

Test Item Analysis on Mock Board Licensure Examination: A Decision Support System

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Abstract:- This study introduces a Decision Support System called Test Item Analysis on Mock Board Licensure Examination –Decision Support System (TIAMLE-DSS) System. The TIAMLE-DSS will use Statistical technique in the process of discovering knowledge which in turn can be used as basis for intervention in the Curriculum Development and Modification in a certain program. TIAMLE-DSS is an Application tools that will produce Statistical Analysis on Item Test Analysis for Test Discrimination Index and Item Difficulty values on Student LEAE Mock Board Test Licensure Examination. The data to be tested by this TIAMLE-DSS were the April 2016 Agricultural Engineering graduates of ICET, SPAMAST- Digos Campus who participated in the LEAE Mock Board Examination last July 2016 who took-up the August 2016 LEAE. The prepared Licensure Examination Questionnaire for Mock Board Exam was provided by the LEAE Reviewer Committee that used as Data for Test Questionnaire by the System.

Keywords:- Test Analysis, Test Validity, Test Exam, Mock Board Exam, Reliability Testing, Item Difficulty Analysis, Discrimination Index.

I. INTRODUCTION

A university has several ways of characterizing the quality of Philippine universities (HEIs). The performance of HEI graduates in state licensing examinations was one of the most frequently used tangible measures in the country(Quiambao, Baking, Buenviaje, Nuqui, & Cruz, 2015). There have been several attempts to identify model performance prediction and license examination strategies, but many studies recommend a detailed analysis that covers other independent variables and approaches(Zahn et al., 2012). The student test performance is practiced in a variety of ways in college classrooms. Many times instructors return exams and check the correct answers during class in developing quality assessment and specifically effective analysis of test items plays a major role in contributing to the fairness of the test (Kargar, Tarmizi, & Bayat, 2010). In such cases, item analysis can help in identifying potential mistakes in scoring, ambiguous items, and alternatives (distractors) that don't work. Item analysis refers to a statistical technique that helps instructors identify the effectiveness of their test items(Shakil, 2008). Boyle and Radocy in their book highlighted the importance of conducting item analysis.

They advocate that item analysis facilitates test developer in the process of test quality enhancement which typically involves assessment cycles of the preserve, eliminate, improve or endorse particular item. Problematic items specifically items with ambiguous wording and wrongly keyed be reviewed based on the calculated difficulty index and discrimination coefficient values to improve the quality of the test(Shakil, 2008)(McCowan & McCowan, 1999). The Content expert should be consulted to improve items identified as problematic regarding language and content appropriateness(Luciano, 2014). The quality of each particular item must be analyzed in order to evaluate the quality of each item regarding item difficulty and item discrimination. Decision support systems (DSS) are defined as interactive application systems intended to help decision makers utilize data and models in order to identify problems, solve problems and make decisions(Kouatli, 2015). The goal of decision support systems is to improve effectiveness, rather than the efficiency of decisions(Gareau, S., 2010). The study introduces a TIAMLE-DSS (Test Item Analysis and Decision Support System), a system tool that can help diagnose items in the Mock Board Exam using item Difficulties and Discriminating Index. Using the test questionnaire and the results of the examination board, the TIAMLE-DSS can provide reviewers with information on which test areas to improve, provide information on what improves to be done in test learning and provide further insights and skills leading to the development of a better test in the future. The System tool can help instructors to analyze their evaluations efficiently. By using Item Analysis, the evaluator can analyze and improve questions for future tests if necessary or adjust credit in current attempts to more accurately reflect the performance of students.

II. LITERATURE SURVEY

In SPAMAST, Agricultural Engineering Licensure Exam is at the Institute of Computing Engineering and Technology (ICET). One of the pressing concerns of the Southern Philippine ICET Agri-business and Aquatic and Technology School (SPAMAST) is the batting or passing percentage of its graduates in Agricultural Engineering Licensing (LEAE). Based on the Philippine Regulation Commission (PRC) licensing review, SPAMAST experienced low performance in the Agricultural Engineering Board Program offered from 2006 to Present. Administration, faculty, and students are concerned about performance because SPAMAST's consequences for

failure were trouble for everyone. To improve and increase the LEAE Passing Percentage in SPAMAST, a user-friendly tool must be used to enable the ICET to implement an intervention program in a timely manner, develop a good curriculum and implement timely modifications to the Mock Board Review System before the students take the Licensure Examination. Garciano, (2015) found that academic performance such as General Education Subjects, Agricultural Engineering (AE) Major Subjects and 80% Score Performance on the Mock Board Examination has a high correlation in achieving a higher rate of passage for BSAE graduates in SPAMAST. Meanwhile, Mock Board Examinations defined one of the predictors that influenced graduate licensing examination performance. It was recommended to continually conduct comprehensive or mock exams to graduates before taking Licensure Examination to increase their likelihood of passing the board exam. (Achacoso, 2013) Identified specific test learning strategies. Helping a student identify this phenomenon when it occurs is particularly important for developing student's metacognitive skills. Someone who experiences knowledge illusion is generally sure they knew the answers to an exam. The reality is that a student may have learned the information well enough to recognize terms on a multiple-choice test, for example, but the exam's cognitive demands may have gone beyond recognition. Examining student test performance is a practice done in college classrooms in various ways. Often, instructors return exams and go over the correct answers during class. Another common way student's get feedback on the performance of the exam is to check their scores on course management systems, such as Blackboard, or to see the teaching assistant during office hours. What's important is that, at the post-secondary level, it's up to individual students to figure out why they've done some way on an exam. After looking at the score, most students put out the test and move on to the next academic task. Analyzing one's performance, however, is a great opportunity to improve future similar tasks. Explicitly teaching students to analyze their test performance can help them better understand their cognitive process or what is known as metacognitive (Flavell, 1979). This means that when students become aware of what they do and are unfamiliar with specific content, they develop greater metacognitive awareness. This type of awareness can help foster self-regulated learning in college students.

Jacobs (1991), Miller (2012) and Wells and Wollack (2003) analyzed according to the other testing features: • Validity tests—tests should be suitable from three points of view for objective student tests:

- Validity content—tests should be capable of evaluating student subject knowledge.
- Validity of the criterion—tests should be able to measure the knowledge of students.
- Predictive validity—testing should, for example, be able to predict student knowledge during an oral examination.

- Reliability of tests—tests should be reliable and consistent and should not be randomly errored. Test difficulty—testing should not discourage students from continued learning; it should not be too hard or too easy.
- Test discrimination—test should show that there is a difference between qualified and unskilled students and that qualified students are expected to answer test questions correctly.

In short, item analysis allows additional quality control over tests to be exercised. Well-specified learning objectives and well-designed items give a breakthrough in that process, but item analyzes can provide feedback about how successful they really have done.[3]These item analyzes can also diagnose why certain items haven't been particularly good and thus suggest ways to improve them. Analysis of items provides statistics on overall test performance and individual test questions administered by Blackboard Learning Management System[2]. These data help instructors to analyze the efficacy of their evaluations. The blackboard Item analyzes allow teachers to analyze questions for future tests and, if necessary, to improve them or to adjust credit for the current attempts to better reflect student performance[6]. The instructors can conduct item analysis for single or multiple tests, question sets, random blocks, self-graded questions and short answers and test questions. Statistics are generated only for scored questions and are not generated for short answers / test questions not yet scored. Once an instructor has manually graded all assigned questions in an evaluation, the instructors can then retake the item analysis for a comprehensive list of statistics for the evaluation. Factors promoting such poor discrimination should be considered sensitively[7]. The item analysis reduces the need for test developers to develop an ideal achievement test, which serves as tools to assess learner progress and instructional quality in model-based teaching among students in public universities for teachers of beginner string ensemble. Instructive Evaluation Resources (IAR 2011) considers that "an item analysis contains numerous statistics that can provide useful information to improve the quality and accuracy of multiple or true / false decisions." The quality of each item has been analyzed to evaluate the quality of each item in relation to the problem and discrimination of items. The problem is essentially the proportion of students who answered an item correctly. In the meantime, item discrimination is a measure to make a distinction between high score students and low score students. All of the mentioned works acknowledged the importance of statistical analysis, which is an important element in the integrated decision support system for curriculum development and modification. To date, the Mock Board Exam has been focused on statistical analysis on the items difficulty and discriminatory values that have served as variables that form the basis for the decision support system which will lead to a good passing performance rate of future student licensing exams.

III. THEORETICAL FRAMEWORK

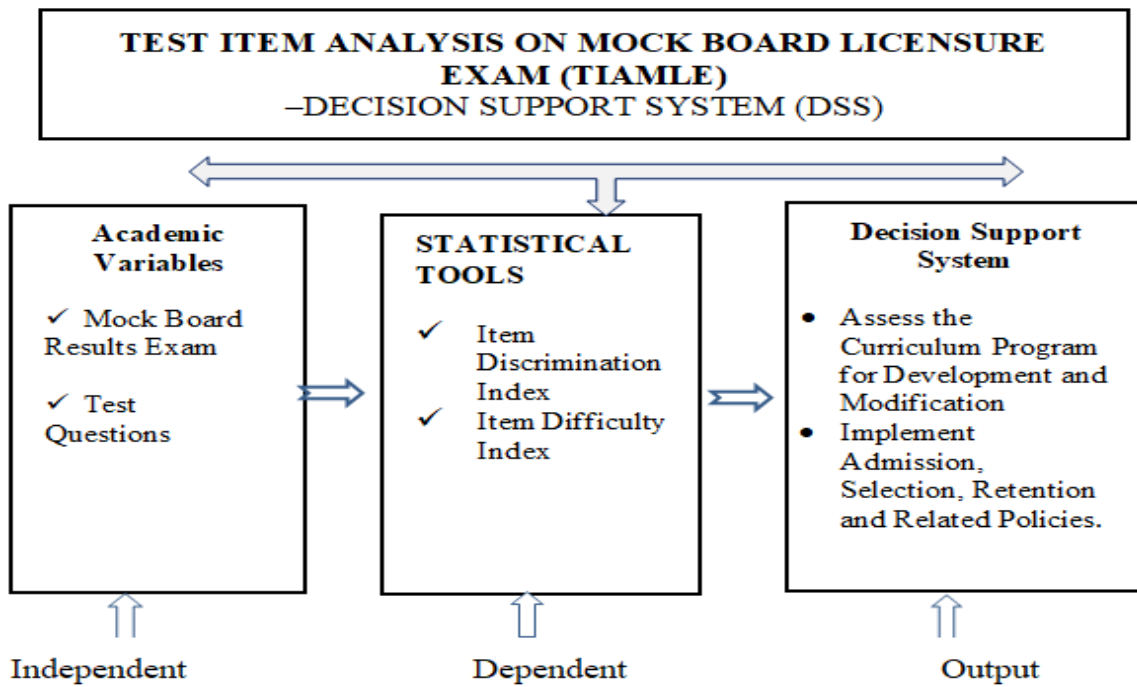


Fig 1:- Conceptual Framework

Figure 1 shows the Conceptual Framework of the Study. The Result of Mock Board Exam and Test Questionnaire are the Independent Variables while Item Difficulty and Discriminating Index derived from Board Examination Result is the Dependent Variables. The Independent and Dependent Variables would be the basis for the Decision Support System help improve Outcome variable. The Independent, Dependent and Outcome

Variables are the components of TIAMLE-DSS Desktop Application System.

IV. SYSTEM FLOW

The overall system works on three important processes which are mentioned below:

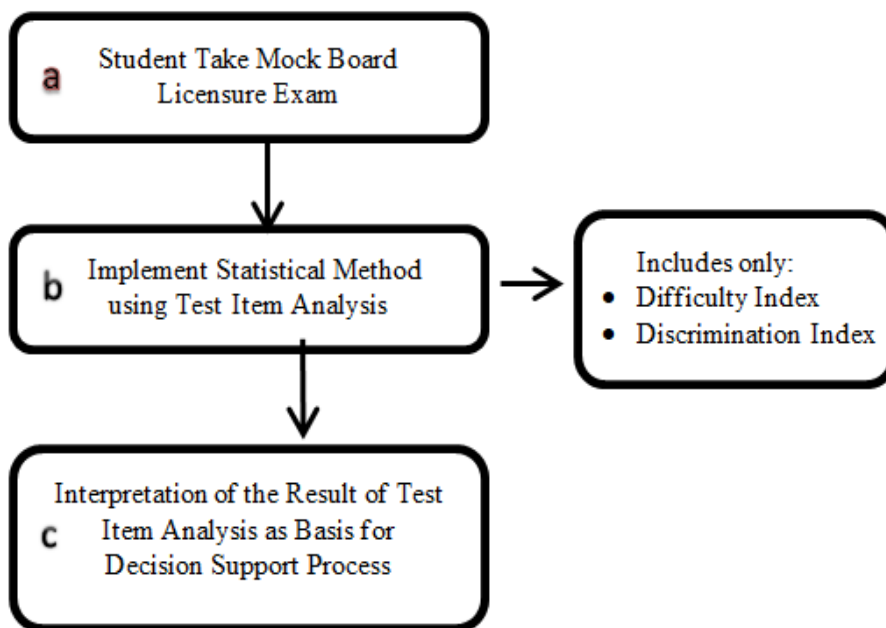


Fig 2:- Flowchart of Test Item Analysis

A. Student Take Mock Board Licensure Exam

Using the TIAMLE-DSS, the student must take the Test Questionnaire provided by the System as shown in Figure 3.

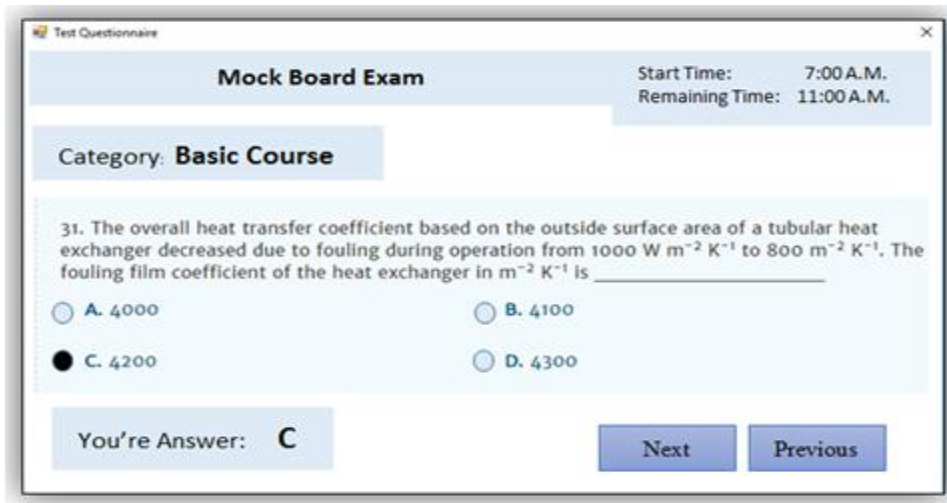


Fig 3:- TIAMLE-DSS for Test Questionnaire

B. Implement Statistical Method using Test Item Analysis

The Statistical Method used for analysis of the tests that embedded in the TIAMLE-DSS are the following:

➤ **ITEM TEST DIFFICULTY**

Defines the number of students who can correctly answer the item divided by the total number of students. The p-value shall be calculated using the following: $p = R / T$

T Where: p= item problem index R= number of correct answers for item T= total number of answers includes correct and incorrect answers Item difficulty, commonly called p-value, refers to the proportion of examiners who correctly replied to Item. The p-value is between 0.0 and 1.00. A high p-value shows a simple item. The IAR recognized the difficulties index values and their assessment as tabled in Table 1.

Range of Difficulty Index	Interpretation	Action
Below 0.20	Very difficult item	Revise or discard
0.62	Ideal value	Retain
Above 0.90	Very easy item	Revise or discard

Table 1:- Range of Item Difficulty for Item
Source: Instructional Assessment Resources (IAR 2011), Sabri (2013)

➤ **INDEX OF DISCRIMINATION-**

Is the difference between the upper group proportions that have the right part in the lower group that have the right part. The Discrimination Index value ranges from -1.0 to 1.0. The Item Discrimination Index (D) calculated by: Formula $D = (UG-LG)/n$ Where: D = discriminatory UG

index = number of upper group students 27 percent who correctly responded LS = number of lower group students 27% who answered correctly n = number of upper or lower level students. The items were classified according to the Ebel (1972) Guidelines discrimination index and (Sabri, 2013) as Table 2 Tabulate.

Index Range	Evaluation	Action
0.40 and above	Very good items	Accept
0.30 – 0.39	Reasonably good	but subject to improvement
0.20 – 0.29	Marginal items	usually, need and subject to improvement
Below 0.19	Poor items	to be rejected or improved by revision

Table 2:- Evaluation of Discrimination Indexes
Source: Ebel (1972), Ovwigho (2013) the Sabri (2013)

C. Interpretation of the Result of Test Item Analysis as Basis for Decision Support Process

After the Students completed all the Test Questionnaire provided by TIAMLE-DSS, the System may produce Summary for Test Item Analysis on Test Item

Difficulty and Discrimination index as Shown in Figure 4 as basis for Decision Process as shown in Figure 5, the Process Model for Test Item Analysis and Decision Support System.

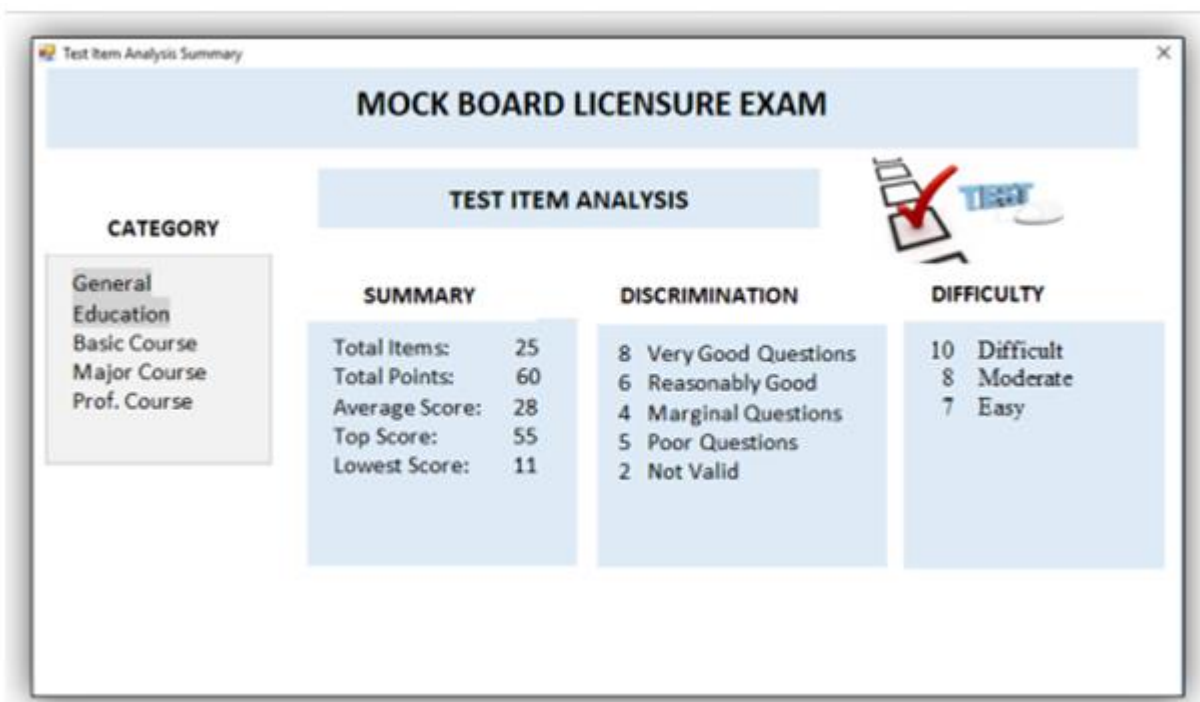


Fig 4:- Interface for Summary on test Item Analysis

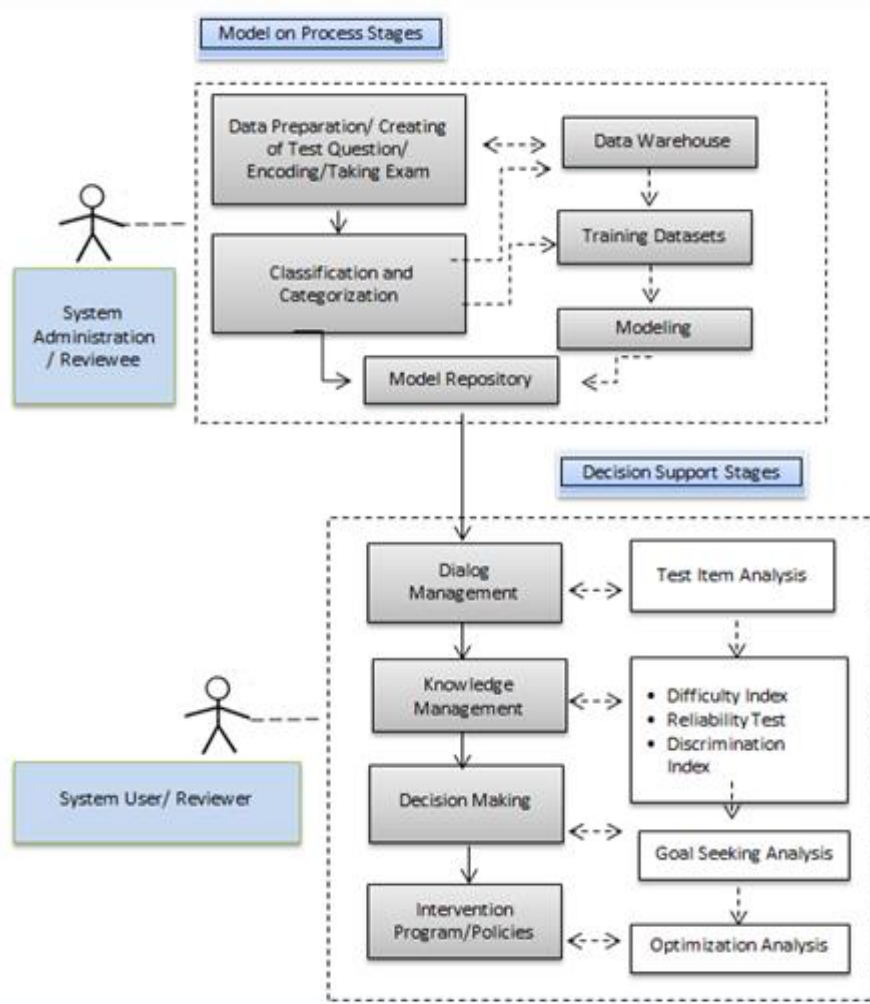


Fig 5:- Process Model for Test Item Analysis and Decision

➤ *Support System*

Figure 5 Show the process model for Test Item Analysis and Decision Support System. It has two Stages the Test Item Analysis Stages consist of Data Preparation in the form of Questionnaire and Data from student Exam Results needed on Training Datasets that will produce Modeling into the Modeling Repository basis for Decision Support System. The Decision Support Stage consist of Dialogue Management of which what-if analysis should be done, Knowledge Management which needs sensitivity analysis, decision making that needs goal seeking analysis and Intervention on Program/Policies that needs optimization analysis

V. SYSTEM DESCRIPTION

The TIAMLE-DSS is a Client and Server Application that gives detailed information about the Test Item Analysis on the Mock Board Licensure Test Exams. The system tools can help diagnose items in the Mock Board Exam using Statistical Method for Test Item Analysis Item Difficulty and Discriminating Index. Using the Test Questionnaire and Result of Mock Board Exams from the examinee, the TIAMLE-DSS can provide information to Students what areas to improve in the test, provides data what improvement to do in the test learning, and provide insights and skills that lead to the preparation of bitter test in the future. For Reviewers whose careers

are focused on reviewing students for Licensure Exam, there is a genuine concern to improve and assess the improve reliability of Test questions for students facing licensure examination.

The produce result from students exams were then utilized by TIAMLE-DSS to determine the quality of each particular Item regarding Item Difficulty and Item Discrimination analysis. To analyze the exam results from the Mock Board Licensure Exam and Questionnaire. The Students need to take the Test Exam provided by TIAMLE-DSS. The collected data such as answers to Test Questions, number of attempts, etc.

Specifically, the TIAMLE-DSS system has the following functionalities:

- The Test Questionnaire will be categorized according to the following classification Attributes: Course_GenEd, Course_Basic, Course_Major, and Course_Special.
- The System User Administrator /Reviewer can Create a Mock Board Questionnaire and the functionality to Generate and Compute a Summary Results per individual Student Takers
- The System will produce Summary on Test Exams, Test Item Analysis on Difficulty, and Discrimination Index.

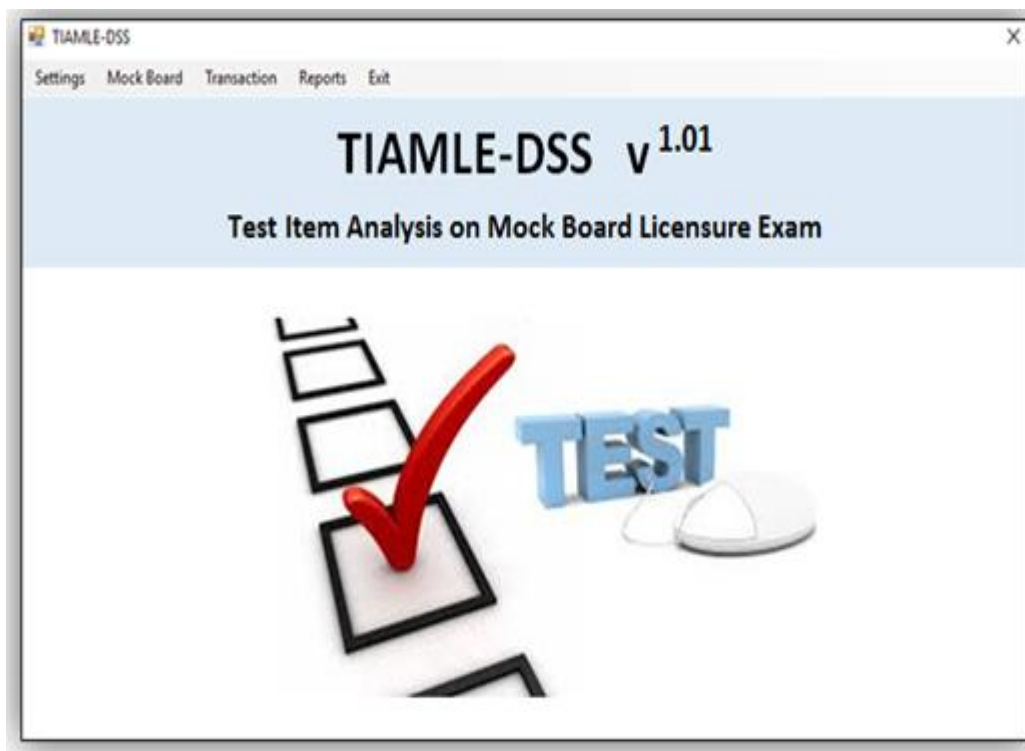


Fig 6:- Main Interface for TIAMLE-DSS

Figure 6 shows the Main Interface for the System. It has Menu for Settings, Mock Board, Transaction and Reports Menu.

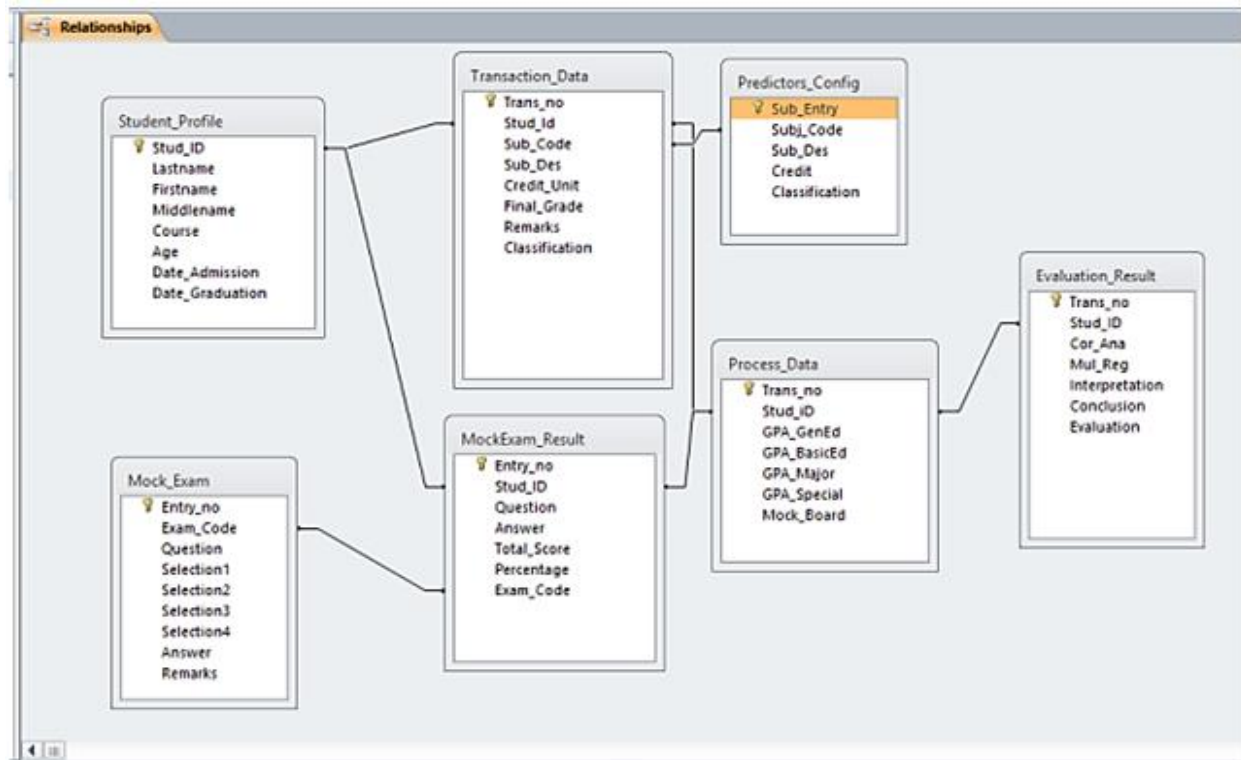


Fig 7:- Entity Relationship Diagram

VI. SYSTEM FLOW CHART

The flowchart of the system is shown below:

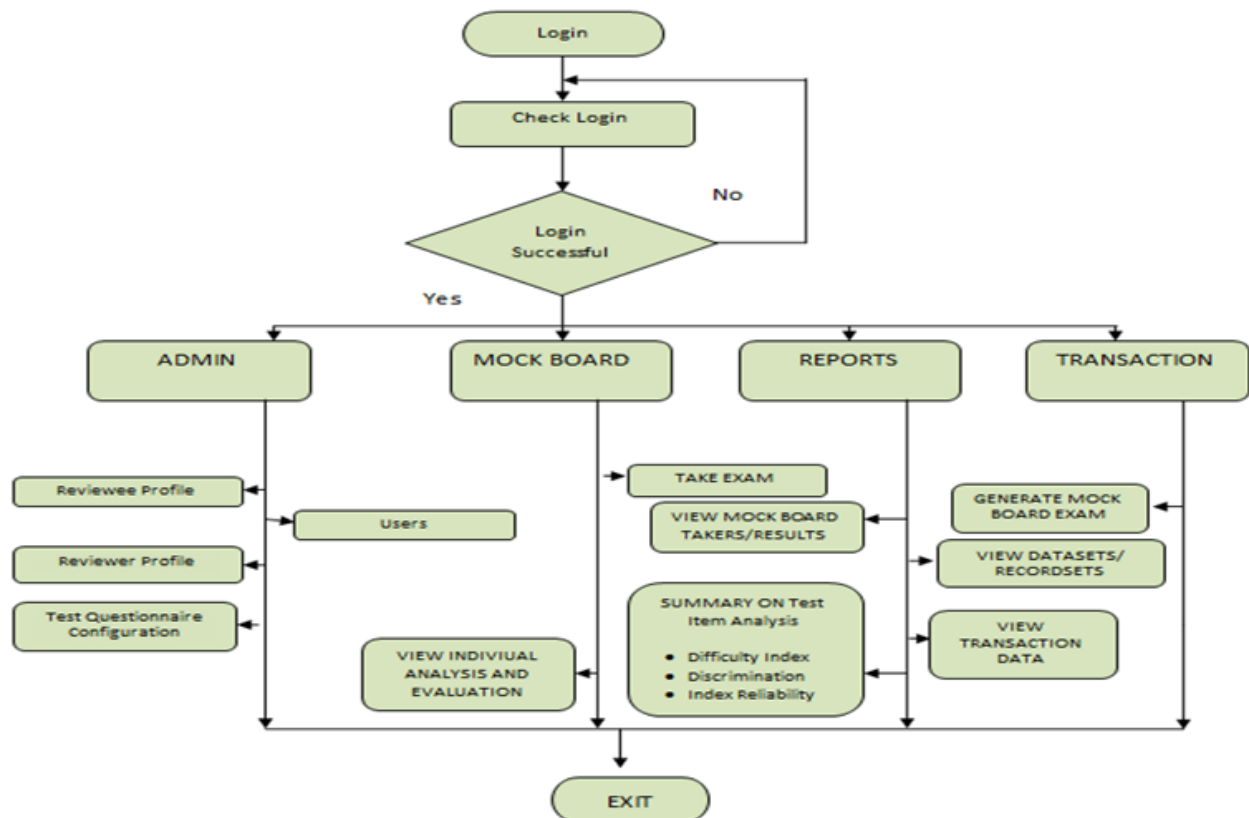


Fig 8:- Data Flow Diagram of TIAMLE-DSS

Figure 8 shows the Data Flow Diagram for the TIAMLE-DSS. It has Settings, Mock Board, Reports, and Transaction Menu.

The TIAMLE-DSS has two Users : the System User Administrator /Reviewer and Student/Reviewer.

A. Steps in Using the Account for Student/Reviewee:

Steps involved in the system are explained below:

- Step 1: In this step, the student need to log-in to the system
- Step 2: In this step, the student needs to click the menu for Mock Board menu to enter to the Test Questionnaire form.
- Step 3: In this step, the student need to Select the Answer for every question in the items ms in the Test
- Step 4: In this step, the student can View the Individual Test Item Analysis and Evaluation Reports.

B. Steps in Using the Account for Administrator /Reviewer:

Steps involved in the system are explained below:

- Step 1: In this step, the Administrator/Reviewer needs to log-in to the system
- Step 2: In this step, the Administrator/Reviewer need to click the Settings Menu, Add, Edit or Delete Information for Reviewer Profile and Student Profile. Also, it has to configure settings for Test Questionnaire and Test Configuration.
- Step 3: In this step, the Administrator/Reviewer need to click the Transaction Menu to create Test Questionnaire for every Category on the Test Exam.

- Step 4: In this step, the Administrator/Reviewer may click the Report Menu to view the Mock Board Result and Result for Test Item Analysis.

VII. RESULTS

The data tested by TIAMLE-DSS were ICET Agriculture Engineering, SPAMAST-Digos Campus graduates of April 2016 who took part in the LEAE Mock Board Examination last July 2016 and LEAE in August 2016. The LEAE Reviewer Committee provided the prepared Licensure Examination Questionnaire for the Mock Board Examination. The integration into one data warehouse for the different tables was done, and the data were transformed into meaningful groups in line with the study aims. The TIAMLE-DSS data sets were classified as General Education Subjects (Course GenEd), Basic agricultural engineering (Course Basic), Circular Engineering Projects (Course Prof) and Major Specialized Subjects (Course Special). After the student has completed the examination process. The system passes through and displays the analysis of test items as shown in Figure 11 and 12. The interfaces display the results from the statistical analysis of the Difficulty and Discrimination Index test item analysis. Figure 10 shows the Summary of Test Result Questionnaire Test Item Analysis, after all participants have been completed. After Student completed the process of Taking exams. the system goes through and shows the Test Item Analysis as shown in Figure 11 and 12. The Interfaces shows the results of Statistical Analysis for Test Item Analysis on Difficulty and Discrimination index. Figure 10 also shows the Test Item Analysis on the Summary of Test Result Questionnaire after all takers were completed.

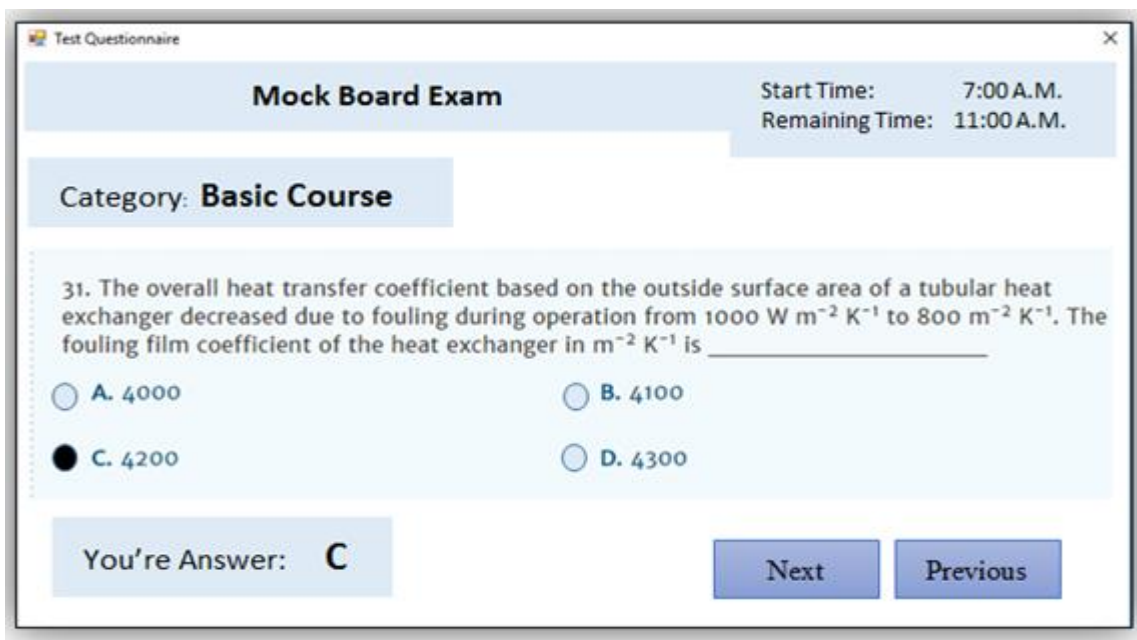


Fig 9:- Test Questionnaire

Figure 9 shows the test questionnaire for Exam Category. It shows Test Question, Multiple Choices, Answer and buttons for Next and Previous Questions.

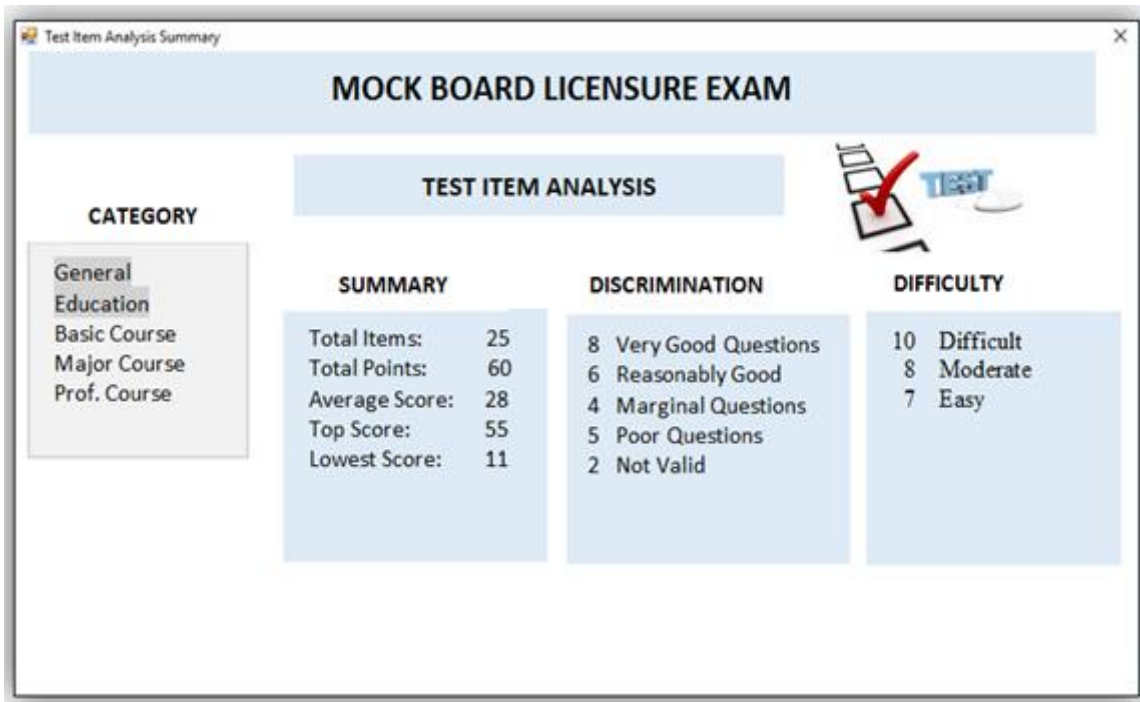


Fig 10:- Summary of Test Item Analysis

Fig. 10 show the Interface for Test Item Analysis Summary Result. The Interface show the Summary from the Test Exams Difficulty Index, Discrimination. Also, it shows Record for Total Score, Total Items, Top Score, and Lowest Score.

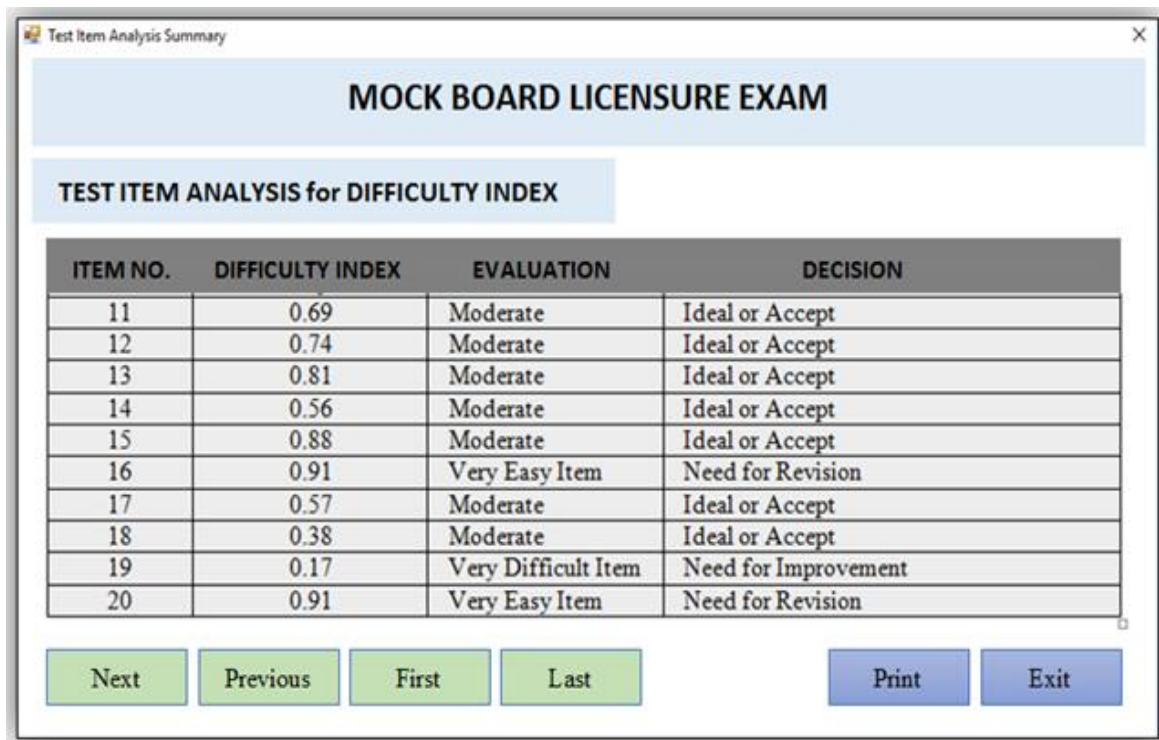
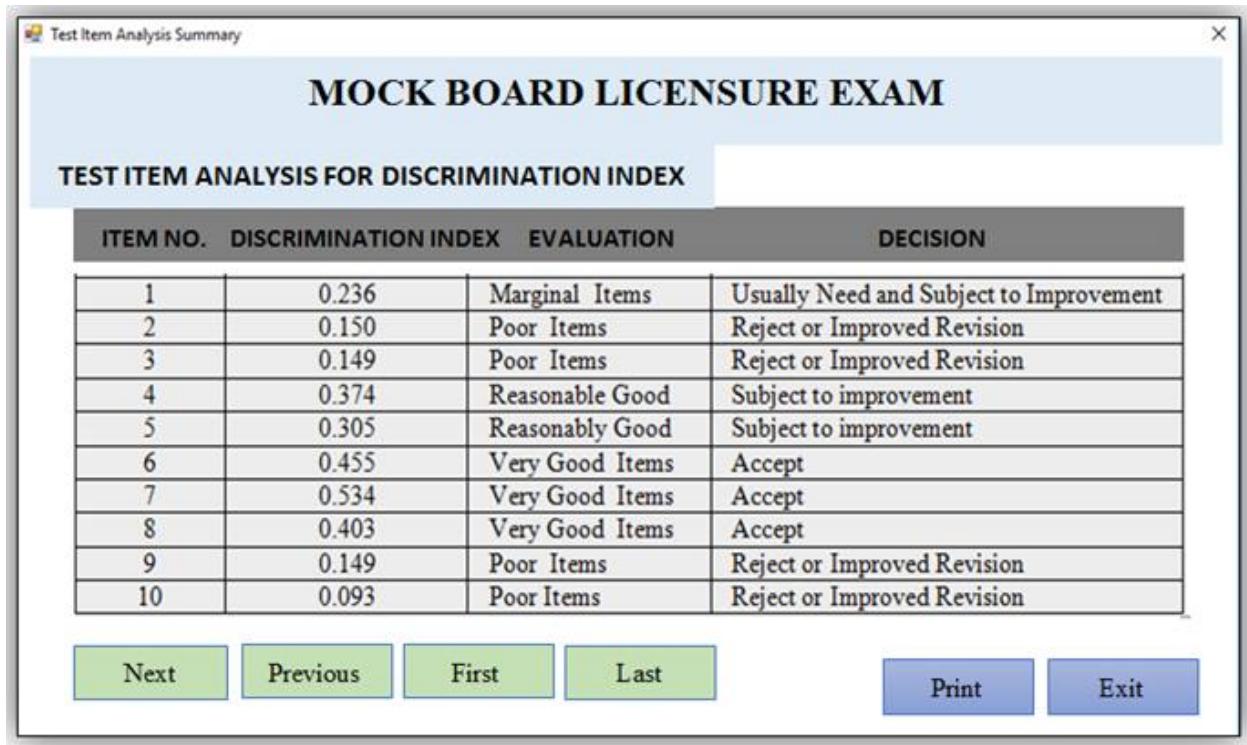


Fig 11:- Test Item Analysis for Difficulty Index

Figure 11 shows the Interface Result output for Difficulty Index on Test Exams. It also shows Item numbers that were evaluated for moderate, very easy item, and difficult item.



ITEM NO.	DISCRIMINATION INDEX	EVALUATION	DECISION
1	0.236	Marginal Items	Usually Need and Subject to Improvement
2	0.150	Poor Items	Reject or Improved Revision
3	0.149	Poor Items	Reject or Improved Revision
4	0.374	Reasonable Good	Subject to improvement
5	0.305	Reasonably Good	Subject to improvement
6	0.455	Very Good Items	Accept
7	0.534	Very Good Items	Accept
8	0.403	Very Good Items	Accept
9	0.149	Poor Items	Reject or Improved Revision
10	0.093	Poor Items	Reject or Improved Revision

Fig 12:- Test Item Analysis for Discrimination Index

Figure 12 shows the Interface Result output Discrimination Index. It shows Item numbers that was considered as Accepted, Rejected, and need for improvement.

VIII. CONCLUSION

In this paper, the TIAMLE-DSS will use statistical technique in the discovery of knowledge, which can be used to intervene in the program development and modification. TIAMLE-DSS is an application tool that produces statistical analysis on the Discrimination Index item test analysis and the LEAE student movement testing license test item difficulty values. TIAMLE-DSS has interfaces which show the Summary Test Test Analysis Result, Summary of Discrimination Item Analysis and Difficulty Index.

REFERENCES

- [1]. Achacoso, M.V. (2015). Test Analysis: A Tool for Developing Students' Metacognitive Awareness and Self-Regulation.
- [2]. Boopathiraj, C. & Chellamani, K. *Analysis of Test Items on Difficulty Level and Discrimination Index in the Test for Research in Education*. International Journal of Social Science and Interdisciplinary Research 2013; 2:
- [3]. Brožová, H., and Rydval, J. (2013) 'Analysis of the exam test quality', Proceedings of the 10th International Conference on Efficiency and Responsibility in Education, Prague, pp. 120– 127
- [4]. Brožová H. and Rydval J. (2014) "Analysis of Exam Results of the Subject 'Applied Mathematics for IT'", Journal on Efficiency and Responsibility in Education and Science, Vol. 7, No. 3-4, pp. 59-65, online ISSN 1803-1617, printed ISSN 1803-1617, doi: 10.7160/eriesj.2014.070303.
- [5]. Glerl, M.J. 2010. *Identifying Sources of Differential Item and Bundle Functioning on Translated Achievement Test: A Confirmatory Analysis*. University of Alberta, "Journal of Educational Measurement, Summer 2010 Vol.38.No.2.pp.164-187
- [6]. Gareau, S., hilard d. (2010). Academic performance of students admitted with different entry certificate in Nigeria certificate in education programme in federal college of education (technical), Omoku. *Journal of Technology and Science Education*, 4(1), 39–47. <http://doi.org/10.3926/jotse.107>
- [7]. Kargar, M., Tarmizi, R. A., & Bayat, S. (2010). Relationship between mathematical thinking, mathematics anxiety and mathematics attitudes among university students. *Procedia - Social and Behavioral Sciences*, 8, 537–542. <http://doi.org/10.1016/j.sbspro.2010.12.074>
- [8]. Kouatli, I. (2015). Student advising decision to predict student's future GPA based on Genetic Fuzzimetric Technique (GFT). *IEEE International Conference on Fuzzy Systems, 2015-Novem*. <http://doi.org/10.1109/FUZZ-IEEE.2015.7337925>
- [9]. Kaspříková, N. (2011) 'Multivariate Analysis of Examination Papers', Proceedings of the 8th International Conference on Efficiency and Responsibility in Education, Prague, pp. 120– 127.
- [10]. Kaspříková, N. (2012a) 'Data analysis of students' performance', Proceedings of the 9th International Conference on Efficiency and Responsibility in Education, Prague, pp. 213–218
- [11]. Le, L.T. (2012). *Item Point-biserial Discrimination*. Retrieved November 29, 2013 from Australian

Council of Educational Research Web site:
<http://www.acer.edu.au/documents/Conquest-Notes-5ItemPointBiserialDiscrimination.pdf>

- [12]. Luciano, J. (2014). The Influence of Curriculum Quality on Student Achievement on the New Jersey Assessment of Skills and Knowledge (NJ ASK) Language Arts and Mathematics for Fifth-Grade Students in the Lowest Socioeconomic School Districts. *ProQuest Dissertations and Theses*, (2014), 243. Retrieved from <https://search.proquest.com/docview/1658785154?accountid=13042>
- [13]. Macanip, R., School of Education Xavier University –Ateneo de Cagayan” *Item Analysis –All you need to it”*
- [14]. Mcgahee, T.W. & BALL, J. (2009). *How to read and really use an item analysis*. Nurse Educator, 34, 166-171. Morrison, S., Nibert, A., & Flick, J. (2006). *Critical thinking and test item writing*. Houston: Health Education Systems, Inc.
- [15]. Morrison, SUSAN PhD, RN; Adamson, CAROLYN PhD, RN; NIBERT, Ainslie PhD, RN; HSIA, SUSAN PhD, RN. *HESI Exams: An Overview of Reliability and Validity*. CIN: Computers, Informatics, Nursing: July/August 2004 - Volume 22 - Issue 4 - pp 220-226
- [16]. McCowan, R. J., & McCowan, S. C. (1999). Item Analysis for Criterion-Referenced Tests. *Online Submission*, 39. Retrieved from <http://eric.ed.gov/ERICWebPortal/recordDetail?accession=ED501716>
- [17]. Penn, B.K. (2009, August). *Test item development and analysis*. Presented at Creighton University School of Nursing Faculty Retreat, Omaha, NE.
- [18]. Quiambao, D. T., Baking, E. G., Buenviaje, L. M. B., Nuqui, A. V, & Cruz, R. C. (2015). PREDICTORS OF BOARD EXAM PERFORMANCE OF THE, *I(1)*, 1–4.
- [19]. Sandra, C.L.(2010)). *Assessing the Quality of Multiple-Choice Test Items*. January/February 2010 - Volume 35 - Issue 1 - pp 12-16.doi: 10.1097/NNE.0b013e3181c41fa3
- [20]. Shakil, M. (2008). Assessing Student Performance Using Test Item Analysis and its Relevance to the State Exit Final Exams of MAT0024 Classes-An Action Research Project. *Polygons*, 2(May), 1–35.
- [21]. Schreyer Institute for Teaching Excellence. (2013). *Improve Multiple Choice Tests Using Item Analysis*. Retrieved November 28, 2013, from Pennsylvania State University, Schreyer Institute for Teaching Excellence Web site: <http://www.schreyerinstitute.psu.edu>
- [22]. Villanustre, F., & Hickling, B. (n.d.). *Beginner ’ s Guide to Data Security and Information Security Compliance & Audits*.
- [23]. Zahn, C. M., Saguil, A., Artino, A. R., Dong, T., Ming, G., Servey, J. T., ... Durning, S. J. (2012). Correlation of National Board of Medical Examiners Scores with United States Medical Licensing Examination Step 1 and Step 2 Scores. *Academic Medicine*, 87(10), 1348–1354.