analysis, including data reduction, data presentation/display, and conclusion drawing/verification.

RESULTS AND DISCUSSION

The study was conducted on algorithmic and programming subjects with the main material of using Just BASIC Software in the mathematics education study program at the University of PGRI Palembang through the provision of Student Work sheets that have been validated by experts and peers. The Student Work sheet is done with an allocation of 150 minutes. After the researcher processes and analyzes the ability of mathematical logical thinking. Student answers are analyzed according to the indicators of students' mathematical logical thinking abilities. The indicators used in this study are three, namely: 1) Harmony thinking, 2) Ability to argue, and 3) Drawing conclusions. The following is presented the student value data

Tabel 1. Grade of Student Work sheet 1

Range of Value	Frequency	Percentage (%)	Category
81-100	12	35,3	Very High
61-80	10	29,4	High
41-60	9	26,5	Moderate
21-40	3	8,8	Low
0-20	0	0	Very Low
Jumlah	34	100	

The student scores are also shown in descriptive data. The following is a descriptive table of students' mathematical logical thinking abilities.

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Table 2. Mathematical Logical Thinking Ability of Student Workseheet 1

Descriptive statistics	Score
Average	7,1
Maximum Value	9,6
Minimum Value	3
Mode	80.58

Table 1 shown the average students' mathematical logical thinking ability is 6.87, included in the high category. The results of identifying students' logical thinking skills in Student Work sheet 1 presented in Figure 1:

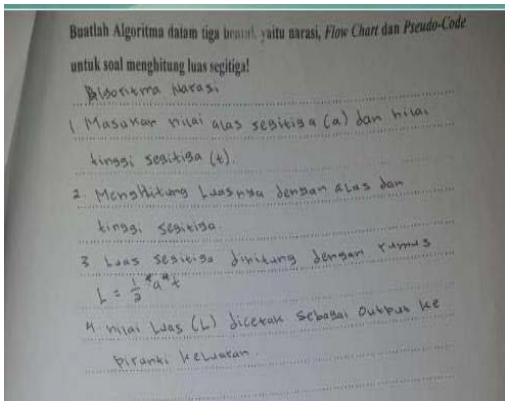


Figure 1. The Answer of Student Workheet 1

Based on the students' answers, it shown that students must use their mathematical logical thinking skills to solve the problem. Students must make algorithms how to calculate the area of a triangle into three forms, namely narration, flowchart, and Pscudo-Code.

Indicators of harmony thinking appear on students' answers, the answer shown that students can determine the steps taken regularly in solving problems given from the beginning of planning until a solution is obtained. In the form of descriptions/narratives can often confuse students because the logical sequence is not appropriate. This is due to a misunderstanding in understanding the language itself. Furthermore, in designing an algorithm using pseudo-code (pseudo code), the input, output and process components must be clearly defined. The answers contained in this problem are clear. The use of English structure is appropriate to describe an algorithm

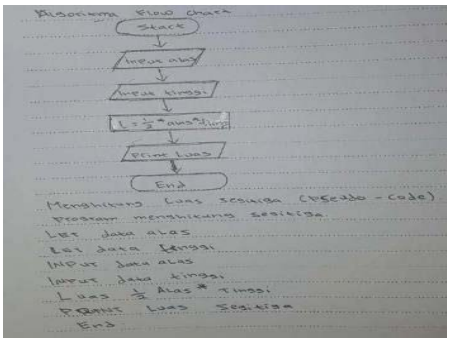


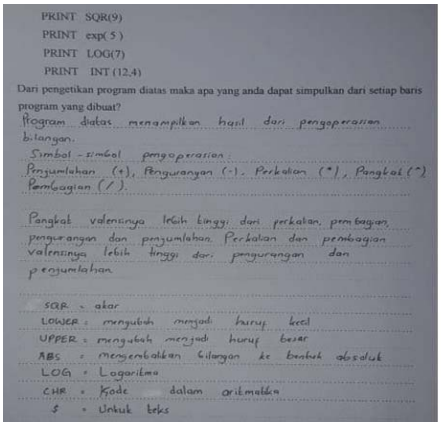
Figure 2. The Answer of Student Work sheet 1 Flow Chart Form

Flowchart is a method for describing each stage of problem solving by presenting certain symbols. The student's answer in using the flowchart is correct because the use of the symbol used is parallelogram symbol that states input/output, the rectangle that states the process and the rectangular round states start, and end.

Indicators of ability to argue also arise in this problem, namely when students are asked to provide their arguments, students can provide arguments regarding the steps to be used appropriately (coherently), use the appropriate symbols, and draw conclusions on the final results given.

Indicators of conclusions are also clearly seen when students give their arguments, namely with the right final results. Narrative, flowchart, and Pscudo-Code algorithms are interrelated with each other.

The second lesson is given Student Work sheet 2. The following is the result of student work sheet 2 and the key of the answer:


PRINT SQR(9)
PRINT exp(5)
PRINT LOG(7)
PRINT INT (12,4)

Dari pengetikan program diatas maka apa yang anda dapat simpulkan dari setiap baris program yang dibuat?

Program diatas menampilkan hasil dari pengoperasian bilangan.

Simbol - simbol pengoperasian :

Penjumlahan (+), Pengurangan (-), Perkalian (*), Pangkat (^) Pembagian (/).

Pangkat valensinya lebih tinggi dari perkalan, pembagian pengurangan dan penjumlahan. Perkalan dan pembagian valensinya lebih tinggi dari pengurangan dan penjumlahan.

SQR = akar
LOWER = mengubah menjadi huruf kecil
UPPER = mengubah menjadi huruf besar
ABS = mengembalikan bilangan ke bentuk absolut
LOG = Logaritma
CHR = Kode dalam aritmatika
$ = Untuk teks

Figure 3. The Answer of Student F

The answer above shown if student have understood what is ordered in Student Work sheet 2 in analyzed each step of the process. Students do their work sheet 2 in a mathematics laboratory using computers and software of Just Basic Language Programming. Before analyzing students are required to follow on work sheet 2 command on computer or laptop. After that the students are directed to answer the questions in the work sheet 2. During the work sheet 2 work process, the indicators that appear are seen from the answers of students F namely:

Indicators of demand thinking occur when students are asked to run the program. Students can write programs using Just BASIC Software appropriately and can run programs whose results finally appear and use menus on the display of Just BASIC Software, one of which is a run menu that functions to run programs that have been created, test and check syntax errors made. If this step not correct and the writing of the program is still wrong, the final results of the program will not appear.

Indicators of argumentation ability also shown when students are asked to explain how to run the program in accordance with the appropriate completion steps. F detailed and meticulous students in analyzing this matter, it can be shown from the answers of the students who saw the difference not only in the difference in the color of the writing but every command that was done. Student F understands every word he writes in the student's answer sheet, for example SQR, namely root, CHR code in arithmetic and Log for logarithms. This shows that the indicators of students' mathematical logical thinking abilities, namely indicators of drawing conclusions are fulfilled.

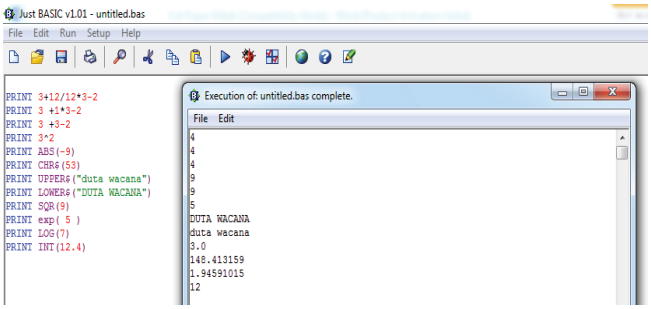


Figure 4. The Answer of Student F on Software

After giving the answer to the works sheet, student F also proves the answers obtained into the software to obtain the correct solution as shown in Figure 4 above.

In the next session, students were given work sheet 3 with more specific material to the Just Basic Software subject. The works sheet 3 contains material and steps that students must work on using a computer or laptop. Furthermore, the researcher and the correction team analyze student work by looking at indicators of students' mathematical logical thinking skills.

Table 3. Nilai mahasiswa LKM 3

Range of Value	Frequency	Percentage (%)	Category
81-100	23	58,9	Very High
61-80	15	38,5	High
41-60	1	2,6	Medium
21-40	0	0	Low
0-20	0	0	Very Low
Total	39	100	

From the results of works sheet 3, it can be seen that more than 50% of students' logical thinking ability is in the very high category. It is also shown that even students' mathematical logical thinking skills are increased compared to work sheet 1. The following is the description of LKM 3 which is stated in table 4

Table 4. Mathematical Logical Thinking Ability Student Work Sheet 3

Statistik deskriptif	Skor
Average	8,1
Maximum Value	9,6
Minimum Value	5,4
Mode	8,081

Based on the results of the description table above it can be seen that students increasingly understand the programming algorithm using just BASIC software. The minimum score of 5.4 students increasing compared to the results of works sheet 1, namely 3. Figure below is one of student's answer of work sheet 3.

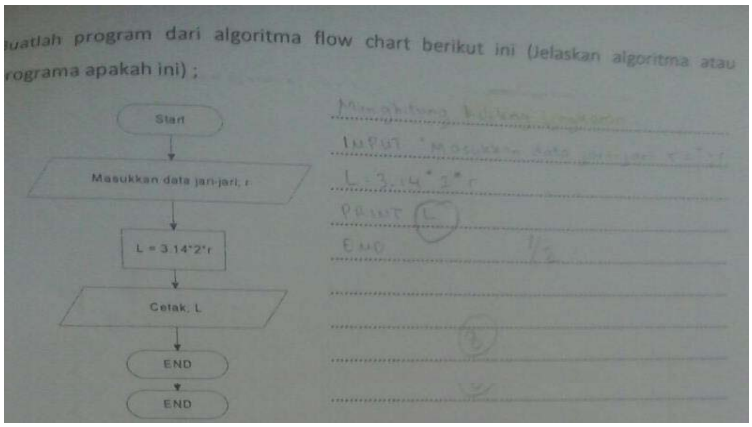


Figure 5. The Answer of Student M

On work shee 3, the indicator of students' logical thinking ability can be seen in the indicators of thinking that when student solve the problems, student M can understand to make the program from the flowchart algorithm by using programming instructions starting from INPUT, PROCESS and OUTPUT. Starting by writing the title of the program, "Calculating the Circle", followed by INPUT "Enter the data radius r =", then PROCESS with “L = 3.14 * 2 * r” then OUTPUT “ Print L” and END with “End”. The INPUT instruction is used to enter data after the program is run. Flowchart symbols or drawings for INPUT instructions are the same as OUTPUT instructions, namely the flat shape of parallelogram. PROSES instructions are used to process data or variables. The shape of the flowchart is depicted with a rectangular flat symbol. OUTPUT instruction is an instruction used to display the results of data processing by a computer, either through the display screen, printer, disk, or speaker. The general form of writing is the PRINT command. While the flowchart symbol or image for OUTPUT instruction is a flat shape of parallelogram. The program created by M students has been well directed, but there is one programming writing on the wrong answer so that the program should not work when writing the program title, students do not write "PRINT" for the title of program.

The ability to argue indicator is seen after the student has written the answer provided on the sheet through proof by running the program into a computer or laptop. Student M forgets to write "PRINT" before the program title in the answer sheet. But the programs created on the computer are correct and the program can run.

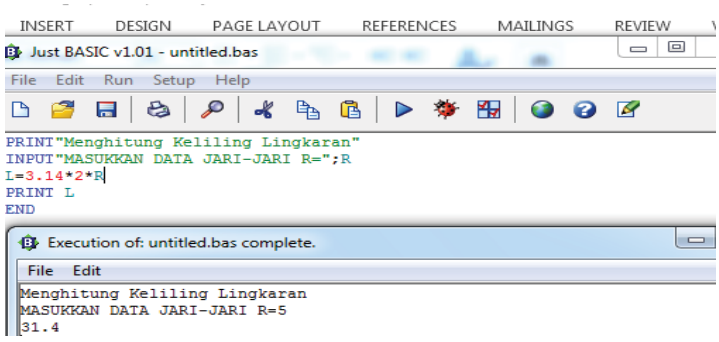


Figure 6. The Answer of Student M

Indicator of conclusions is shown when students can conclude the flowchart agorithm on the work sheet is some steps before make the program on computer to calculate the area of the circle. Students can prove it when they make the program on computer or laptop.

CONCLUSION

The results of the study show that: 1) In the indicator of harmony thinking of students can determine the steps taken regularly in solving the problems given from the beginning of planning to a conclusion, 2) In the indicator of ability to argue, students can give their arguments logically according to the facts or the information related to the problem planning steps and problem solving is taken, 3) In the conclusion drawing indicator, students can draw a conclusion from an existing problem based on the completion steps that have been taken

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