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Information System Web Design For Class English Proficiency Test Using Fisher Yates Shuffle Method

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Abstract

Information technology has been rapidly developing over the past few decades, and the COVID-19 pandemic has further accelerated the adoption and implementation of technology in various aspects of our lives, particularly in the business sector and education., where improvements in the learning system that were originally offline become online, practical, and easy. Currently, information regarding the English Test at Faculty of Social Sains and Humanities Buddhi Dharma University (UBD) is still running manually starting from registration, scheduling, exam, and announcement of English test results which of course requires more time for both participants and faculty staff. In order to boost students English knowledge, an English comprehension exam test is needed as organized by the faculty, that is English Proficiency Test (EPT). The design of this EPT information system, a part of being able to change the manual method, and also to simplified the EPT procedure. The new system is using website which combined with Fisher-Yates Shuffle method for randomization the exam test to reduce fraudulent actions in the process of conducting English training tests, being followed by 94 respondents as English training participants, system tested using the User Acceptance Test (UAT) method with five aspects of quality components. The results obtained that the system built had a good criteria with a value of 75.93%.

I. INTRODUCTION

In the current era of technology, computers have an important role, especially in human life. The application of information technology, one of which is in education, has developed rapidly and has increased in terms of quality, speed, practicality and also convenience. In facing competition in the era of globalization, students, especially university students, must be able to have English language skills. These skills are needed as capital to prepare a quality generation and have high competitiveness. One of the instruments to measure students' English skills is through the Test of English as a Foreign Language (TOEFL) [1]. TOEFL is a test used to determine a person's level of ability in English [2]. This test is intended for people who do not use English as their mother tongue. Generally, this test is used as one of the prerequisites for someone who wants to continue their studies or work in a country that uses English in their daily communication. There are 4 abilities that are measured in the TOEFL, namely Listening Comprehension, Structure and Written Expression, Reading Comprehension, and Writing.

Universities generally provide a predictive TOEFL score called the English Proficiency Test (EPT). EPT is a test to measure a person's ability to speak, read and or write in English which aims to test a person's ability to master English without being associated with the teaching and learning process [3]. EPT is the standard English exam for students because there are several universities that use it as a graduation requirement at the undergraduate level, and also to apply for jobs [4]. The Faculty of Social Sains and Humanities, Universitas Buddhi Dharma (UBD) has been conducting offline EPT training, where students have to come to campus and register manually and take the training and tests provided. The ongoing Covid-19 pandemic has made the training process difficult, so researchers designed a system that can adapt online between EPT training instructors and students. This website-based EPT training information system designed will be combined with the Fisher Yates Shuffle Method. This method is a random permutation technique from a finite set [5]. By applying this method to the website, one of the features in the form of exam tests will be random and save more time. With this training class information

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system, it is hoped that it can provide convenience for participants and instructors in the process of implementing more effective and efficient English language training at UBD.

II. LITERATURE REVIEW

Previous studies have shown that the conventional method is starting to be abandoned and turning to computerization for both training and exams to test students' abilities. With the development of software on the Online Question Paper setter using a random algorithm function using SQL queries and Java Enterprise Edition, this application can reduce cheating in student exams and reduce the workload of faculty members from institutions [6]. Research conducted by [7] combines the test format as part of the Computer-Based Test of English Competence where the results of this study have high validity and reliability. The most famous methods with randomization are the Linear Congruent Method (LCM) and Fisher-Yates Shuffle methods. Both of them are known for their benefit. Linear Congruent Method (LCM) also known as Linear Congruential Generator (LCG), is also an algorithm that can be used for randomization of problems and has been known for its easy and fast random number generation function. In several research this method can also be used as an option to randomize the questions [1], [5], [8].

This algorithm is a technique for randomizing, such as randomizing the arrangement of puzzles in games [9], or in multiplayer games to randomly bring up enemy objects [10]. Several other studies that use the Fisher-Yates algorithm such as [3], [5], [11], [12], and [13] giving good results in randomizing exam questions. In another research by [14] Fisher-Yates method is unbiased and used because this method has a good randomization strategy and is suitable for numerical randomization with better execution time than the naive shuffle algorithm. According to research from [15] found that the Fisher-Yates Shuffle Algorithm has a faster randomization process performance than LCM.

English Proficiency Test is a test to measure a person's ability to speak, read and or write in English which aims to test a person's ability to master English without being associated with the teaching and learning process [3]. There are 4 abilities that are measured in the TOEFL, that is Listening Comprehension, Structure and Written Expression, Reading Comprehension, and Writing. TOEFL (Test of English as a Foreign Language) is a test used to determine a person's level of ability in English [2]. This test is intended for people who do not use English as their mother tongue. Generally, this test is used as one of the prerequisites for someone who wants to continue their studies or work in a country that uses English in their daily communication.

Besides the TOEFL, there are several other types of tests that are almost the same, namely IELTS, TOEIC and ESOL. TOEFL was developed and issued by ETS (Educational Testing Service) based in New Jersey, USA. This test was first introduced in 1963. Currently there are 3 kinds of TOEFL tests issued by ETS, namely PBT (Paper Based Test) TOEFL, CBT (Computer Based Test) TOEFL and iBT (Internet Based Test) TOEFL. The results of both the PBT and CBT tests did not result in a significantly different TOEFL score. What really matters is the competency of the participant [16]. Of these three types, the most commonly used are PBT and iBT [14].

a. TOEFL PBT

PBT is a form of TOEFL Test that uses an answer sheet in the form of paper. This is the first test system issued by ETS. In PBT, the tests carried out include listening, structure and reading. The range of scores given is 310-677. In addition, the time given to do this test is about 2-2.5 hours.

b. TOEFL CBT

CBT is a test that no longer uses paper. All tests are carried out on a computer using certain software. This test system emerged in 1998. The skills tested include listening, structure, reading and writing. In this system, the score ranges from 0-300 with processing time between 2-2.5 hours.

c. TOEFL IBT

The test with the iBT system is the most popular and widely used test. This test system is also computer-based, it's just that this test is connected to the internet network, thus, the test is carried out online.

Fisher-Yates Shuffle is an algorithm to generate random permutations of a finite set, in other words to shuffle a set. The basic process of Fisher-Yates is similar to randomly selecting a numbered ticket out of a pile of cards. The Fisher-Yates algorithm used provides randomization which is almost non-existent [15] so that randomization of answers gets good and balanced results.

In a previous study conducted by Muhammad Arief Hasan [15] produced an online exam randomization website for new students by implementing the Fisher Yates-Shuffle. The use of the Fisher Yates-Shuffle algorithm that is used in the CBT (Computer Based Testing) application to randomize new student admissions online exam questions results in a reduction in cheating acts in the implementation of the new student admissions exam.

Testing the Fisher Yates-Shuffle algorithm [17] was also applied to exams that were still carried out conventionally, resulting in less efficiency in activities and the length of the exam process. By making an application with the Fisher Yates-Shuffle algorithm, it makes the process of exam activities faster, saves time and space and can also be used by students to carry out exam activities more easily and more comfortably.

From the research results of Imam Haditama [18] produced an android application for learning Sundanese scales to introduce 3 types of regional musical instruments, using the Fisher Yates-Shuffle and Fuzzy Tsakamoto algorithms to produce randomization with very good accuracy, namely 100% on each user display.

III. METHODS

a.Fisher-Yates Algorithm

The flowchart of the Fisher Yates-Shuffle randomization method show in Figure 2. The randomization is appropriate if the entire array has been randomized. The randomization method produces an irregular array order [18].

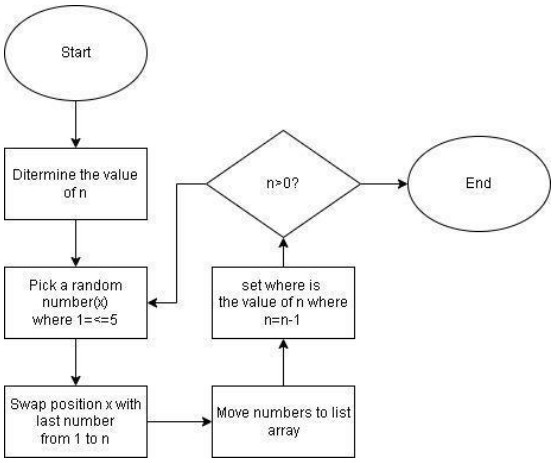

Fig. 1 Flowchart Fisher Yates-Shuffle

The Fisher Yates-shuffle method is implemented in the system, that displayed in the form of a script as follows:

```
let answer = ['A','B','C','D','E'];
let randomArray = (arr) =>
        { for(let i = arr.length -1; i > 0; i--){
                const j = Math.floor(Math.random() * (i+1));
                [ arr[i], arr[j] ] = [arr[j], arr[i] ];
        }
        return arr;
}
console.log('before scrambled')
console.log(answer)
console.log('after scrambled')
console.log(randomArray(answer))
```

b.User Acceptance Testing (UAT)

UAT Is the process of verifying that the solution created in the system is suitable for the user. This process make sure the software doesn't crash and conforms to user request documents [19], but rather ensures that the solutions in the system will work for the user.

Testers and developers identify and fix these issues during the early stages of functionality testing, testing during integration and at the system testing stage.

TABLE 1
Table Likert Scale [20]

Information	Scale
Very Bad	1
Bad	2
Enough	3
Good	4
Very Good	5

Questionnaire questions made based on 5 qualities aspect uses consisting of from :
1 .Learnability, is level convenience user in use system for complete his first time using system.
2. Efficiency, is ability system for support user in complete his job in relative fast time.
3. Memorability, is level convenience user in use system with good after a long time no use.
4. Errors, are possibility error occurs or error on the current system used by users and can restored return from error.
5. Satisfaction, is level satisfaction user in use system, good appearance system nor how it looks its use.

In Table 2, shows the questions given to respondents.

TABLE 2
Questionaire questions

No	Questions
	Learnability
Q1	Are the available system features complete and easy to understand?
Q2	Can the user visually understand the use of each feature or button provided by the system?
Q3	If the user first accesses this system, the system can indirectly provide a good description of the stages of use?
	Efficiency
Q4	Does switching from one page to another not not take much time?
Q5	The system does not contain features that are not needed by the user?
Q6	With this system, the instructor can confirm to the user quickly?
	Memorability
Q7	If you do not access this system for a long time, as a user will it be easy to remember the features of this system?
	Errors
Q8	No faulty system features were found when used?
Q9	Is there a help notification when having trouble using system features?
	Satisfaction
Q10	Users feel happy using this system?
Q11	Do users want to keep visiting this system?

This below is the UAT formula [21]:

$$Qn = \sum_{i=1}^{5} \quad F(i) * Scale(i) \text{ …….....(1)}$$

$$P = \left(\frac{Total\ Qn}{N}\right) / 5 * 100\% \text{ ….……...(2)}$$

Description :
Qn = Questions (1,2,3,4…n)
n = 1,2,3……11
F = Frequency Answer
Scale = Likert Scale
P = Percentage
N = Total Responses obtained

Range Criteria Interval show in Table 3:

TABLE 3
Table of Interval Criteria [21]

Score	Scale
0% - 19.99%	Very Bad
20% - 39.99%	Bad
40% - 59.99%	Enough
60% - 79.99%	Good
80% - 100.00%	Very Good

IV. RESULTS

This system is built using the waterfall methodology which is composed of several stages, that is requirements specification, design, implementation, testing, and maintenance. The system is designed to facilitate participants and instructors in EPT activities. Instructors can provide materials for training activities, create the assignment. Participants can register, learn the EPT materials, and do assignments. The Fisher-Yates Shuffle method will be explained as follows.

a.Fisher-Yates Shuffle Algorithm

Fisher-Yates Shuffle Simulation of randomization answers to each question. The following are the steps in randomizing answers if you have 5 answer choices for permutations so that they have unequal possibilities.

1.Take one token content at random (i). The value of i that can be taken is the value that is still in the Range 1-5.

2.The value of i is exchanged for tokens to m (the value of m is the limit on the number of tokens). The value of m
is 5 positions of the i value that have been taken randomly and exchanged to 5.

3.The repetition is carried out until the value to be randomized has been randomized.

b. Fisher-Yates Shuffle Randomization Method

The fisher-yates shuffle algorithm process in randomization as many as 5 answers that is: a, b, c, d, e will be used as a scratch 1-5, after that make a range then the randomization process is carried out, then rolls (for the selected answers from all available answers) then the results are entered into the result (the results of all the questions that have been randomized). The fisher-yates shuffle algorithm process can be observed through in table 4 below: [19], [20].

TABLE 4
Fisher Yates Simulation Process

Step	Range	Roll	Stratch	Result
			1 2 3 4 5	
1	1-5	4	1 2 5 4	3
2	1-4	3	1 2 4	3 4
3	1-3	1	2 5	1 3 4
4	1-2	2	5	2 1 3 4
5				5 2 1 3 4

c. Random Questions Page Display With Fisher-Yates Shuffle

In this view, the questions in master will be randomized. The participants will get the questions with the answer choices that have been randomized by the Fisher-Yates shuffle algorithm method. It show on figure 3:

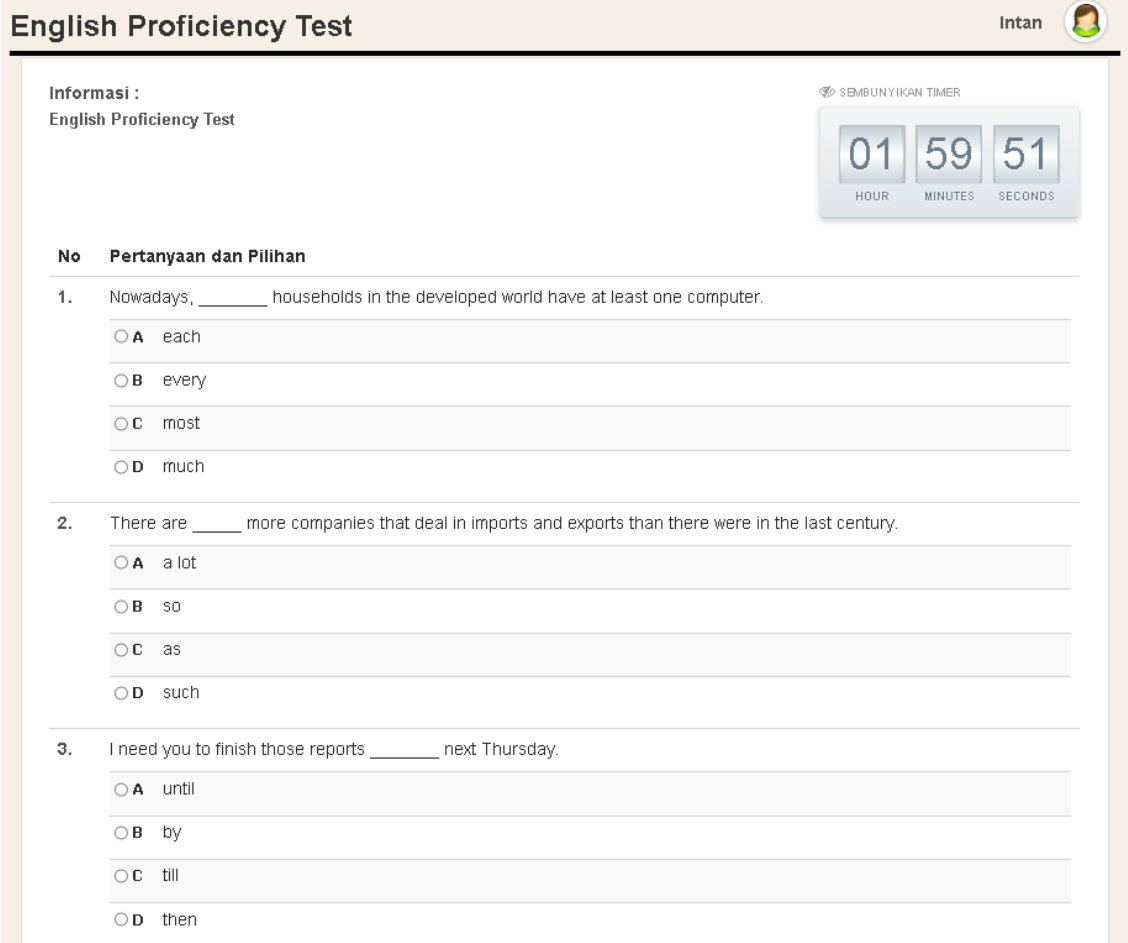

Fig 3. Display System

In this designed system, the teacher or tutor can set the time duration for the exam and can input several master questions and answers at the same time. During the exam, the system will provide various questions based on the master questions and the Fisher Yates Algorithm method will randomize the answers to each participant.

In this study, the User Acceptance Testing method was used to distribute questionnaires to 102 participants, and only 92 EPT training participants filled out the questionnaire. The following is a summary of the rating scale based on filling out the questionnaire shown in Table 5. below:

TABLE 5
Respondent Questionaire Result

No	Scale Frequency					Calculation					Total
	1	2	3	4	5	1	2	3	4	5	
Aspect Learnability											
Q1	1	6	22	37	28	1	12	66	148	140	**367**
Q2	1	6	28	34	25	1	12	84	136	125	**358**
Q3	1	5	26	39	23	1	10	78	156	115	**360**
Aspect Efficiency											
Q4	2	4	29	35	24	2	8	87	140	120	**357**
Q5		2	39	30	23	0	4	117	120	115	**356**
Q6	3	7	26	37	21	3	14	78	148	105	**348**
Aspect Memorability											
Q7		3	29	35	27	0	6	87	140	135	**368**

Aspect Errors											
Q8	4	9	26	31	24	4	18	78	124	120	**344**
Q9	3	9	27	29	26	3	18	81	116	130	**348**
Aspect Satisfaction											
Q10	3	6	22	38	25	3	12	66	152	125	**358**
Q11	3	5	26	39	21	3	10	78	156	105	**352**

To calculate the total value of Q1 then formula (1) is used so that the results are as follows:

$$Q1 = \sum_{i=1}^{5} \quad F(i) * Scale(i) \text{ .....(5)}$$

Q1 = ((1*1) + (6*2) + (22*3) + (37*4) + (28*5)
= 367

And to calculate the percentage value then formula (2) is used so that the results are as follows:

$$P1 = \left(\frac{367}{94}\right) / 5 * 100\% \text{ .....(6)}$$

P1 = 78.09%

the average value based on each aspect is shown in Figure 4 below:

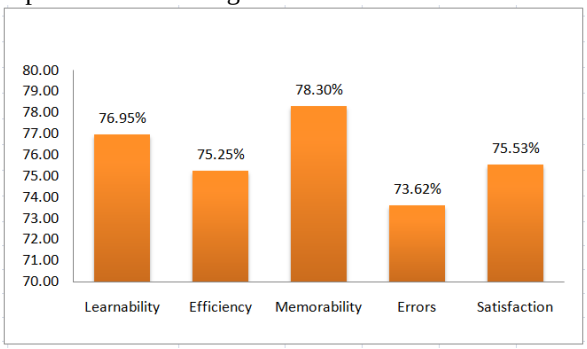

Fig 4. UAT in five aspect result

Based on the graph above, the overall value is 75.93%, which means that the system developed is in good criteria.

V. CONCLUSIONS

The EPT class training system with the Fisher Yates method that has been designed can make it easier for instructors and students in listening, structure and reading training, can also make it easier to work on test questions and can minimize cheating. The results of the measurement system on 94 respondents have met 5 aspects of quality with UAT testing. The result of measuring Learnability aspect is 76.95%, Efficiency aspect is 75.25%, Memorability aspect is 78.30%, Error aspect is 73.62%, and Satisfaction aspect is 75.53%. Overall average value of the five aspects is 75.93%, which means this system is in good criteria.

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