Computerized Semester Exams by Randomization Order of the Questions with Linear Congruential Generator Methods (Study Case: Agathos Vocational High School)

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Abstract

Taking advantage of computer technology in education will help the semester exams in every school become simpler during the process of the exam and scoring, Agathos Vocational High School use manual exam system. They have to print out test paper, undisciplined students can cheat during exam, mistakes during marking the test, and unorganized archives when filing the student's results. To solving their current problems designed a new system will organize the information electronically in filling the student's grades and making a random order of questions using Linear Congruential Generator (LCG) method. This computerized system will help the teachers prepare the questions and answer, teacher only have three days to input in database. Marking the answers and filling the grade are automatically by system. With using LCG method, every student will get randomized questions based on Student's ID Number, this will reduce the possibility of cheating and the students will not be able to continue filling their answers after the time is over. After implementation the system, it gives a benefit to prepare for the exam from 8 days to 1 day. The system test results is 64% can be accepted by the user.

I. INTRODUCTION

The rapid growth of era and also the information technology advances in Indonesia that are needed and used for daily needs have become common thing for humans. As sharing data for business, education and health needs as well as integrated data storage. Furthermore, by being connected to a computer network that is a system consisting of computers and network devices, that work together to achieve the same purpose so the computers can connect to each other and share data in one of the same server network[1]. Education is a process that takes place in life as an effort to balance conditions in oneself with external conditions. This balancing process is a form of survival that is carried out, so that oneself can follow every activity that takes place in life[2]. Developing technology can be implemented into the education sector, so school data can be integrated and minimize human error. The activity of teachers and school staff is faster in accessing and changing some school data as needed.

Vocational educationbuild 8 graduates competencies [3]. Beside that vocational education has three main benefits: (a) for students as self-improvement, increased opportunities for employment, increased opportunities for entrepreneurship, increased income, preparation of further education, self-preparation for society, nation, state, adaptation to change and environment; (b) for the world of industry can obtain high-quality workforce, ease the cost of business, help advance and develop the business; (c) for the society can improve people's welfare, increase national productivity, increase state income, and reduce unemployment. Seeing the benefits of advances in information technology so many educational institutions began to develop their systems, so that the system became integrated using network servers. As well as in the implementation of the National Examination conducted by computer-based by several schools.

Based on information from the Principal, Agathos Vocational School is one of the Vocational High Schools that has two specializations that is Accounting and Multimedia which in the implementation of semester exams still manually have to print semester exam question sheets and it take up for one week, students still continue the semester

exams even though the exams time is up so the activity of the teacher is hindered, the possibility of students cheating on the semester exam, the teacher needs more time in correcting the answers, several day overtime work and irregular storage of student grades that slows down the teacher's work process.With the development of information technology, makes Agathos Vocational School wants to improve their system.So Agathos Vocational School no longer needs to prepare for semester exam equipment, students become time discipline, students can not cheat, teachers doesn't need to correct answers by manually because the value directly in database and stores student value data become organized and easily accessed by teachers who need it.To prevent students from cheating during the semester examination, the system formed uses the Linear Congruent Generator (LCG) as a method of randomizing semester exam questions and report card features that can process student academic grades such as: assignments and semester exams to be final grades so they can be used by homerooms to ease the printing of student report cards.

II. STUDYOF LITERATURE

No	Title	Abstract	Object	Methods	Results	Conclusion	Keyword
1	Modifikasi Metode Linear Congurential Generator untuk Optimalisasi Hasil Acak	Conventional exam implementation is considered to be less effective and efficient because it requires large costs and a long time in its implementation so it needs to be improved by changing the examination system to computerization . In each test execution, it is necessary to pay attention to fraudulent actions by students in the form of cheating and cooperation in exchanging answers. This study aims to provide different random questions to each student using the Linear Congruential Generator (LCG) method. However, the use of the LCG method still has weaknesses where the results of randomization are easy to	Conventiona l exam	Linear Congruentia l Generator dan Couple Linear Congruentia l Generator	CLCG produces more patterns because the process carried out uses two linear equations and the results form two vectors namely row vectors and column vectors. The randomizatio n pattern system is difficult to predict.	The simulation results show that the Couple Linear Congruential Generator method has a more complicated randomizatio n pattern than the Linear Congruential Generator method. The randomizatio n pattern is influenced by the value and amount of the combination of values given to the variable. In addition, the more variable values are, the more complicated the randomizatio n pattern produced by CLCG.	LCG, CLCG, Pattern, Randomizatio n

		guess, so the need to optimize randomization is to use two LCG and the help of the matrix which is the Coupled Linear Congruential Generator (CLCG) method. The modified CLCG method produces better randomization and a more complex pattern compared to the LCG method.					
2	Penerapan Metode Linear Congurent Method (LCM) Dalam Perancangan dan Pembuatan Game Monopoli Edukasi untuk Tokoh Pahlawan Nasional	The lack of supporting media in introducing National Hero Figures made people less familiar with their own Hero Figures, for this reason appropriate media was needed in introducing National Hero Figures, one of which was through the Educational Monopoly Game that could provide information about National Heroes. The Linear Congruent Method (LCM) is used to randomize questions on monopoly games. Based on the results of testing, the Linear Congruent Method (LCM) randomization method can be	Monopoli Game	Linear Congurent Method	The right combination of constants will result in randomization of truly random questions and avoid the occurrence of repetition of randomization because it uses the LCM method	There is no recurrence of the same randomization when the game is played.	Education Games, LCG, National Heroes

		implemented in the Monopoly Education game for National Hero Figures. In this study there was no repetition of the same question when the application was reopened.					
3	*Design and Implementations of Linear Congruential Generator into FPGA*	This paper exposes circuit design of linear congruential generator (LCG) and implementation in FPGA. The circuit is derived from LCG algorithm proposed by Lehmer. Wordlengths reduction technique has been used to simplify the circuit. Several nets connection among the blocks of the circuit are ignored or disconnected. Simulation either behavior or timing have been done successfully. Four best Xilinx chips are chosen to gather comparison data of maximum speed and area occupied. Kintex 7 is the fastest chip among all it is about 309 MHz and Spartan 6 is slowest one which is only 73 MHz. The	Circuit Design of LCG	Linear Congurential Generator	The maximum frequency of the design circuit is 309 MHz. Kintex 7 is the best chip that applies the LCG circuit design	The maximum frequency of the design circuit is 309 MHz (Kintex 7, m = 255), and the minimum frequency is 73 MHz (Spartan 6, m = 2³¹-1). Kintex 7 is the best chip that applies the LCG design circuit.	LCG, FPGA, Xilinx, Word Length Reduction, Kintex

		area occupied is similar among all of the selected chips.					

III. FRAMEWORK

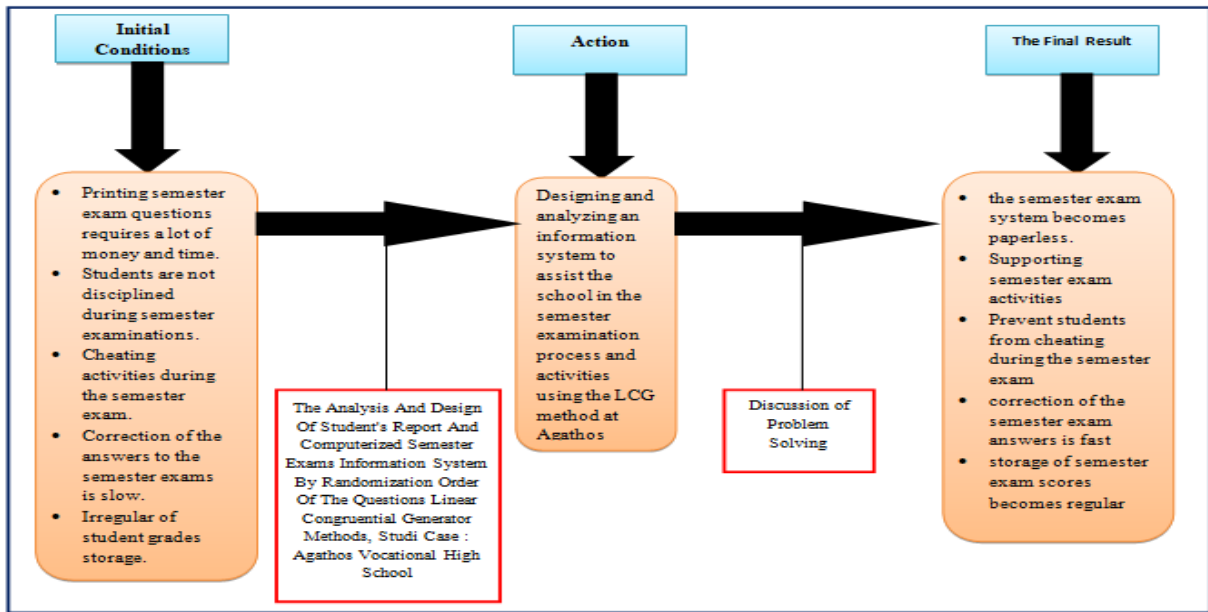The following is a description of the framework:

Fig.1 Computerized Semester Exams with LCG Method

In figure. 1 shows the problems exist in the current conditions in Agathos Vocational High School, by observing and interviewing for several days to the user, it can be concluded that Agathos requires a computerized system to solve the problems that have occurred. By using computerized exam and LCG method, it will provide better result.

IV. METHODS

Linear Congruential Generator (LCG) Random numbers resulting from processing computer programs are pseudo random numbers, this is because the generation process uses arithmetic operations. Algorithms or methods have been often used to generate random numbers. Linear Congruential Generator (LCG) method is a method of generating random numbers that are often used in computer programs. LCG uses a linear model to generate random numbers defined by:

$$Xn = (aXn - 1) + b \bmod m$$

Where:
Xn   = the n-th of random number
Xn-1 = previous random number
a   = multiplier
b   = increment

m   = modulus

X0 is the initial key to randomization of a sequence, also called seed.

The initial period of numbers that will be randomized from the Linear Congruential Generator (LCG) method is not greater than the modulus (m), and some cases show that the randomization results does not exceed the modulus (m).This LCG method has the advantage at a speed where only a few bit operations are needed. This Linear Congruential Generator (LCG) method has its own characteristic, that is, there will be a repetition at several randomization times in a certain period if the modulus (m) is greater than the number of numbers to be randomized. The repetition is one of the deficiencies that this method has. One of the characteristics of this method is that there is a repetition in a certain period of time or after randomization, to overcome the repetition, the determination of the LCG constants (a, b and m) determines whether or not random numbers are obtained in the sense of obtaining random numbers as if there was no repetition by doing several tests[5].

V. RESULTS

The result of the study by using LCG method was implemented into Agathos Vocational School Systems as in figure below:
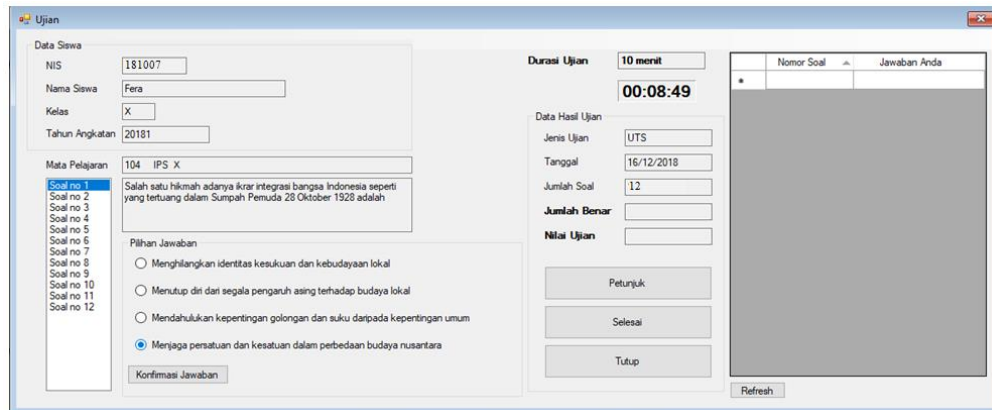

Fig. 2 Random question use Linear Congruental Method

In figure.2 show the question which using Linear Congruential Method. Every student after Login by their Student's ID number will get random questions. The last three digits of the student id, will be entered into the LCG randomization method, as explained earlier above. That's automaticly shuffle the number of question on every computer which used by students for exam.

In this stage the method is explained thoroughly in the process of randomizing the sequence. With the example three digit last of Student's ID Number is 7 and the number of questions is 12.

Initiation:
$X_n = (aX_n - 1 + b) \bmod m$

Declaration:
a = 1
b = 5
X0 = 7
m = 12

Result:
$X_1 = (1 * X_0 + 5) \bmod 12$
       (1*7+5) mod 12
       (7+5) mod 12

12 mod 12 = 0
$X2 = (1 * X1 + 5)$ mod 12
(1*0+5) mod 12
(0+5) mod 12
5 mod 12 = 5
$X3 = (1 * X2 + 5)$ mod 12
(1*5+5) mod 12
(5+5) mod 12
10 mod 12 = 10
$X4 = (1 * X3 + 5)$ mod 12
(1*10+5) mod 12
(10+5) mod 12
15 mod 12 = 3
$X5 = (1 * X4 + 5)$ mod 12
(1*3+5) mod 12
(3+5) mod 12
8 mod 12 = 8
$X6 = (1 * X5 + 5)$ mod 12
(1*8+5) mod 12
(8+5) mod 12
13 mod 12 = 1
$X7 = (1 * X6 + 5)$ mod 12
(1*1+5) mod 12
(1+5) mod 12
6 mod 12 = 6
$X8 = (1 * X7 + 5)$ mod 12
(1*6+5) mod 12
(6+5) mod 12
11 mod 12 = 11
$X9 = (1 * X8 + 5)$ mod 12
(1*11+5) mod 12
(11+5) mod 12
16 mod 12 = 4
$X10 = (1 * X9 + 5)$ mod 12
(1*4+5) mod 12
(4+5) mod 12
9 mod 12 = 9
$X11 = (1 * X10 + 5)$ mod 12
(1*9+5) mod 12
(9+5) mod 12
14 mod 12 = 2
$X12 = (1 * X11 + 5)$ mod 12
(1*2+5) mod 12
(2+5) mod 12
7 mod 12 = 7

Before the begin examinations, teacher will set the timer. Students must answer before the exam time runs out. After finish system will calculated the grade, and show the result.
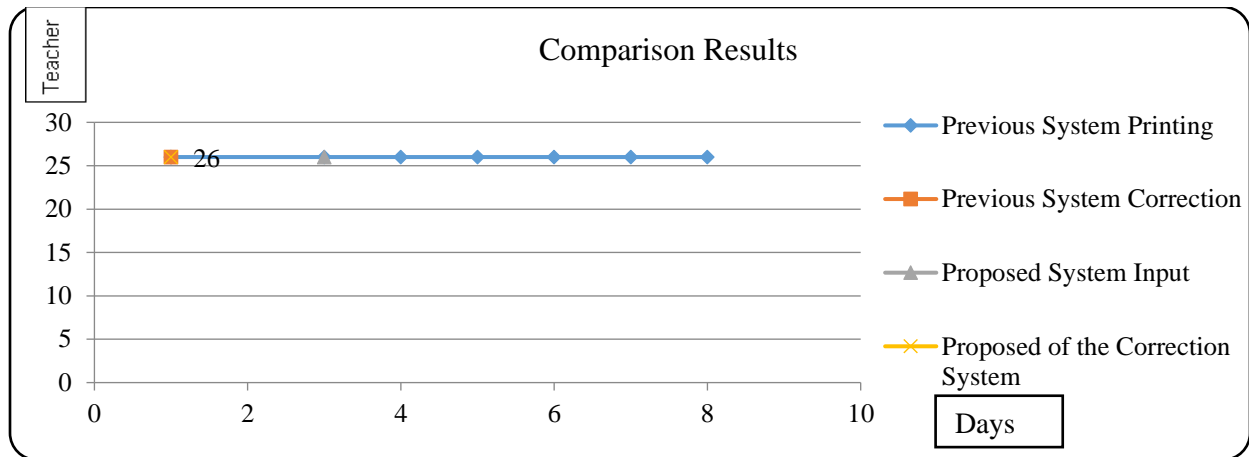
Fig. 3 Comparison of Result Charts

In figure. 3 show the comparison currently system need 8 days to prepare and print the question paper, and Plus one day to correction the result. After implemented the new system, it's only need three days to input the question in database, and one day for the exam along with correction of exam result.
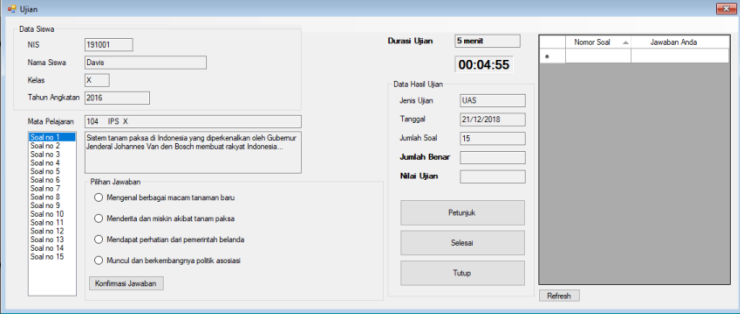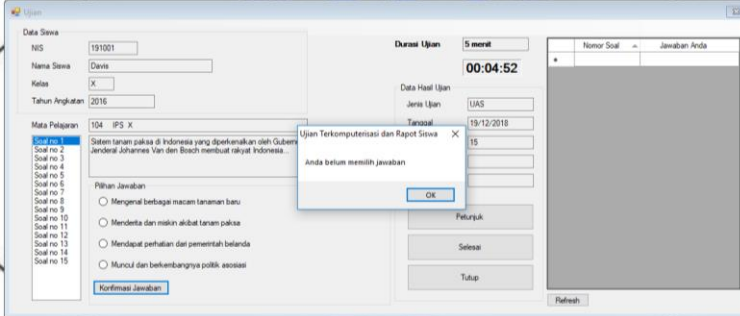
Table I. Comparative Results

No	Previous System	Proposed System
1	Printing takes 8 days and costs per question Ex: 150/question sheets, 15 subjects,67 students, 4 sheets question/subjects 150 x 15 = Rp 2250/student; Rp 2400 x 67 = Rp 150.750 Total expense each semester is : Rp 150.750 x 4 = Rp 603.000	The Input process done in 3 days and Paperless
2	Students still continue semester exams even though the exams time is up	Students fill the questions answer according the set of duration
3	Students have the possibility of cheating	The order of the question is randomized based by Student's ID Number with implementation of Linear Congruential Generator method. So each student will be get a different questions.
4	• 8 days for printing question sheets • 1 day plus overtime work to correct semester exam answer sheets	• 3 days Inputted questions are stored in the database • The results of the semester exam are immediately calculated
5	Students grades are still physically stored	Student grades are stored in the database

VI. TESTING

Black Box Testingis "The testing software in terms of functional specifications without testing the design and program code"[8].So the Black Box testing method focuses on the functional requirements of the software. System testing is done by observing the output of various inputs. If the system output is in accordance with the design for data variations, then the system is declared good. Black Box testing is not an alternative to white box testing, but is a

complementary approach to finding other errors, besides using the white Box testing method. The result show below Table II.

Table II. Black Box Testing

Scenario Test	System
Students click on the answer confirmation button, but have not chosen an answer	
Scenario Result	System
The system will deny access and show the notification "You have not selected an answer"	

User Acceptance Test is a test carried out by the user where the user is a staff or employee of an agency that directly interacts with the system and is verified whether the existing function has been running according to its needs or functions[9].

VII. CONCLUSIONS

Change the exam manual system become computerized, so Agathos Vocational School can save the money up to IDR 603,000 and the work time up to 8 days. The system duration feature makes students become discipline in fillingon semester exams. The system randomizes the order of semester exam questions, so that preventing cheating by students. Correction of exam answers is done automatically so the teachers becomes more effective. Student test results it's saved by electronically in database, so that it does not require a lot of space and searching of results data can be faster. The system test results of 64% can be received by the user, that is majority Agree and Strongly agree with the implemented system.

REFERENCES

[1]. **Wahana Komputer.** *Panduan Belajar MySQL Database Server.* Jakarta Selatan : Media Kita, 2010.

[2]. **Sukamto, Rosa Ariani and Shalahuddin, Muhamad.** *Rekayasa Perangkat Lunak Terstruktur dan Berorientasi Objek.* Bandung : Informatika, 2015.

[3]. **Marwan, Ady, Suttardi and Ramadhan, Rahmat.** *Penerapan Metode Linear Congruent Method (LCM) Dalam Perancangan Dan Pembuatan Game Monopoli Edukasi Untuk Tokoh Pahlawan Nasional.* Kendari : SemanTIK, 2017. Vol. 3. 2502-8928.

[4]. **Biantara, I Made Divya, et al.** *Modifikasi Metode Linear Congruential Generator Untuk Optimalisasi Hasil Acak.* Semarang : Seminar Nasional Informatika, 2015. 1979-2328.

[5]. **Futaki, Sofyan Saoqi, Marisa, Fitri and Wijaya, Indra Dharma.** *Aplikasi Kamus Istilah Kebudayaan Indonesia Berbasis Desktop Menggunakan Metode Fisher-Yates.* Malang : JIMP - Jurnal Informatika Merdeka Pasuruan, 2018. Vol. 3. 2503-1945.

[6]. **Perry, William E.** *Effective Methods for Software Testing.* Indiana : Wiley Publishing, 2006.

[7]. **Saroni, Muhammad.** *Orang Miskin Bukan Orang Bodoh.* Yogyakarta : Bahtera Buku, 2011.

[8]. **Winagun, Kuntang.** *Pendidikan Vokasi Sebagai Pondasi Bangsa Menghadapi Globalisasi.* Ponorogo : Jurnal Taman Vokasi, 2017. Vol. 5. 2579-4159.

[9]. **Zulfikar and Hubbul, Walidainy.** *Design and Implementations of Linear Congruential Generator into FPGA.* s.l. : International Journal Of Electronics Communication and Computer Engineering, 2014. Vol. 5. 2278-4209.