



Electronic Table of Specification in Educational Field (E-TOS)

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ABSTRACT

The main goal of this study is to build Computer application to construct a Table Of Specification-TOS in educational field, The Table Of Specification-TOS is a tool used to ensure that a test or assessment measures education content and students thinking skills that test intends to measure depending on knowledge-base of Bloom's taxonomy (educational objectives), usually lecturers construct specification table using mathematical calculations based on many factors such as total number of questions in exam, exam topics, total number of pages for each topic or hours spent to learn each topic, and key educational objectives. But the construction of the table takes a long time with the possibility of calculation errors. To solve this problem, I build an application to construct Table Of Specification electronically and I named the application Electronic Table Of Specification (E-TOS), that built by using the visual basic language and I achieved a significant result in constructing Table Of Specification-TOS. The proposed (E-TOS) application found to be more efficient in constructing table of specification-TOS that ensures accurate results by avoiding calculation errors, and getting fast results if it compared with manual calculation.

Keywords: Construction Table of Specification by visual basic Language; Electronic Table of Specification; Electronic-Test Blueprint; Table of Specification and Bloom's Taxonomy; Visual basic language.



Introduction

The Table Of Specifications - TOS is a tool used to ensure that a test or assessment measures educational content and students thinking skills that test intends to measure depending on knowledge-base of Bloom's taxonomy (educational objectives), during the 1948 convention of the American Psychological Association, a group of educational psychologists decided it would be useful to classify different levels of understanding that students can achieve in a course, In 1956, after extensive research on educational goals, the group published its findings in a book edited by Dr. Benjamin S. Bloom, a Harvard professor. Bloom's Taxonomy of Educational Objectives lists six levels of intellectual understanding: (Knowledge, Analysis, Comprehension, Synthesis, Application, Evaluation), These levels of understanding assist in categorizing test questions. Teachers tend to ask questions in the knowledge category 80% to 90% of the time. These questions are not bad, but using them all the time is, try to utilize higher order level of questions. These questions require much more brain power [1], Mehrens and Lehmann (1998) See table of specification as a (blue print) of a test, the content areas to be covered and the relative emphasis to be placed on each areas and instructional objectives [2].

Akem (2006) views the table of specification as a guide to assist a teacher or examiner in the evaluation system. "The table shows the total number of items to be allocated to each instructional objectives, it also suggests what might be covered under each item, take decision on what types of items to be used. In fact the blue – print stage" is the last and crucial stage in an evaluation plan since it enables the teacher to combine properly the objective and the content areas, bearing in mind the importance and the weight attached to each areas [3].

Table Of Specification-TOS constructs manually by following three steps: step 1- choosing the educational measurement goals, and domain to be covered (Bloom's Taxonomy), step 2- breaking the domain into key or fairly independent parts-concepts, terms, procedures, applications, and step 3- constructing the table [4], but it takes a time and calculation errors could be happened, to solve this problem, I build a computer application named (E-TOS) by using visual basic language to construct Table Of Specification-TOS, my application (E-TOS) contain different application windows for inputting construction factors that leads to construct Table Of Specification-TOS.

Construction Table Of Specification-TOS by using E-TOS application is more efficient. The proposed application ensures fast and accurate results and avoiding manual calculation errors.

Methods

The purpose of the proposed application is reducing time needed to construct Table Of Specification-TOS and get the result without any errors, we can reduce the time needed to construct Table Of Specification-TOS by using computer application because computer could be performing all calculations faster than human, and computer can be more accurate, I used visual basic language to build E-TOS application that help lecturers to construct TOS electronically.

Construct Electronic Table Of Specification (E-TOS) Application

Electronic Table Of Specification (E-TOS) is a computer application, I designed it to construct Table Of Specification-TOS by using visual Basic language according to sequence of steps referred to as Software Development Life Cycle–SDLC [5], Software Development Life Cycle–SDLC is a set of phases explain step by step how can write and develop a



program to construct Table Of Specification-TOS in educational field, there are six major phases in Software Development Life Cycle: 1-Analyze, 2-Design, 3-Design the interface, 4-Code, 5-Test and correct, 6-Complete the documentation, as shown below:

1. Analyze:

In this phase I will describe the problem and determine the inputs, outputs, and how can construct Table Of Specification–TOS:

Input:

Total number of test questions, educational objectives (Knowledge, Analysis, Comprehension, Synthesis, Application, Evaluation), Construct TOS Type, Topic Title, (Topic Pages or Spent Hours).

Processing:

1. Calculate Total number of educational objectives = (Knowledge + Comprehension + Application + Analysis + Synthesis + Evaluation)
2. Calculate Relative Weight of educational objective for each objective = (Educational Objective /Total number of Educational objectives) X100%
3. If Construct TOS Type = (Construct depending on total number of pages for each topic) then go to step 4, otherwise go to step 8.
4. Calculate Total number of pages for all Topics.
5. Calculate Relative Weight for each topic = (Topic pages/ Total number of pages for all Topics) X100%
6. Calculate Total number of questions for each topic = (Total number of Test Questions X Relative Weight of topic) / 100
7. Calculate Total number of Questions for each topic according to Educational objective = (Total number of questions for each Topic X Relative Weight of educational objective for each objective)/100
8. Else If Construct TOS Type = (Construct depending on hours spent to learn each topic) then got to step 9.
9. Calculate Total Time spent to learn All Topics.
10. Calculate Relative Weight for each topic = (spent Hours / Total Time spent to learn All Topics) X 100%
11. Calculate Total number of questions for each topic = (Total number of Test Questions X Relative Weight of topic) / 100
12. Calculate Total number of Questions for each topic according to Educational objective = (Total number of questions for each Topic X Relative Weight of educational objective for each objective) / 100

Output:

Display Table Of Specification–TOS electronically.

2. Design plan the solution to the problem

In this phase I will write Algorithm steps that describe the logical sequence that followed to construct Table Of Specification–TOS electronically, and Algorithm Steps are:

- 1) Start
- 2) Open Window1 Total number of test questions.
- 3) Read (Total number of test questions).
- 4) If user click on Next button, then go to step 5 else go to step 3.



- 5) Open Window2 Educational objectives.
- 6) Read educational objectives (Knowledge, Analysis, Comprehension, Synthesis, Application, Evaluation).
- 7) If user click on Next button, then go to step 9 else go to step 8.
- 8) Else if user click on Previous button, then go to step 2 else go to step 6.
- 9) Calculate Total number of educational objectives = (Knowledge + Comprehension + Application + Analysis + Synthesis + Evaluation).
- 10) Calculate Relative Weight of educational objective for each objective = (Educational Objective / Total Educational objectives) X100 %
- 11) Open Window3 Construct TOS Type
- 12) Read Construct TOS Type.
- 13) If user click Next button, then go to step 14 else go to step 16.
- 14) If Construct TOS Type = (Construct depending on total number of pages for each topic) then go to Step 17 else go to step 15.
- 15) Else If Construct TOS Type = (Construct depending on hours spent to learn each topic) then go to Step 36 else go to step 12.
- 16) If user click on Previous button, then go to step 5 else go to step 12.
- 17) Open Window4 Topic Information (Construct depending on total number of pages for each topic).
- 18) If user click New Topic button, then go to step 19 else go to step 22.
- 19) Read Topic Title and Topic Pages.
- 20) If user click Add Topic button, go to step 21 else go to step 22.
- 21) Topic Title and Topic Pages will be added as a row in the table Topic Information According to Topic Pages.
- 22) If user select any row from the table then go to step 23, else go to step 18.
- 23) If user click on Delete Topic, then go to step 24, else go to step 18.
- 24) Selected row from step 22 will be deleted from the table.
- 25) If user click on Construct Table button, then go to step 26 else go to step 18.
- 26) If table Topic Information According to Topic Pages has row, then go to step 27 else go to step 28.
- 27) Calculate Total number of pages for all Topics.
- 28) If table Topic Information According to Topic Pages has row, then go to step 29 else got step 30.
- 29) Calculate Relative Weight for each topic = (Topic pages/ Total number of pages for all Topics) X100%
- 30) If table Topic Information According to Topic Pages has row, then go to step 31 else go to step 32.
- 31) Calculate Total number of questions for each topic = (Total number of Test Questions X Relative Weight of topic) / 100
- 32) If table Topic Information According to Topic Pages has row, then go to step 33 else go to step 34.
- 33) Calculate Total number of Questions for each topic according to Educational objective = (Total number of questions for each Topic X Relative Weight of educational objective for each objective) / 100
- 34) Display Table Topic Information According to Topic Pages (E-TOS).
- 35) If user click on Previous button, then go to step 11 else go to step 54.

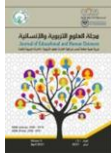


- 36) Open Window5 Topic Information (Construct depending on hours spent to learn each topic).
- 37) If user click New Topic button, then go to step 38 else go to step 41.
- 38) Read Topic Title and Topic Hours.
- 39) If user click Add Topic button, go to step 40 else go to step 41.
- 40) Topic Title and Topic Hours will be added as a row in the table Topic Information According to Topic Hours.
- 41) If user select any row from the table then go to step 42, else go to step 37.
- 42) If user click on Delete Topic, then go to step 43, else go to step 37.
- 43) Selected row from step 41 will be deleted from the table.
- 44) If user click on Construct Table button, then go to step 45 else go to 37.
- 45) If table Topic Information According to Topic Hours has row, then go to step 46 else go to step 47.
- 46) Calculate Total Time spent to learn All Topics.
- 47) If table Topic Information According to Topic Hours has row, then go to step 48 else go to step 49.
- 48) Calculate Relative Weight for each topic = (spent Hours / Total Time spent to learn All Topics) X 100%
- 49) If table Topic Information According to Topic Hours has row, then go to step 50 else go to step 51.
- 50) Calculate Total number of questions for each topic = (Total number of Test Questions X Relative Weight of topic) / 100
- 51) If table Topic Information According to Topic Hours has row, then go to step 52 else go to step 53.
- 52) Calculate Total number of Questions for each topic according to Educational objective = (Total number of questions for each Topic X Relative Weight of educational objective for each objective) / 100
- 53) Display Table Topic Information According to Topic Hours (E-TOS).
- 54) Stop.

3. Design the interface

Electronic-Table of Specification (E-TOS) is a computer application used to construct Table of Specification-TOS, I designed it by using visual basic language.

Visual basic used to design and develop window applications, window application is an application having interface with fields to get user input and some buttons to interact with user requirements and view the output, window term is called form in visual basic, thus the terms form and window describe the same entity, I used visual studio as editor application to build my application in visual Basic, visual studio has many features to develop applications and test it, and it has suitable toolbox used to add controls in window form, Visual basic Control's is an object, control is a type of user interface element you create on a visual basic form by using a toolbox control, In fact, in visual basic, the form itself is an object, every visual basic control consists of three important elements (Properties is a value or characteristics held by a Visual Basic object, such as Caption or Fore Color, etc., Methods is a procedure created as a member of a class and they cause an object to do something, Event is a signal that informs an application that something important has occurred, for example, when a user clicks a control on a form, the form can raise a Click event and call a procedure that handles the event, there are various types of events associated with a Form like click, double



click, close, load, resized, etc...) [5], (Figure 1) describe HIPO (Hierarchy plus Input-Process-Output) for my E-TOS application, (Figure 1) breaks down the major parts of a program so we can see what it must be done in general and HIPO (Hierarchy plus Input-Process-Output) is reading from top to bottom and from left to right.

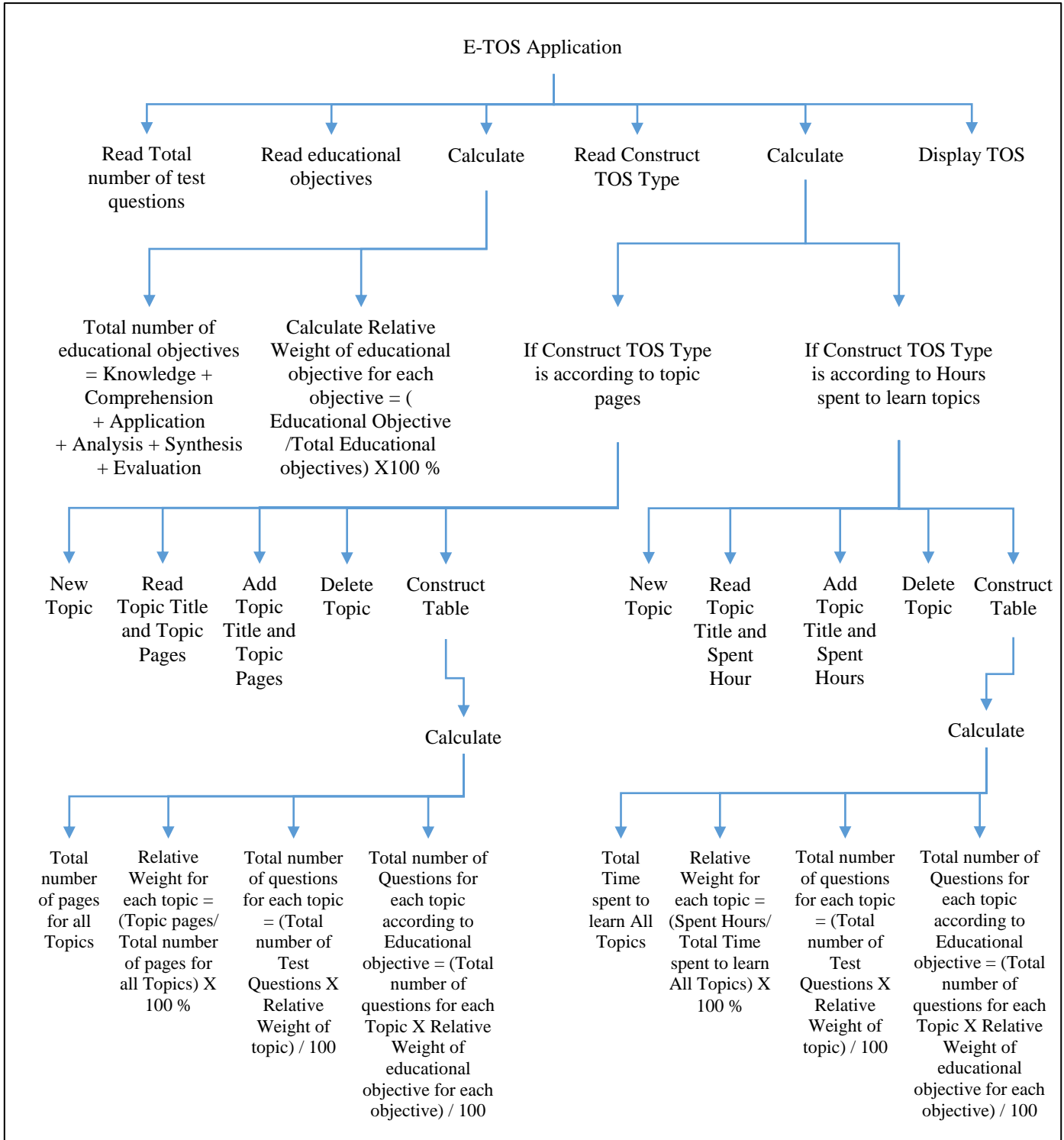


FIGURE 1 : DESCRIBE HIPO (HIERARCHY PLUS INPUT-PROCESS-OUTPUT) FOR MY E-TOS APPLICATION



4. Code

Translate the algorithm into a programming language.

Coding is the technical word for writing the program. During this phase the program is written in visual basic to build the computer application E-TOS, I used the algorithm devised in design-phase along with a knowledge of visual basic.

5. Test and Correct – Result and Discussion

The proposed application E-TOS implemented on computer having central processing unit type Intel(R) Core(TM) i7-10510U CPU @ 1.80GHz 2.30 GHz supported by memory size 8.00 GB RAM, operate by Windows 10 (64 bit) as Operating System, compiled by Microsoft .Net Framework 4, Microsoft .NET Framework is a software development framework for building and running applications on Windows, Visual Basic .Net libraries depending on .Net framework to run E-TOS application on operating system, Constructing table of specification by E-TOS application was measured and evaluate the performance, and no error located as showing below.

Figure 2 describe Window1 that used to input Total number of test questions and when user click on Next button then the input value will be checked if it integer then will open Window2 as showing in Figure 4, otherwise it will view message inform user to input valid value as showing in Figure 3.

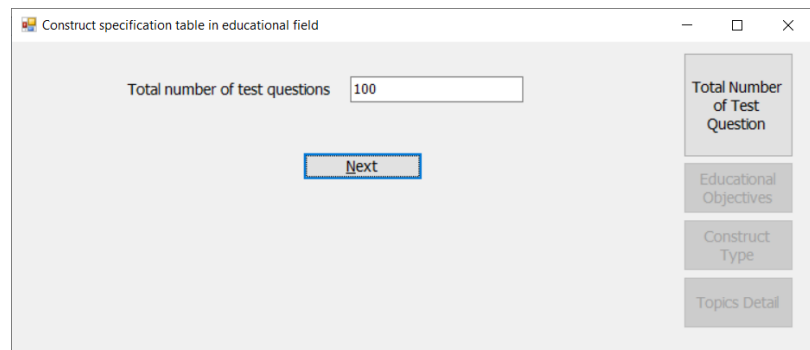


FIGURE 2 : WINDOW 1 - INPUT TOTAL NUMBER OF TEST QUESTIONS

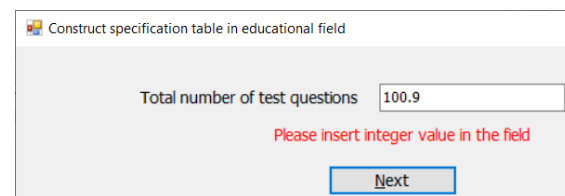
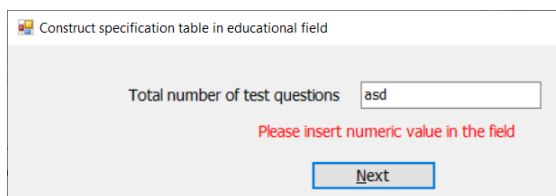


FIGURE 3 : WINDOW 1 – INPUT INVALID VALUE IN THE FIELD OF TOTAL NUMBER OF TEST QUESTIONS



Figure 4 describe window2 that used to input integer value for educational objectives otherwise message of invalid value will appear.

When user input at least one valid value then click on the Next button window3 will open as showing in the Figure 5.

Educational objective		
Knowledge	<input type="text" value="40"/>	<input type="text" value="40"/> %
Comprehension	<input type="text" value="30"/>	<input type="text" value="30"/> %
Application	<input type="text" value="30"/>	<input type="text" value="30"/> %
Analysis	<input type="text" value=""/>	<input type="text" value="0"/> %
Synthesis	<input type="text" value=""/>	<input type="text" value="0"/> %
Evaluation	<input type="text" value=""/>	<input type="text" value="0"/> %

Buttons: Previous, Next, Total Number of Test Question, Educational Objectives, Construct Type, Topics Detail.

FIGURE 4 : WINDOW 2 – INPUT EDUCATIONAL OBJECTIVES

Figure 5 describe Window3 that used to Select constructing type from two choices, if user select “Depending on the total number of Topic Pages” then click on Next button Window4 will open as showing in Figure 6, and if user select “Depending on amount of time spent to learn each topic” then click on Next button Window5 will open as showing in Figure 7.

Construct type

Depending on the total number of Topic pages

Depending on amount of time spent to learn each topic

Buttons: Previous, Next, Total Number of Test Question, Educational Objectives, Construct Type, Topics Detail.

FIGURE 5 : WINDOW 3 – SELECT CONSTRUCT TABLE OF SPECIFICATION-TOS TYPE



Figure 6 describe Window4 that used to input topic information, according to fields and buttons window:

New Topic Button: it used to clear all fields from any value to accept new value in the Fields “Topic Title” and “number of pages for topic”

Add Topic Button: it used to add the valid value that inputted in the fields as a new row in the table otherwise it will view message in red color font to inform user how can input valid value.

Delete Topic: it used to delete selected row from the table.

Construct Table: it used to view the constructed Table Of Specification-TOS electronically (the result) which calculated according to the inputted values.

Construct specification table in educational field

Topic information

Topic Title

Number of pages for topic

ID	Topic Title	Pages	Topic Weight %	Total Number of question	Knowlec question	Comprel question	Applicat question	Analysis question	Synthes question	Evaluati question
1	Chapter 1	8	13.33	13.33	5.33	4	4	0	0	0
2	Chapter 2	10	16.67	16.67	6.67	5	5	0	0	0
3	Chapter 3	12	20	20	8	6	6	0	0	0
4	Chapter 4	14	23.33	23.33	9.33	7	7	0	0	0

Total Number of Test Question

Educational Objectives

Construct Type

Topics Detail

FIGURE 6 : WINDOW 4 – INPUT AND CONSTRUCT TABLE OF SPECIFICATION DEPENDING ON TOTAL NUMBER OF PAGES FOR EACH TOPIC



Figure 7 describe Window5 that used to input topic information, according to fields and buttons window:

New Topic Button: it used to clear all fields from any value to accept new value in the Fields “Topic Title” and “Hours spent to learn topic”

Add Topic Button: it used to add the valid value that inputted in the fields as a new row in the table otherwise it will view message in red color font to inform user how can input valid value.

Delete Topic: it used to delete selected row from the table.

Construct Table: it used to view the constructed Table Of Specification-TOS electronically (the result) which calculated according to the inputted values.

Construct specification table in educational field

Topic information

Topic Title

Hours spent to learn topic

ID	Topic Title	Hours	Topic Weight %	Total Number of question	Knowned question	Comprehension question	Application question	Analysis question	Synthesis question	Evaluation question
1	Chapter 1	1	7.69	7.69	3.08	2.31	2.31	0	0	0
2	Chapter 2	3	23.08	23.08	9.23	6.92	6.92	0	0	0
3	Chapter 3	2	15.38	15.38	6.15	4.61	4.61	0	0	0

Total Number of Test Question

Educational Objectives

Construct Type

Topics Detail

FIGURE 7 : WINDOW 5 - INPUT AND CONSTRUCT TABLE OF SPECIFICATION DEPENDING ON HOURS SPENT TO LEARN EACH TOPIC



5.1.Computation Time Between Construction TOS Manually and Electronically

The Application of Electronic-Table Of Specification (E-TOS) tested by inputting different values and given fast results if it compared with manual construction of Table Of Specification-TOS.

Table 1 describe the input and output values of construction table depending on Topic Pages: Input value: are [Total Number of Test Question = 100, Educational objective (Knowledge=40%, Comprehension=30%, Application=30%), And rows in column Topic Title, Topic Pages]

Output value (Results): are Rows in column [Relative weight of Topic %, Knowledge Question 40%, Comprehension Question 30%, Application Question 30%, Total Number of Topic question].

Total Number of Test Question = 100						
Topic Title	Topic Pages	Relative Weight %	Knowledge Question 40%	Comprehension Question 30%	Application Question 30%	Total Questions
Chapter 1	8	13.33	5.33	4	4	13.33
Chapter 2	10	16.67	6.67	5	5	16.67
Chapter 3	12	20	8	6	6	20
Chapter 4	14	23.33	9.33	7	7	23.33
Chapter 5	16	26.67	10.67	8	8	26.67
Total Pages	60					

TABLE 1 : CONSTRUCTION TABLE OF SPECIFICATION DEPENDING ON TOPIC PAGES

Table 2 describe the time taken to construct Table 1, Test 1 and Test 2 are Manual construction of Table Of Specification-TOS and each of them are taken long time if it compared with my E-TOS application Test 3.

Test Type	Total Time of construction in Minutes
Manual construction of TOS - Test 1	15:40
Manual construction of TOS - Test 2	11:35
Construction of TOS by E-TOS application - Test 3	01:17

TABLE 2 : CONSTRUCT TABLE OF SPECIFICATION-TOS ACCORDING TO TOPIC PAGES

Table 3 describe the input and output values of construction Table Of Specification-TOS depending on Hours spent to learn topics:

Input value: are [Total Number of Test Question = 100, Educational objective (Knowledge=50%, Comprehension=25%, Application=25%), And rows in column Topic Title, Topic Hours].



Output value: (Results) are Rows in column [Relative weight of Topic %, Knowledge Question 50%, Comprehension Question 25%, Application Question 25%, Total Number of Topic question].

Total Number of Test Question = 100						
Topic Title	Topic Hours	Relative Weight %	Knowledge Question 50%	Comprehension Question 25%	Application Question 25%	Total Questions
Chapter 1	1	7.69	3.84	1.92	1.92	7.69
Chapter 2	3	23.08	11.54	5.77	5.77	23.08
Chapter 3	2	15.38	7.69	3.84	3.84	15.38
Chapter 4	3	23.08	11.54	5.77	5.77	23.08
Chapter 5	4	30.77	15.38	7.69	7.69	30.77
Total Hours	13					

TABLE 3 : CONSTRUCTION TABLE OF SPECIFICATION DEPENDING ON HOURS SPENT TO LEARN TOPIC

Table 4 describe the time taken to construct Table 3, Test 1 and Test 2 are Manual construction of Table Of Specification-TOS and each of them are taken long time if it compared with my E-TOS application Test 3.

Test Type	Total Time of construction in Minutes
Manual construction of TOS - Test 1	13:39
Manual construction of TOS - Test 2	09:00
Construction of TOS by E-TOS application - Test 3	01:20

TABLE 4 : CONSTRUCT TABLE OF SPECIFICATION-TOS ACCORDING TO HOURS SPENT TO LEARN TOPIC

5.2.E-TOS Accuracy

The Application of Electronic-Table Of Specification (E-TOS) tested by inputting different values and given accurate results, the application designed to reject invalid value and give messages in red color font to inform user how can input a valid value, Further, to avoid user delete selected row by mistake the application handle this action by showing confirmation message box that ask user confirm delete task.

6. Complete the documentation

The main goal of this application is to construct the table of specification electronically to avoid possible mistakes result and reduce the time taken when using manual calculation, lecturers can be evaluating the educational objectives according to the Bloom's taxonomy by using this application.



This application constructs the Table Of Specification-TOS in educational field depending on “number of topic pages” or “spent hours to learn each topic” that evaluated by inputted Bloom’s taxonomy.

The advantages from this application is to get fast and accurate results if it is compared with manual calculation.

7. Conclusion

The purpose of this application is to help lecturers to evaluate the complicity of test questions and evaluate the educational objectives according to the Bloom’s taxonomy, this application constructed the Table Of Specification-TOS in educational field depending on “number of topic pages” or “spent hours to learn each topic” that evaluated by inputted Bloom’s taxonomy, visual basic language provides the application E-TOS with special windows used for inputting bounded valid values to avoid application from accepting invalid values, my E-TOS application ensures getting accurate results in less time if it compares with manual calculation, that approved by testing and comparing the results.

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