Research Article
Randomization of Institutional Testing Program Test of English as a Foreign Language Using Fisher Yates Algorithm

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Abstract: ITP TOEFL (Institutional Testing Program Test of English as a Foreign Language) was performed using the same questions in one session and in one room. There is several activities in the ITP TOEFL include: asking questions, fill in the answers and assessments. Question management in ITP TOEFL is necessary to avoid a cheating in exams. This research develops a model of ITP TOEFL using Fisher Yates Algorithm. Fisher Yates Algorithm is used to randomize question. This randomization method aims to produce many variations of question in ITP TOEFL. The result of this research is procured many variations of different questions but with the same criteria (weighted equally) among the test participants (1.31×10^{10}).

Keywords: Fisher yates algorithm, ITP TOEFL, variations of question

INTRODUCTION

The TOEFL (Test of English as a Foreign Language) is a test used to measures the ability of non-native English speakers to use and understand English that among others is read, written and heard. The TOEFL scores normally used for measure the ability of the international students to use English in an academic environment. According to Pyle and Muñoz (1991), TOEFL is a test that often is used as a requirement to enroll at the university in the United States for foreign student. Usually the TOEFL test is still using conventional systems. Some of the TOEFL management consists of creation of questions; examinees answered the questions and assessment of the exam results. All these processes are typically done manually. This process is certainly less effective in terms of cost, time and energy (Bukhori *et al.*, 2015). To improve the efficiency of the TOEFL test process, so it needed a computerized test.

ITP TOEFL is an Institutional Testing Program Test of English as a Foreign Language. The purpose of this test is evaluating the English proficiency of someone whose native language is not English. Each section of the test uses a multiple-choice format to measure the ability of understanding the English language. Scores obtained in the ITP TOEFL only be used on specific needs and only reported to the institution administering the test. Students who need a TOEFL score for admission to colleges and universities must take the TOEFL test (TOEFL.ITP, 2015).

ITP TOEFL is usually held using the same questions in one session and in one room. There are several activities undertaken during the ITP TOEFL among others: asking questions fill in the answers sheet and assessments. Question management in ITP TOEFL is necessary to avoid cheating in exams. This research develops a model ITP TOEFL test using Fisher Yates. Fisher Yates Algorithm, in this research, used to randomize question. This randomization method aims to produce many variations of question in ITP TOEFL so that TOEFL exam questions among participants may have different arrangements but with the same criteria.

Randomization is usually used to solve various types of problems. The various examples of randomizations are: a probability of die is cast, a name on a piece of paper is drawn blindly from a basket, a probability of coin is flipped, or and the outcome of that flip, cast, or determines the activity that will happen next after a certain activity occurs. Perhaps, the outcome of the coin flip determines who has to do the specific job; the role of the die determines who won some money; the draw of a name determines who gets to participate in some activity.

When these tools (the coin, the die, or the like) are used as atool for making decisions, the outcome can said to be left to chance, or, randomized (Jameel, 2015).

Randomization usually used by person to predict their fate. Sometimes, they assume randomization as a tool for justice. At other times, because of the uncertainty of the randomization, that makes them feel increased element of excitement. Statistics use

randomization methods because, when some people are randomly chosen to participate in a survey, conveniently, the parameter of those chosen individuals are representative of the entire group from which they were chosen. In other words, what is discovered about them is probably true about the larger group. The use of lottery to generate a representative sample is known as random sampling or random selection. The elements that are good when using Fisher Yates algorithm is that it provides output an unbiased result that is; every permutation of the array is equally likely. The development of the latest Fisher Yates Algorithm is an in-place randomizes, which means that given the array initialization, it randomizes the elements of the array in place rather than producing a random copy of the array. So, it is an efficient algorithm for randomization, requiring only time proportional to the number of elements being randomized and also it does not need any additional storage space for randomized element. However, the randomized effect of algorithm depends on the random generations quality of index (Saeed *et al*., 2014).

In this research, randomization used to produce many variations of question in ITP TOEFL. Randomization algorithm used in this research was Fisher yates. The Fisher-Yates shuffle algorithm (the Knuth shuffle) starts with treat a list of items and swaps each item with another in the list. Each iteration of the range of swappable items shrinks. The Fisher-Yates shuffle algorithm starts at index zero (or can be done by running on the list in reverse) and begins with selecting an item from 0 to N at random. This selection freezes the 0th element in the shuffled list. The next iteration shifts to index 1 and selects an item from the remaining 1 to N indices. This process repeated until the entire list is executed (Nedrich, 2014). By using this fisher yates algorithm is expected to produce many questions in ITP TOEFL.

METHODOLOGY

The TOEFL measures the ability of non-native English speakers to use and understand English as its read, written and heard. The TOEFL was develops in 1963 by the National Council. The Council was formed through the cooperative effort of more than 30 public and private organizations concerned with testing the English proficiency of nonnative speakers of the language applying for admission to institutions in the United States (Educational Testing Service, 2003).

The ITP TOEFL tests are a well-known brand at major universities, so describing a student's ability for placement in terms of an ITP TOEFL score is something a receiving institution or study-abroad program will probably know and understand. The ITP TOEFL tests are paper-based, multiple-choice tests. Students answer questions by filling out an answer sheet. The ITP TOEFL tests are administered on two levels:

Level 1: (intermediate to advanced) (Table 1) consists of three sections: Listening Comprehension, Structure and Written Expression and Reading Comprehension,

Level 2: (high beginning to intermediate) (Table 2) consists of three similar sections, plus vocabulary is added to the Reading section (Institute of International Educations, 2015).

The ITP TOEFL test is composed entirely of multiple-choice questions with four possible answers per question. There are three parts in ITP TOEFL test: (a) Listening Comprehension contains recorded material that is similar to what we hear if we were with a group of North American students at a college or university. The language includes the vocabulary and idiomatic expressions common to spoken English, as well as the special grammatical constructions used in speech. This section test comprehension of both short and long conversations and talks, (b) Structure and written expression consists of sentences that test knowledge of important structural and grammatical elements of standard written English. These sentences include a variety of topics and give no particular advantage to individuals in specific fields of study. When topics have a national context, they refer to United States or Canadian history, culture, art, or literature, However, knowledge of these contexts is not needed to answer the structural or grammatical points

Table 1: Level intermediate to advanced

Section	Number of question	Admin. time	Score scale
Listening comprehension	50	35 min	31-68
Structure and written expression	40	25 min	31-68
Reading comprehension	50	55 min	31-67
TOTAL	140	115 min	310-677

Table 2: Level high beginning to intermediate

Section	Number of question	Admin. time	Score scale
Listening comprehension	50	22 min	20-50
Structure and written expression	25	17 min	20-50
Reading and vocabulary	40	31 min	20-50
TOTAL	95	70 min	200-500

Table 3: Weighting criteria structure and written expression

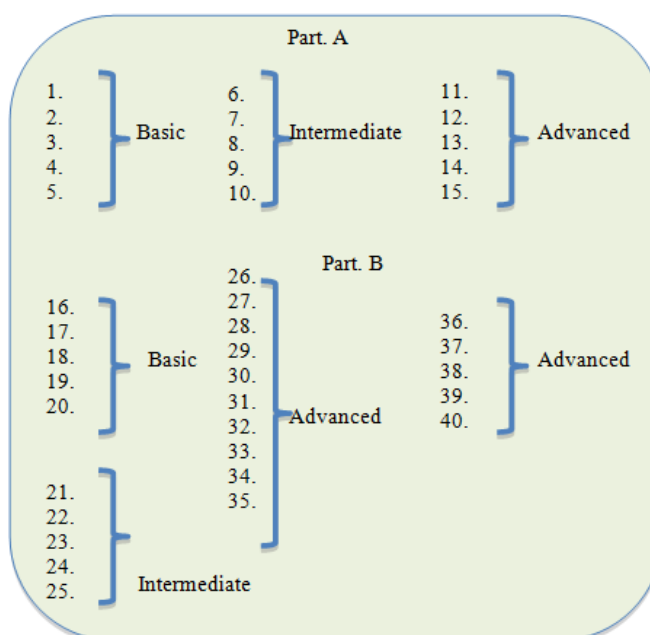| Basic	Intermediate	Advanced
Pronouns personal	Present and past	Present perfect continuous
Pronouns possessive	Present perfect and past	Past perfect continuous
Pronouns reflexive	Future	Future continuous and future perfect
Regular and irregular verb	Modals	Modals and semi modals
Singular/Plurals	Conditionals and wish	Linking verbs, passives, questions
Countable and uncountable	Passive	Verb complementation's
Comparison	Reported speech	Reporting using nouns and adjectives
Simple/Progressive	Question and auxiliary verbs	Compound nouns and noun phrases
Simple/Progressive questions	-ing and the infinitive	Article, determiner and quantifiers
Passive voice	Articles and nouns	Relative clauses and other types of clause
Adjectives	Pronouns and determiners	Pronouns, substitution and leaving out word
Word combinations	Relative clauses	Adverbial clauses and conjunction
Idioms	Adjective and adverbs	Organizing information
Prepositions	Phrasal verbs	

Fig. 1: The pattern of question in structure and written expression

Table 4: Modeling of composition ITP TOEFL

Section	Level	Number of question
Structure Part A	Basic	5
	Intermediate	5
	Advanced	5
Structure Part B	Basic	5
	Intermediate	5
	Advanced	5
Reading Text	Basic	2
	Intermediate	2
	Advanced	3

being tested, (c) Reading comprehensions contains reading passages and questions about the passages. The questions test information that is stated or implied in the passage. Knowledge of some of the specific words is also tested. Because many English words have more than one meaning. It is important to remember that these questions will test the meaning of a word of phrase within the context of the passage (Educational Testing Service, 2013).

Structure and written expression in the TOEFL are divided into three weighting criteria: basic, intermediate, advance (Murphy, 1998) (Table 3).

In this study, the composition of the basic, intermediate and advance in ITP TOEFL Structure and Written Expression and Reading modeled (Table 4).

The pattern of structure and written expression is started from the question pattern that is usually used (Fig. 1).

The pattern of questions in this research is using Fisher Yates algorithm. The principle of Fisher Yates algorithm is:

- Enumerate the numbers from 1-N.
- Pick random number k: $1 \leq k \leq N$ and swap k with N.
- Adjust N, N = N-1
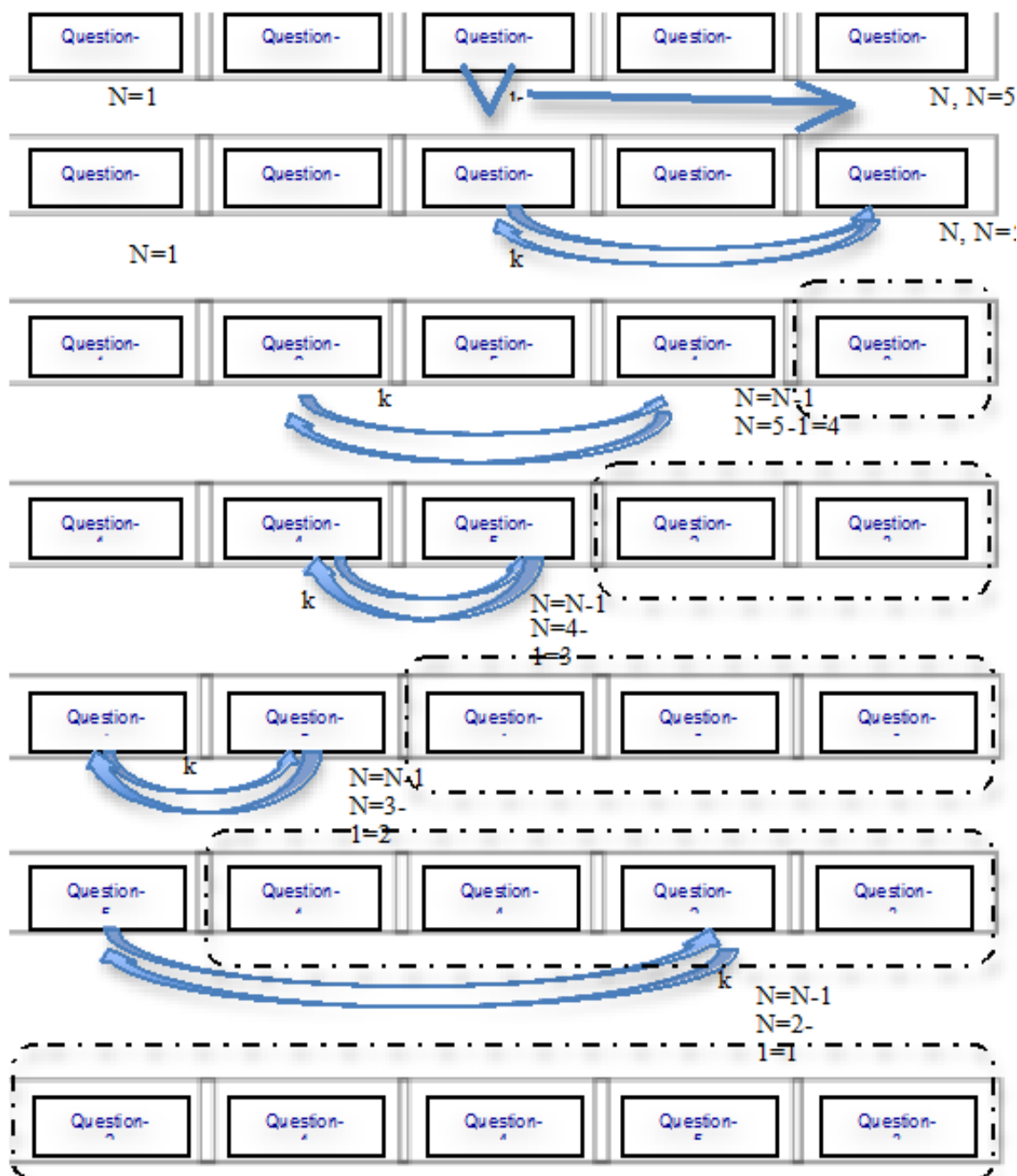- Repeat the steps b and c until $N \leq 0$ (Fig. 2).

Fig. 2: The flow chart of the fisher Yates

When Fisher Yates algorithm is applied to the randomization of structure and written expression, the first step that must be done is to classify each question in the question group level basic, intermediate and advanced. Each of these questions group is randomized by using Fisher Yates (Fig. 3). In the first matter pattern, the randomization process pattern (question 1, question 2, question 3, question 4, question-5) will form the second matter pattern (question 2, question 1, question 4, question-5, question 3). And so on so obtained the dynamic pattern of the questions.

RESULTS AND DISCUSSION

The ITP TOEFL test use academic content to measure the English-language proficiency of nonnative English speakers. This test is paper-based. All questions are multiple choice and participants answer the questions by filling in the answer sheet. The consequences of the paper-based test are the variation of question is limited and this process is certainly less effective in terms of cost, time and energy (Bukhori *et al.*, 2015). Generally, the questions on a test are
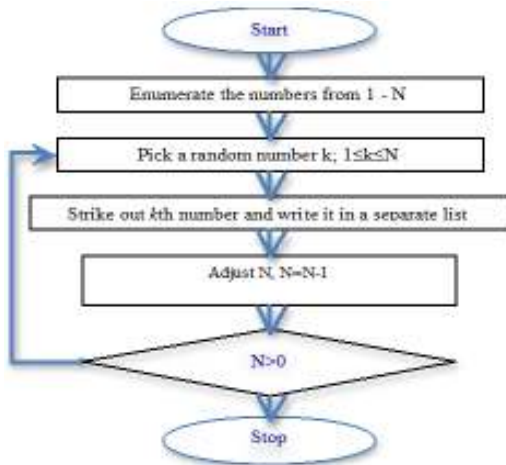
Fig. 3: The randomization of structure and written expression using fisher Yate

assumed to be kept secret from test participant (Yuqian and Vincent, 2013). However, for tests that are taken on a large scale, for example ITP TOEFL test, this is very hard to achieve.

To produce many variation of question, in this study, is used randomization using Fisher Yates. The randomization in addition to produce variations in question is also to improve the confidentiality of the matter. The confidentiality of the matter can be improved by increasing the probability of differences in question with equal criteria. Several research have been conducted about the probability that can be used to improve performance include: probability is used to determine optimal transaction (Bukhori *et al*., 2011), higher probability of losing is possible to construct a winning strategy (Bukhori *et al*., 2013). The probability in this study is used to increase confidentiality of ITP TOEFL

The use of Fisher Yates algorithm to randomizing ITP TOEFL questions can be exemplified by setting a number of questions on the question bank. For example we have 15basic questions, 15 intermediate questions and 15 advance questions in the question bank. If these matters are randomized using Fisher Yates, it will get the first types of question (Fig. 4).
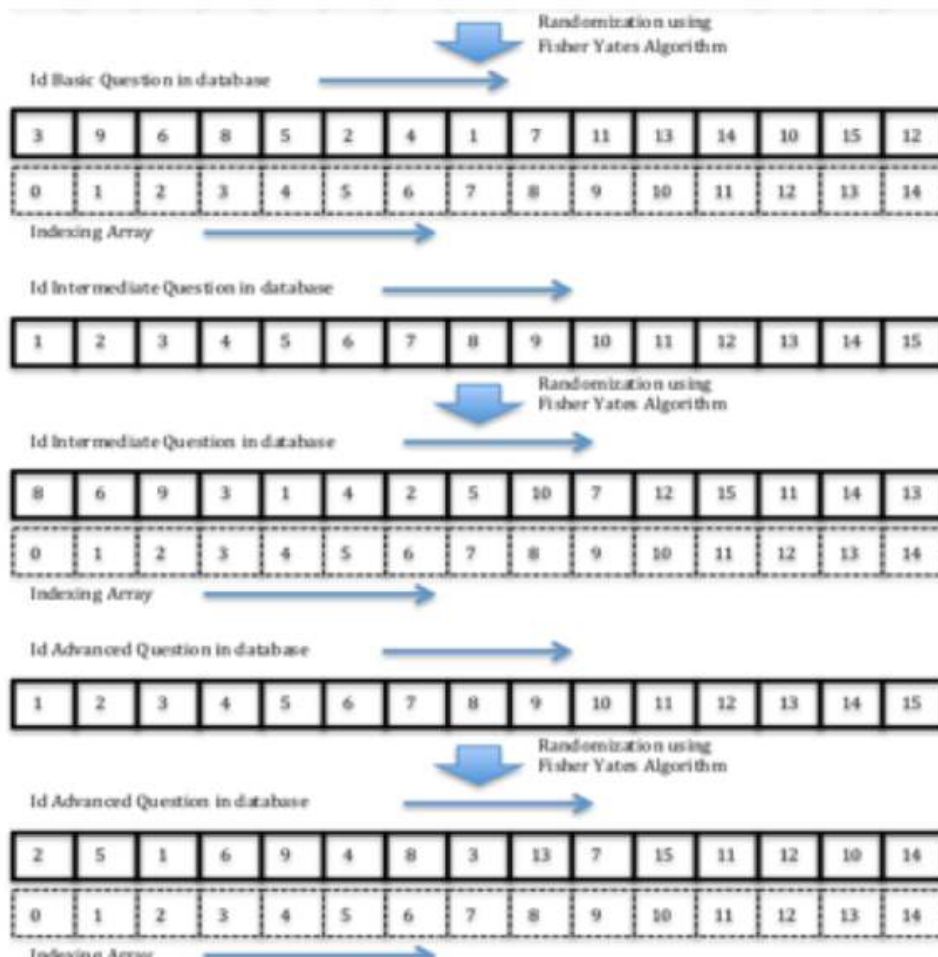

Fig. 4: Randomization using fisher Yates

Part A

1. Basic level Id question 3	6. Intermediate level Id question 2	11. Advanced level Id question 8
2. Basic level Id question 9	7. Intermediate level Id question 5	12. Advanced level Id question 6
3. Basic level Id question 6	8. Intermediate level Id question 1	13. Advanced level Id question 9
4. Basic level Id question 8	9. Intermediate level Id question 6	14. Advanced level Id question 3
5. Basic level Id question 5	10. Intermediate level Id question 9	15. Advanced level Id question 1

Part B

16.Basic level Id question 5	26.Advanced level Id question 6	36.Advanced level Id question 4
17.Basic level Id question 7	27.Advanced level Id question 3	37.Advanced level Id question 5
18.Basic level Id question 10	28.Advanced level Id question 2	38.Advanced level Id question 9
19.Basic level Id question 3	29.Advanced level Id question 1	39.Advanced level Id question 7
20.Basic level Id question 2 10	30.Advanced level Id question 8	40.Advanced level Id question
21.Intermediate level Id question 9	31.Advanced level Id question 13	
22.Intermediate level Id question 11	32.Advanced level Id question 15	

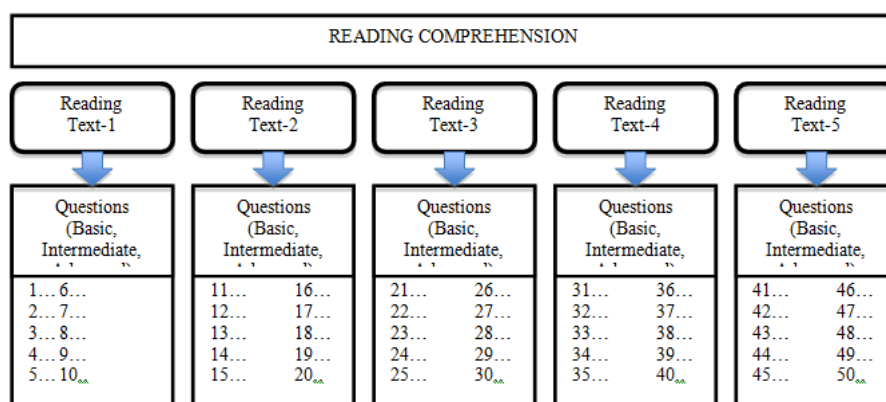Fig. 5: Composition of matter structure and written expression

Fig. 6: Composition of matter reading comprehension

Randomization of questions using Fisher Yates followed by setup process of the question based on those levels. Randomization was done to determine the composition of matter according to its weight. On the matter of structure, the first of 5 questions is basic level. So the questions 1 to 5 at the structure and written expression Part A is the randomization results of the Fisher Yates basic level with index arrays 0-4. On the matter of structure and written expression questions 6 to 10 at the structure Part A is the randomization results of the Fisher Yates intermediate level with index arrays 0-4 and the matter of structure and written expression questions 11 to 15 at the structure Part A is the randomization results of the Fisher Yates advance level with index arrays 0-4.

In the part B also uses randomization and setup questions similar to part A. Part B are 25 questions. Part B also has level basic, intermediate and advanced. Part B started by Number 16 to 40, so the whole matter is a total of 40 questions. The matter of the basic level in part B started by number 16 to 20, which is the result of randomization Fisher Yates basic level index array 0-4. The question number 21 to 25 is the result of randomization Fisher Yates intermediate level index array 0-4. The question number 26 to 40 is the result of

randomization Fisher Yates advanced index array 0-4. Figure 5 is a composition of matter structure and written expression after randomization using Fisher Yates Algorithm.

In the reading comprehension section there are 5 reading text. Each text has 10 questions. The levels of questions in the reading comprehension are basic, intermediate, advanced, advanced and advanced in each text. Experts or the manufacturer ITP TOEFL exam determines decision of level in the reading matter. Randomization matter at Reading comprehension also uses algorithms Fisher Yates, with randomization based on each reading text. So each text reading randomized (Fig. 6).

Randomization method on each text by making id text questions that are related one too many on the questions. Id questions text are randomized by Fisher Yates algorithm, so questions on the reading comprehension cannot be separated with text on the reading comprehension. Because reading text cannot be separated from the question. Furthermore, randomization in reading comprehension equal to randomization questions on structure and written expression by Fisher Yates algorithm. Combination matter that made more and more variety when using

Table 5: Number of questions that differ formed by using fisher Yates algorithm

Section	Level	NC*	Permutation $P(n,r) = \frac{n!}{(n-r)!}$	NCD*
Listening	-	1	$P(1,1) = \frac{1!}{(1-1)!}$	1
Structure Part A	Basic	5	$P(5,5) = \frac{5!}{(5-5)!}$	120
	Intermediate	5	$P(5,5) = \frac{5!}{(5-5)!}$	120
	Advanced	5	$P(5,5) = \frac{5!}{(5-5)!}$	120
Structure Part B	Basic	5	$P(5,5) = \frac{5!}{(5-5)!}$	120
	Intermediate	5	$P(5,5) = \frac{5!}{(5-5)!}$	120
	Advanced	15	$P(15,15) = \frac{15!}{(15-15)!}$	1.307.674.368.000
Reading Text	Basic	2	$P(2,1) = \frac{2!}{(2-1)!}$	2
	Intermediate	2	$P(2,1) = \frac{2!}{(2-1)!}$	2
	Advanced	3	$P(3,3) = \frac{3!}{(3-3)!}$	6
Total Permutation (P)				1.307.674.368.611 $1,31 \times 10^{10}$

NCD*: Number of Questions That Differ; NC*: Number of Question

Fisher algorithm Yates. So the question that appears more dynamic. Number of questions that differ formed by using Fisher Yates algorithm (Table 5).

CONCLUSION

Based on this research, it can be concluded that Question management in ITP TOEFL is necessary to avoid a cheating in exams. This research develops a model ITP TOEFL test using Fisher Yates algorithm. Fisher Yates Algorithm, in this research, used to randomize question. This randomization method aims to produce many variations of question in ITP TOEFL so that ITP TOEFL exam questions among participants may have different arrangements but with the same criteria and will simplify code generation about the ITP TOEFL system. The result of this research shows that by using Fisher Yates algorithm, ITP TOEFL examination system can produce up to 1.31×1010 pattern of matter. The more pattern, the less cheating in ITP TOEFL.

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