LINEAR CONGRUENT METHOD (LCM) IN TESTING SYSTEM USING CLIENT-SERVER MODEL

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Abstract
This study aims to apply the Linear Congruent Method (LCM) method using client-server test system, so as to minimize the weakness of examining process and the teacher's mistake in valuation that may occur. LCM method in this research was used to scramble questions data before testing and sent to the Client (Student) by the Server (Teacher) via a TCP/IP Socket. The system was designed through the VB.Net Programming Language. The results showed that by implementing LCM method in test system lead to 100% performance.

Keywords:LCM, Sistem Ujian, Client-Server.

1.0 INTRODUCTION

Information and Communication Technology (ICT) in the learning system has developed at this time, including of Examining process[1].This rapid development revolves around quality, rapidity, and practicality so that in many of the current exam processes, both the exams for entry systems and graduate competency measurement system have switched from conventional to computerized exams[2].

The Exam is intended to be a measure of the achievement of a goal of teaching so that students can know the level of ability to understand the field of study being pursued[3]. If the result is not maximal, then the learning process should be improved by quality and quantity process. Testing is one way to evaluate the learning process. In many testing processes, certainly validity an assessment is too important so as to improve the competitiveness of graduates[4].

Cheating in the exam becomes one of the factors of invalidity of student ability. In the Conventional Test System,the paper-based test is still many factors that allow students to commit acts of cheating[5]. In addition, paper-based test as conventional test systems is still very inefficient and effective because it requires a lot of cost and time management. Another problem that arises in this manual system is the assessment process conducted by teachers tend to spend a long time. After checking the answers of the students' final exams, the teacher must calculate the grade of the Student Exam by calculating the points of the correct answers.

From these problems, has been created and implemented computer-based test system[6],[2]. However, most of the computer-based test system is more directed to the peer

to peer method, so with the client-server system that proposed in this study could be an alternative solutions. Client-server systems, using Visual-based, and Web-based, has been widely developed, but to implement the LCM method as a randomization system has not been done so that in this research implemented LCM techniques in the client-server based test system.

1.2 Problem Formulation

Based on the problems that have been described above, it can be taken a problem formulation is how to apply Linear Congruent Method (LCM) method in the test system based on client-server?

1.3 Objectives and Benefits of Research

Benefits derived from this research, in addition to the contribution of science by implementation test system with LCM techniques as a method of randomization, also obtained the following benefits:

1. The effectiveness of the final system of examination conducted by various educational institutions,
2. Avoid cheating examinees in the exam process.
3. Facilitate the teacher in the management of the final exam.
4. Facilitate students and teachers to see the results of the exams that have been done.
5. Teachers can be represented in overseeing the exam process and the exam results will be sent via e-mail that has been registered before.

2.0 THEORETICAL

2.1. Examining System

Examiningis a test aimed at measuring a person's achievement after he or she goes through the learning process over a period of time by looking at or assessing the ability of examinees in answering/resolving a number of issues given[7]. However, when viewed in terms of form, this test can be done in writing, interviews (questions and answers), physical activities and others[8], [3]. While in terms of media used, the test can be done paper based or computer based test[9].The results of the examination of paper-based test and computer-based have been done, as reviewed by Öz in 2018 which analyzes the reliability and validity of achievement tests. The results of this study state that in terms of reliability, validity, and score obtained by exam participants did not significant differences, so that computer-based systems could be integrated into the curriculum not only for instructional practices but also for assessment purposes.[10].

Computer-based systems that are widely applied can be an online exam system and the computer must be connected to the Internet network during the test was done. The concept of the exam applied to most systems integrates into electronic-based learning systems, as developed by Kaiiali in 2016, which makes a breakthrough by developing the Moodle open source online system becoming more mobile. In the developed system, not only for the literacy process but also for the Implementation in the examining process [11], although the computerized system of interaction that occurs can be less profitable and can be a problem[12].

Implementation of the computer-based system in the test, for most educational institutions, will be difficult, mainly support schools in remote areas with an insufficient band with the internet. For that start many developed computer-based test system by simply utilizing Local Area Network (LAN). In terms of features Application of the test that is widely used, not much different from the online system, but this test does not require internet connection but uses a computer connected to the local network during Exam process[13].

2.2. Linear Congruent Method (LCM)

Linear Congruent Method (LCM)is a random number generator that is widely used in computer programs[14], [15], [16]. LCMutilizing a linear method to generate a random number defined as follow:

$$Xi = (a*x(i-1) + c) \bmod m \tag{1}$$

where:

Xi	=new random value
x(i-1)	=Seed (or starting value)
a	=multiplier
c	=increment
m	=modulus (or divisor)

If there are 20 test questions and have not been randomized, the process of randomizing question can be done by determining the values of a = 1, c = 7, m = 20 and x (0) = 2 as follows, by the formula *xi = (a * x (i-1) + c) mod m*, *xi* is the random number to *n*, *a* and *c* are LCM constants, *m* is the maximum number of random numbers. For the value of *x(i)* not to produce 0 value, then in the simulation of the randomization of this problem, each time *x(i)* has been added tovalue 1.

Implementation of LCM method as a problem-solving system has been done in many application such as in learning game system[16], [17], and also in examining mobile system [18].

2.3. Client-Server System

Client-Server model separates clearly between Server and Client[19], where the Server provides network services and clients receive services[20]. Some computers set up as servers that provide all the resources available in the network so that on the client side is often referred to as front-end and on the server side as a back-end.

The principle with this architecture network is very simple, where the server will wait for requests from Client, process And then deliver the results to the Client. While the Client will send a request to the server. Waiting for the process and seeing the visualization of the results of the process[21]. This Client-Server system main protocol usingTCP/IP(Transmission Control Protocol / Internet Protocol) to communicate each other network in the range.

3.0 METHODOLOGY

Research stages starting from data collection and information. The source of data used inthis study from a Vocational High School (SMK) in Polewali Mandar District. Data obtained by a direct interview process with the principal as executive maker,and teacher as user object in this study. In addition, it was also conducted by observation at the research site directly to monitor how conventional and computerized model test process used so far. Meanwhile, literature study is also applied by looking for reference sources from related journals and research to strengthen literature review in system development using LCM method. The system framework designed to implements LCM method in Client-Server system as shown in Figure 1.

The data source that implement on the system framework, built based on existing data on SMK in the form of data Student, Teacher and Question Data. Then the data will be stored in the database program. Furthermore, before the question tested, then the system first to randomize the existing problem by using the method of LCM (Linear Congruent Method) then the question tested through Client-Server application. The student score will be calculated based on the weight of the questions on the correct answer. By the time the exam process has been completed, students and teachers can see the test results directly via existing applications. The server application has an Email Sender feature that can be used to send the test results to the teacher's email if the teacher does not have time to attend the exam process.

Meanwhile, to implement the LCM method in randomizing the question as Figure 2.a, and the swap process to determine the problems received by each test participant as shown in Figure 2.b, as well as the client-server management system as in Figure 3.
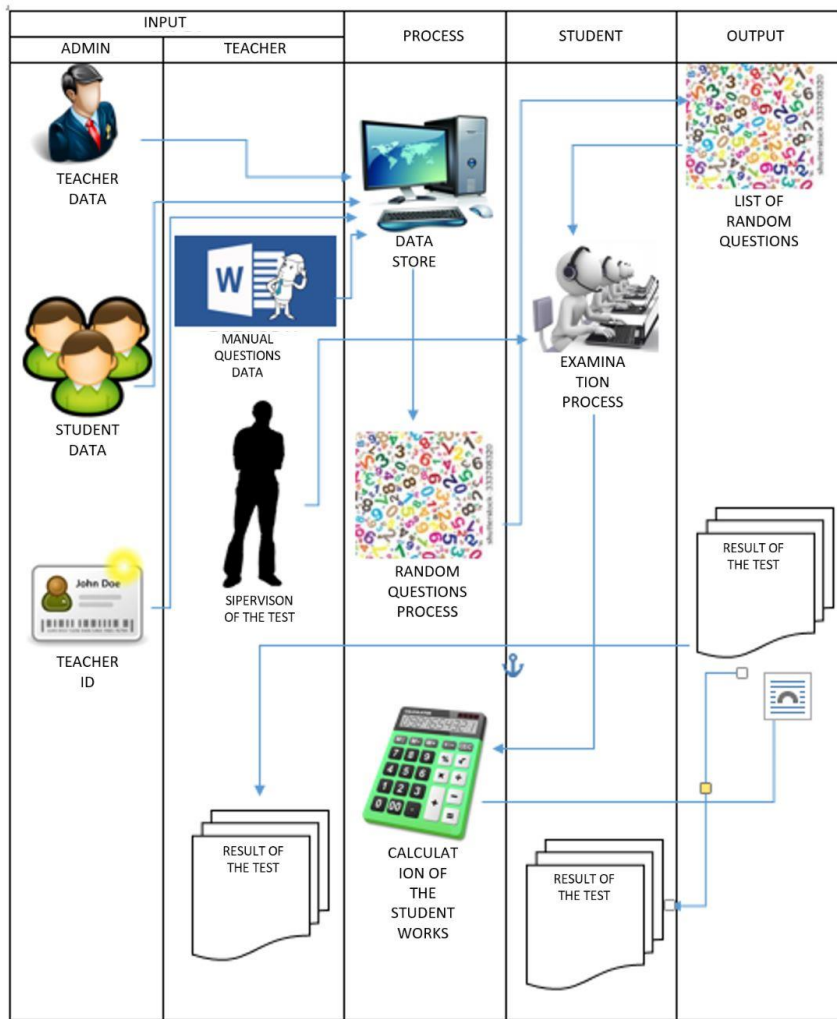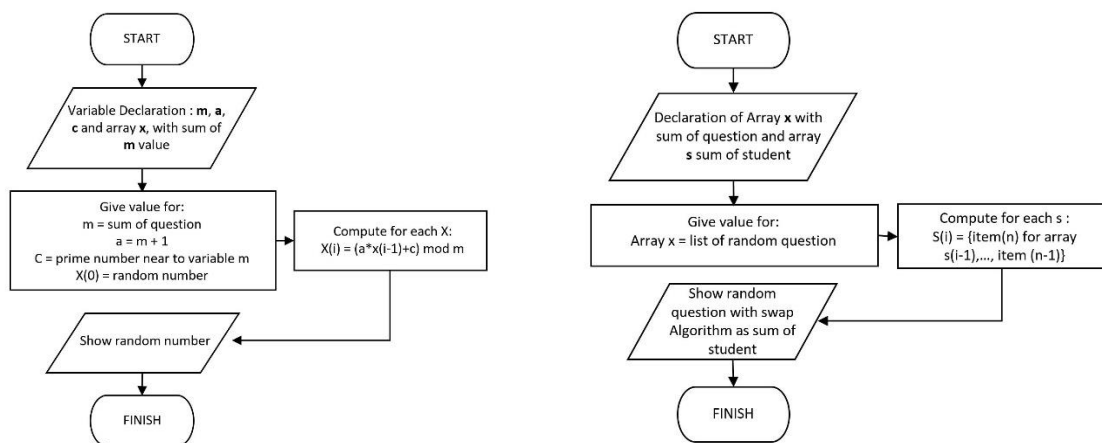
Figure 1.System Framework

a. LCM method in randomizing the question
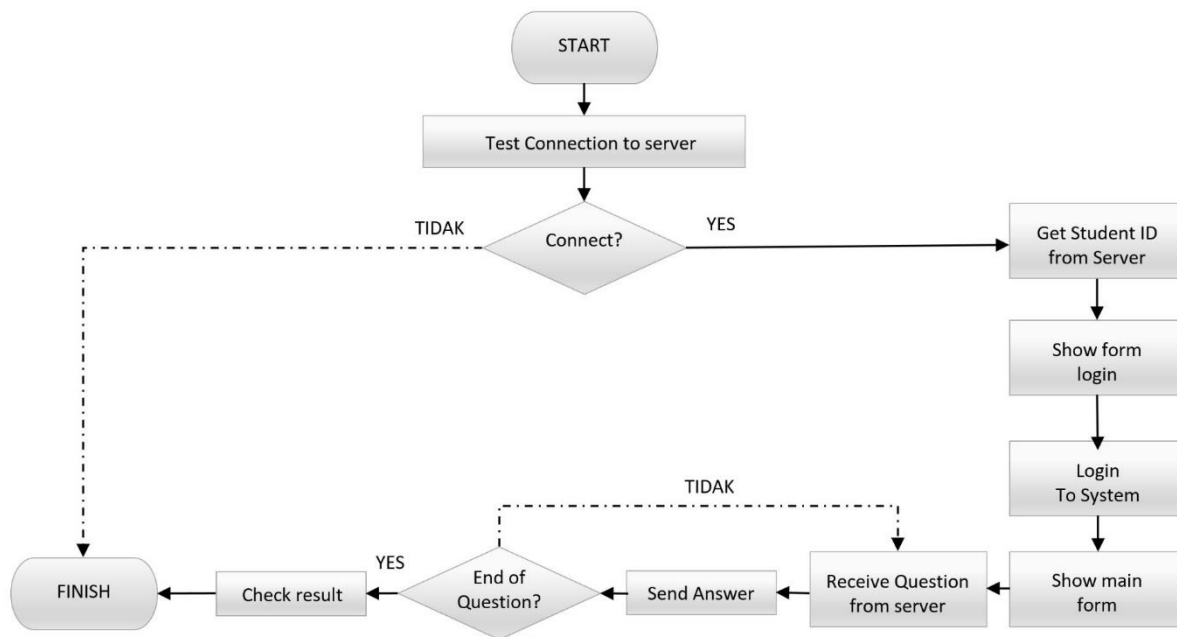
b. Swap Process

Figure2. Core System Process

Figure3. Client-Server management

4.0 RESULTS AND DISCUSSION

In this discussion described how LCM can solve existing problems, namely in randomize the exam questions. This method has several parameters in the formula as equation (1). Related from state of the art of the previews study, to use of LCM method, the initial test process is done with the value of $X(0)$ must be set to 0 *(Zero)*, so if the problem amounts to 50 then the results of calculations LCM will produce numbers continues to be the same, so this case make students guess the question list number to be tested. Example for 50 questionlist, number 1 will compute by LCM by number 48 in many experiments. For that in this study done by giving random value on $X(0)$ with random function in Visual Basic.Net programming with the code as follows:

```
        Dim m AsInteger = jumlahSoal
Dim a AsInteger = m + 1
Dim c AsInteger = cariBilanganPrima(m)
Dim x(m) AsInteger
Dim r AsNewRandom
        x(0) = r.Next() Mod jumlahSoal
```

Wherethe code $x(0) = r.Next() Mod jumlahSoal$ will make the initial problem always be in the random position when first using the Application.

For Experiment, In the first two tests of the application, the first test was obtained X(0) = 21, so that the First Problem was in item 19, while in the second test it was found that X(0) = 29 and First question were in item 27. This indicates that the LCM method can accurately perform the randomization of the question number before it is tested, so as to minimize the cheating done by the examinees.Application testing to randomize question list based on formula (1) with m=50, a=51, c=47, and x(0)=21, as shown in Table 1, and second experiment with m=50, a=51, c=47, and x(0)=29, as shown in Table 2. Client-Server application development in this study concluded that the application leadsto be considered valid by whitebox testing as shown in Table 3. In this case, the program is stated to be free from error and logic error with some assumptions as follows:

a. Can guarantee all Independent Paths in modules that are done at least once.
b. Can work on all logical decisions and all loops that conform to their boundaries
c. Can also work on all basic internal structures that guarantee validity.

Table 1. Randomize Question List Experiment st

x(0)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
x(1)	19	16	13	10	7	4	1	48	45	42	39	36	33	30	27	24	21	18	15	12	9	6	3	50	47
x(0)	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
x(1)	44	41	38	35	32	29	26	23	20	17	14	11	8	5	2	49	46	43	40	37	34	31	28	25	22

Table2. Randomize Question List Experiment 2nd

x(0)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
x(1)	27	24	21	18	15	12	9	6	3	50	47	44	41	38	35	32	29	26	23	20	17	14	11	8	5
x(0)	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
x(1)	2	49	46	43	40	37	34	31	29	25	22	19	16	13	10	7	4	1	48	45	42	39	36	33	30

Table 3. WhiteBox Testing

No.	Flowgraph	Independent path	Region	Cyclomatic Complexity
1	Main Menu	5	5	5
2	Data Menu	5	5	5
3	Process Menu	3	3	3
4	Report Menu	5	5	5
5	Student Data Form	5	5	5
6	Teacher Data Form	5	5	5
7	Question Daya Form	5	5	5
8	Teacher ID Data	5	5	5
9	Client Program	3	3	3
10	Grade Calculation	2	2	2
11	TCP/IP Client	2	2	2
12	Sender Report Form	2	2	2
	Total	47	47	47

5.0 CONCLUSION
5.1. Conclusion

Based on the results of testing and analysis of the study results, it can be concluded that the implementation of LCM method with the initial random technique can randomize the questions list well so that its application can reduce student cheating in the implementation of the examining activity. In addition, based on the results of testing the system using the White Box it can be concluded that the system can function properly.

5.2. Suggestion

The client-server testing systemwith LCM method using Visual Basic.Net programming language is still a lot of things that need to be developed, such as;
  a. The test system that has been built can be developed to be able to load the question with the picture instead.
  b. Test monitoring features can be developed towards System Viewer such as Team Viewer application that allows teachers to view the activities of each student's desktop screen.

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