

Test Item Analysis of Engineering Economy Subjected to Table of Specification: Input for Digital Test Bank and E-Class record for the College of Engineering

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ABSTRACT

This study is aimed at analyzing the 50-item multiple choice test in engineering economy and subjecting it to test item analysis using the Table of Specifications. The substance of this research paper is derived from Bloom's taxonomy of learning, which includes Knowledge, Comprehension, Application, Analysis, synthesis, and evaluation, respectively. The analysis of the 50-item test was centered on the TOS specifically: (1) the list of course objectives; (2) the topics covered in class; (3) the amount of time spent on those topics; (4) textbook chapter topics; and (5) the emphasis and space, respectively. The statistical tools used in this study are: metrics of central tendency that include the average and standard deviation of students' scores after the final examination are subjected to graphical analysis of scores and hypothesis testing to determine if a significant difference exists between the academic performance in the final examination and the final grade of students. The hypothesis testing was done at a 5% level of significance relative to the numerical coefficient for degree of freedom. This study methodically employed a review of related studies and literature to categorize, describe, analyze, and interpret the borrowed materials from different authors both in the local and international domains, respectively. The end goal of this study was to develop a relevant and effective mechanism for a digital LMS intended for testing banking systems and metrics for the grading system. The study further employed CDAI (Categorizing, Describing, Analyzing, and Interpreting), a method that was originally developed by Johnny Saldana (2019). This study was conducted on Quezon City University's main campus during the school year 2023-2024.

Keywords: TOS, Test Item, Grading System, Class Record, Bloom's Taxonomy

Introduction

The continuing innovation of the Learning Management System (LMS) in the College of Engineering of Quezon City University is self-evident that it is transforming to digitalization of its Measurement and Evaluation Metrics as the theory and practice of Table of Specifications (TOS) is now becoming a form part of the College Test Item analysis. Test item analysis is an operation that evaluates student responses to individual test items in order to evaluate the quality of those items and of the test in general. Tests give classroom instructors with indispensable data used to decide about Learning Management System (LMS). While, a table of specification (TOS) may be employed to assist classroom instructors in the College of Engineering to capture the framework and procedure in the decision making process of test items composition and enhance the validity of classroom instructors assessments according to tests constructed. In this study, the researchers dissected the objectives and content of a TOS and employed it to assist compose classroom examinations.

Background of the Study

As a mechanism for Curriculum and Instructional Development, on May 3, 2023, the Dean of the College of Engineering issued a Memorandum Circular to all instructors, stating among other things, that members of the faculty were encouraged to attend the training on Table of Specification (TOS) and Test Item Development that was held on May 6, 2023.

A TOS, sometimes called a test blueprint, is a table that helps teachers align objectives, instruction, and assessment (e.g., Notar, Zuelke, Wilson, & Yunker, 2004). Such technique can be employed for different evaluation methods but is usually associated with composing traditional summative tests. When composing an examination, instructors should be concerned that the test metrics represent a satisfactory sampling of the class content at the cognitive level that the learning resources were taught. The variables with utmost consideration in the TOS are lessons, objectives, content standard, number of items, item placement, and percentage, respectively. The other significant variables to be considered are levels of difficulty, such as easy level, moderate level, and the difficult level. Moreover, other considerations should include item placement, theoretical number of items, practical number of items, and percentage, respectively. An article written by Doctor (2017) published by International Journal of Computing Sciences Research entitled Integrated Educational Management Tool for Adamson University was one of the models that is theoretically adopted in this study. While, in this study the researchers focused on the academic achievements of electronics engineering students, which included the topics, learning objectives, placement of test items, and the index of discrimination of the test items after being subjected to TOS. The study also employed the normal distribution method, calculated the metrics of central tendency, and performed other non-parametric and parametric data analyses. Doctor's (2017) study focused on the development of a web based integrated academic information system that can aid Adamson University faculty to become more effective and efficient in giving costless examinations, in giving student grades, in avoiding redundancy of data and efforts, and in providing accessible and reliable information about examinations and grades. The developed system automates the processes of examination and student grading. To achieve the goal of the study, the researcher followed the phases of software development life cycle aiming to produce high quality software output that meets or even exceeds Adamson University faculty and administrations "expectations". The developed system was tested in Adamson University and evaluated using the ISO/IEC9126 software product evaluation criteria by respondents who include IT Experts and end-users with a descriptive rating of "excellent" with a mean average of 4.76 which proves that the system can be a useful tool for managing educational institutions' examination and student grading". Integrated Educational Management Tool for Adamson University is a system that was successfully constructed using open source

technology in developing web sites. The system has been successfully tested for functionality, reliability, usability, efficiency, and portability of the website with results that revealed that the developed application supports the educational institution's examination and student grading system for efficiency, reliability and accessibility. As a matter of recommendation, Future studies and integration of item analysis, table of specification, and enhancement of sub-modules of the system as suggested as well as making available offline class records and exams with online auto synchronization of data processes. Furthermore, the implication of the study employed the utilization of a new system, Adamson University will come up with a standard institutional class record, test banking system, quality examination materials, paperless examination, class record, and test materials so that the faculty will be able to minimize time for preparing examination materials, and in checking and recording exam results. Time spent for the preparation and revision of examination materials for same subjects will also be minimized so that a smooth collaboration among fellow teachers and synchronizing of courses being taught can be achieved which will result to less deployment and implementation costing since the new system is a product of an open source technology.

Understanding these basic principles and applications of test item analysis and constructing the TOS and the implications for curriculum development and the learning management system in the College of Engineering is the compelling reason for conducting this action research.

Objectives of the Study

The main purpose of this study was to develop a framework of digital test bank, grading system and e-class record for the college of engineering. Specifically, the study aimed to achieve the following objectives:

1. Determine the quality of student responses to the test items in the course of engineering economy pertain that covers the topics, learning outcomes, hours, weight, and the number of items.
2. Determine the student performance using pre-test and post-test
3. Determine the quality of response using Blooms of Taxonomy such as Knowledge, Comprehension, Application, Evaluation, and Synthesis.
4. Formulate the strategic recommendation based on the summary of findings.

Methodology

This action research used quantitative metrics and employed a measure of central tendency to evaluate the outcome of item analysis after the examination is subjected to TOS. The researchers employed descriptive-qualitative techniques to evaluate the level of quality of students scores' in multiple choice test alongside the comparison of quantitative techniques.

The researchers will use a purposive sampling in selecting respondents for the study, which can be classified into two groups. The first group will be the group of Electronics Engineering students who took the 50-item multiple choice test that was subjected to TOS. The second group of respondents will be the instructors who are involved in the preparation of the multiple choice test, particularly during the final examination. Moreover, teachers who participated in constructing the 50-item multiple choice test were included among the respondents of the study to ensure the validity and reliability of the test results. The study also required the learning module of the subject during the implementation of hybrid learning in the post-pandemic period.

In order to measure the academic achievement quantitatively, the researchers used the metrics of central tendency which included the Mean, Median, Mode, and the Standard Deviation, respectively. The data were presented in the normal distribution method and in graphical manner using the Cartesian coordinate system in the X-Y algebraic

functions.

Results and Discussions

COURSE CODE		E1325A																			
COURSE TITLE		ENGINEERING ECONOMICS																			
EXAMINATION PERIOD		SIGNALS																			
TOPIC	LEARNING OUTCOMES	HOURS	WEIGHT	ITEMS	Fundamental		Intermediate				Application		Synthesis		Evaluation		TOTAL ITEMS				
					TEST TYPE		TEST TYPE		TEST TYPE		TEST TYPE		TEST TYPE		TEST TYPE						
Benefit/Cost Ratio	Identify the relation of cost and benefits.	0.5	0.17	8			5				3						8				
Method	2. Solve Mutually Exclusive Alternatives using pre-discussed methods.																0				
	3. Compare independent projects using Evaluation of individual Projects.																0				
	Depreciation and After-Tax Economic Including the Salvage	1. Identify the depreciation and its factors that contributes the depreciation. 2. Know replacement studies that can affect purchase. 3. Know salvage value problems using pre-discussed methods.	0.5	0.17	8			5			3						8				
Discounted Decision Tree Analysis and Sensitive Analysis	1. Perform and interpret problems involving Discounted Decision Tree	1	0.33	17			12			5							17				
	2. Perform and evaluate the sensitive analysis on a given situational problem.	1	0.33	17			12			5							17				
																	0				
							0			34			16		0		0		0	50	
							3			50											

Summary of Cognitive Skills

Knowledge: 33%
Comprehension: 33%
Application: 33%
Analysis: 0%
Evaluation: 0%
Synthesis: 0%

COURSE DESCRIPTION:

This course deals with the study of concepts of the time value of money, and equivalence, basic economic study methods, decisions decisions under certainty, decisions recognizing risk, and decisions admitting uncertainty.

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Figure 2.0 Table of Specification

The Table of Specifications (TOS) calculates the number of hours, weight of the questions given, and the number of items. The Cognitive Domain categories the type of questions such as Knowledge, Comprehension, Application, Analysis, Evaluation, and Synthesis. Four (4) topics were included on the final examination. The Salvage Value and Sensitive Analysis ranked top as most weighted questions with a weighted mean of 33% given followed by Benefit/Cost Ratio and Depreciation ranked second with a weighted mean of 17%. A total of fifty (50) items were given on the final examinations with four (4) topics covered the test questions.

A pretest-posttest experimental design under a quasi-experimental approach was used, which means the aimed of the approach was established a cause-effect relationship. The number of items were down from seventy five (75) items to fifty items (50) number of items based on the administered testing. Same students were given the questions and itemized the questions from two results upper and lower scores. Upper scores defined as correct answer while lower scores signifies the wrong answer.

From the objective no. 3 given, the Cognitive Domain was used under the Bloom's Taxonomy. The Knowledge and Comprehension classifies as the theoretical questions given and served as Low Order Thinking Skills or LOTS while Application and Analysis type of questions ranked as an Average typical type of questions. On the other hand, Evaluation and Synthesis served as the High Order Thinking Skills or HOTS, students produced an output based on topics given. Problem analysis concluded the critical thinking type of solving the problems, this includes justification finalizing the answer of the examinees. A HOTS were not given due to time constraints, a number of hours were classified based on the type of questions.

QUEZON CITY UNIVERSITY
COLLEGE OF ENGINEERING
ELECTRONICS ENGINEERING DEPARTMENT
Number of Students Took the Examination

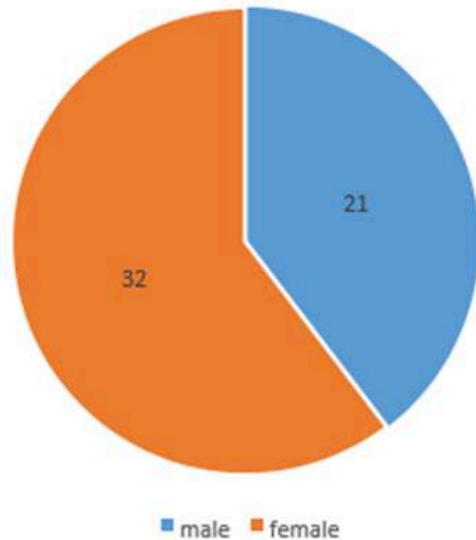


Figure 3.0 Total Number of Students under the course of Engineering Economics

[illegible]

[illegible]

Figure 4.0 Item Analysis

[illegible]

Figure 4.0 Item Analysis

From the figure 3.0 shown above, an item analysis resulted into an average type of questions with a rate of 8.04 where from the rubric given a verbal interpretation identifies an average result. Further, most of unanswered questions and or wrong answers came from problem analysis items 35-50. Ranked 1st tough questions given came from items 45-47 with a high rate of 82%, ranked 2nd were items 48-50 with a rate of 76%, and 71% respectively. On the other hand, the easiest question given was item 18 with a high rate of 78%, followed by items 1 and 10 with a rate of 76%. This is because the questions given were an objective type of questions and students clearly and read most of the questions given.

From the summary of findings given and based from the data results, the table of specifications guided with the number of items, weighted mean of an item, and a number of items. This concludes that the identified labels and/or categories used under the TOS were applicable to monitor and maintained the quality of questions given.

As a result from the TOS instructional materials implemented with the Cognitive Domain with the classifications such as Knowledge, Comprehension, Application, Analysis, Evaluation, and Synthesis. It is imperative to use this tool to determine the progress of the engineering students.

Recommendations

Furthermore, it is also encourage to use the Competency Matrix of the faculty as another tool in utilizing the performance of the engineering students. This identifies how hard and/or easy the item questions given.

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