Exploratory Sequential Design to Develop and Validate Economics Placement Test for Nigerian Universities

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Abstract: This paper presents an exploratory sequential mixed methods approach in validating the Economics Placement Test [EPT] to assess prospective undergraduates' Economics knowledge and perceived skills for admission into undergraduate programmes of Nigerian Universities. Exploratory sequential mixed methods design adopted in this study was characterized by an initial qualitative phase and then followed by a quantitative phase. The qualitative phase comprised of 45 participants. Similarly, the national Economics curriculum and assessment procedures were reviewed in order to develop the instrument. A total of 60 items EPT, response options and keys were constructed following the interviews and documents analysis with the review of experts' panel. In the quantitative phase, the EPT was administered to 600 prospective university applicants. The Rasch Model was used to analyze the data using WINSTEPS. From the result of the analysis, good psychometric properties were obtained. Person and item reliability were adequate indicating an excellent reliability. The test satisfied Asch assumption of unidimensionality. Item-person map showed that the test was able to measure a range of the students' abilities in Economics knowledge and perceived skills. Nevertheless, some defective items found to be irrelevant were removed to produce the final version of EPT. The items satisfied all the Rasch model fits as an evidence of construct validity. Thus, the EPT is a valid and reliable test to be used for measuring students Economics ability, hence providing true picture of students to be enrolled into Nigerian universities.

Index terms: Rash model, Item-person map, Economics Placement Test, Exploratory Sequential Design

I.   INTRODUCTION

Development and validation of instruments especially academic achievement measure involves complex steps, processes and interrelationship of different concepts and latent variables. Therefore, certain guidelines must be followed to develop a test that is closely related to the intended outcome. Two most important steps in test development as spelt out by[1] are; [a] item development should include content definition, preparation of test specification, and preparation of the items pool, content

validation/experts judgment, pilot testing, data analysis and revision of test items. [b] item validation should go through item analysis procedures. All these processes are carefully executed to ensure the development of valid and reliable instrument to estimate item and person ability. Validity is the foundation upon which all assessment systems are built, whether the assessment tool is standardized or locally designed, the aim is to use an instrument that produces the true estimate of the examinee ability which could support valid inferences[2].

The purpose of assessing students learning includes licensing, certification, diagnosis and placement. The entrance examination conducted in universities serves the later purpose [placement] with a view to place qualified applicants into the university's programme of their choices. The feedback of university placement examination must have significant values in taking appropriate decision on students' eligibility.

Joint Admissions and Matriculation Board [JAMB] which was established in 1978 conducts placement or entrance examination called 'Unified Tertiary Matriculation Examination [UTME]' and regulates the admission in all Nigerian universities. All candidates seeking for admissions in Nigeria must sit for the UTME. However, the shortcomings noticed in the process of admitting candidates through UTME led to several calls by stakeholders for an alternative method of admission[3]

Due to the obvious shortcomings of UTME, the federal government of Nigeria granted power to universities to conduct screening tests 'Post-Unified Tertiary Matriculation Examination [Post-UTME]' in 2005[4]. Under this policy, it became mandatory for all universities in the country to organize a screening test for prospective candidates after passing their UTME and before offering them a place into their programmes. Post-UTME is believed to ensure quality and that, when the best candidates are admitted, the results will also be enhanced which in the long run will lead to the production of better quality graduates from Nigerian universities[3]

In large scale assessment of this nature, the question of reliability and validity is of great concern. However, the Post-UTME did not follow any professional criteria; because many universities conducts written screening tests consisting of questions that have no any bearing on the candidate's proposed field of study, using unstandardized items which can be more difficult items[5],[6]. Similarly, since its' inception to date, there are no sufficient empirical evidences on development, validity and reliability of the Post-UTME despites its' validity and reliability issues. This led to several questions and concern on the Post-UTME validity as such stakeholders suggest among others that, Post-UTME items should be allowed to pass through the processes of standardization, test development and content experts should be involved in developing and validating the Post-UTME items in order to establish validity and reliability of results which will lead to valid interpretations[7],[5].

The challenges face by Nigerian universities today is the need for a standardized test to assess the true ability of students and provide valid interpretations with respect to students' eligibility for admission into Nigerian universities.

This study is conducted to develop and provide a preliminary content and construct validity as well as reliability evidences for Economics Placement Test [EPT] for Nigerian Universities. Economics is selected because according to available statistics 53% of the candidates writeEconomics as a compulsory subject for their chosen programme atthe university[8].

II.LITERATURE REVIEW

Rasch Measurement Model

Rasch Measurement Model [RMM] has two significant properties of internal scaling and invariance. These two properties are obtained when the assumption of unidimensionality is met. The model is a prescriptive model because it prescribes specific conditions for the data to meet.

One of the basic assumptions of the RMM is the unidimensionality: the test should measure one trait at a time. The assumption although theoretically sound, it is practically impossible to construct test which measure only one trait or to prevent the test from the influence of extraneous factors[9].Rasch links the opportunities of correct response to each item [P] as a function of examinee ability [θ] [P [θ]] with a constant level of difficulty [b] denoted in an equation 2.

$$P(\theta) = \frac{e^{[\theta - b_i]}}{1 + e^{[\theta - b_i]}}$$
[2]

Rasch analysis is principally designed to meet the construct validity as described. Item analysis under Rasch focuses on calibration of examinee ability and item difficulty, estimation of model fit, assessment of unidimensionality as well as distractor analysis. These are the indicator used in measuring the test item quality and relevance to the trait being measured taking into consideration the person ability[10]. Since its introduction by Georg Rasch in 1960, the application of Rasch in education has led to improvement in learning outcomes and extended to medicine, public health and other disciplines.
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III.OBJECTIVE

The objective of this paper is to develop and validate Economics Placement Test [EPT] to assessprospective undergraduates' Economics knowledge for admission into undergraduate programmes of Nigerian Universities. Specifically, the paper intend to; [a] develop the EPT and [b] validate the EPT

IV.METHODOLOGY

Research Design

The exploratory sequential mixed methods design was used in this study with the intent of developing the EPT. Exploratory sequential mixed methods design adopted in this study was characterized by an initial qualitative phase and then quantitative within a different, sample[11]

Qualitative Phase

The first phase of this study was a qualitative exploration to identify issues critical to Post-UTME placement test in Nigerian universities. The goal of this phase was to construct a typology of issues and produce findings that informed development of instruments to assess students' performance in Economics placement test for Nigerian universities.

The researchers with the guidance of experts' panels developed a structured interview questions being utilized in this study. The sample for the qualitative part of this study were forty five [45] teachers and school administrators selected to participate in the interview. 20-30 participants are enough to collect information through interview in a qualitative study[11]. The researchers conducted a review of National Economics Curriculum and assessment procedures were reviewedand conducted the interview with 15 university teachers and FGD session was conducted with 30 university undergraduates.

The results from the analysis of the interviews and the document review were used to create used typology including codes, text segments and generated themes, to guide the development of the EPT used in this study.

Quantitative Phase

Six hundred [600] senior secondary school III students randomly selected from senior secondary schools in North-western Nigeria participated in this study. The students' gender was used in the selection procedure in order to ensure representativeness of the target population for the developed test.

A 60 multiple choice Economics items were developed from the first phase of this study.

The content validity of EPT was assessed by ensuring content coverage through dividing the curriculum content into five sections [A, B, C, D and E] and distributing the items using a standard test blueprint. Section A [13 items], B [16 items], C [12 items], D [15items] and E [14 items] spread across five domains of Bloom's Taxonomy of Cognitive Objectives. Similarly, 6 experts assessed the initial format of the EPT from the perspective of Economics knowledge and test development criteria. Similarly, a pilot test was conducted and the data were analyzed. Changes were made after the panels' reviews and pilot testing. The final set of 60 items became ready for administration.

The developed and content validated EPT was administered to the participants by the researchers with the aid of teachers in the cooperating schools. Prior to the administration, a letter of permission was obtained from the authorities of the cooperating schools and the purpose of the test was explained to the participants and sort for their consents. The time allowed for answering all the items was 1hour and 15 minutes.

The data were analyzed in three stages using Rasch measurement with WINSTEPS[12]. The first estimation stage in this Rasch analysis was the calibration between examinees' ability and item difficulties. The second stage was the estimation of fit[13]. The third stage was the assessment of unidimensionality using Principal Component Analysis [PCA] of Rasch residuals. The relationship between examinees' ability and item difficulties were presented using respondents-item maps. The mean square values [MNSQ] and Z standard values [ZSTD] were examined to check the fit statistics.

V. RESULT/FINDINGS

Unidimensionality

To ensure the test is measuring the intended objective, assessing unidimensionality is crucial. To determine the unidimensionality in this study, PCA of the Rasch residuals was performed. The results showed that, the raw variance explained by measures is 24.9% closely matched the expected variance of 24.7%. The raw variance explained by person is 5.8% and the variance explained by items is 19.89%. The results showed that, the variance explained of 24.9% is higher than the minimum unidimensionality requirement of 20%.This analysis proved that unidimensionality is achieved and the test measure a unidimensional constructs[13].

Person and Item Reliability

The analysis for 'PERSON RELIABILITY" index wasat .85, while PERSON'S SEPARATION' value measured was at 2.40. This reliability values are considered good; implies that the variability in the students' ability in this study is adequate[14].
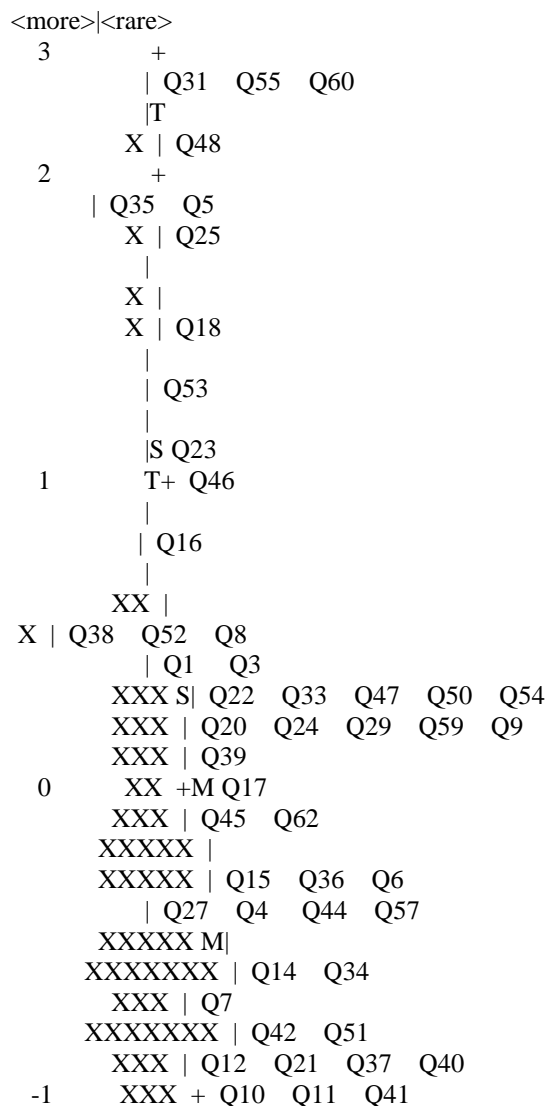
The item reliability and item separation index were .93 and 3.73. These values indicated that the item reliability in EFT is excellent and the sampleswere large enough to confirm the item difficulty hierarchy of the test items[10].

Respondents-Item Maps

The relationship between examinees' abilities in Economics and the test items difficulty levels is presented in Person-Item-Map as in Figure 3.2. The information from the map shows that the mean value of examinees' ability [M] is located on the left side of the map and the mean value of items difficulty [M] placed on the right side of the map. To provide the evidence of representativeness of the test items, it can be observed that the test items were scattered around the mean of examinees' ability value. Evidences shown with the item matched with the persons indicating the test was targeted for this group of students[10], though the ability of one student was below the difficulty levels of all the items and three [3] items appears to be too difficult for all the test takers. Therefore, in order to decide whether to remove or maintain items that might display insufficient model fitness, there is a need to review the model fit of the items to decide whether they indicated a good model fit; so investigation on the estimation of fits [PTMEA CORR, INFIT MNSQ and OUTFIT MNSQ] are necessary. However, there is this little issue, the overall test indices showed that EPT is within an acceptable degree of representativeness[10].

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PERSON - MAP - ITEM
<more>|<rare>
  3          +
             |  Q31   Q55   Q60
             |T
          X  |  Q48
  2          +
          |  Q35   Q5
          X  |  Q25
             |
          X  |
          X  |  Q18
             |
             |  Q53
             |
             |S Q23
  1       T+  Q46
             |
          |  Q16
             |
        XX  |
  X  |  Q38   Q52   Q8
          |  Q1   Q3
     XXX S|  Q22   Q33   Q47   Q50   Q54
     XXX  |  Q20   Q24   Q29   Q59   Q9
     XXX  |  Q39
  0     XX  +M Q17
     XXX  |  Q45   Q62
   XXXXX  |
   XXXXX  |  Q15   Q36   Q6
          |  Q27   Q4   Q44   Q57
   XXXXX M|
  XXXXXXX  |  Q14   Q34
     XXX  |  Q7
  XXXXXXX  |  Q42   Q51
     XXX  |  Q12   Q21   Q37   Q40
 -1     XXX  +  Q10   Q11   Q41
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   XXXXXXXXXXXX |S
        XX S| Q56
         X  | Q2   Q32
        XX  | Q26   Q30   Q58
        XX  | Q49
         X  | Q28
            | Q19
            | Q43
            | Q13
  -2        T+
            |
         X  |T
            |
  -3        +
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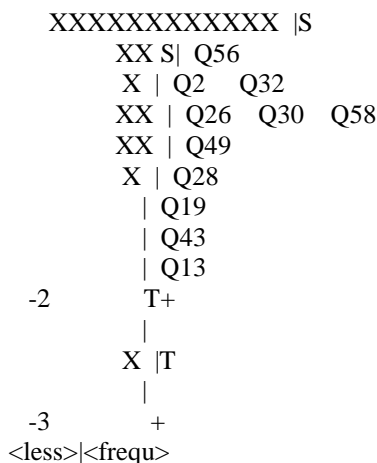
Figure 1: Person-item map items

Model Fit Statistics

Based on the item map [Figure 3.1], there are 3 items which are higher than the most able student. The items are Q31, Q55 and Q60. To decide whether to omit them from the test or maintain to be used in the next administration, the indicators of fit were investigated i.e Point Measure Correlation [PTMEA CORR], INFIT Mean Square [INFIT MNSQ] and OUTFIT Mean Square [OUTFIT MNSQ]. The investigation was carried out in the entire 70 items to check whether these 3 items and any other items which violated the standard. According to [12], to maintain any items in a test should satisfy the following conditions;

1. PTMEA CORR is positive and not 0 or close to it
2. The INFIT and OUTFIT MNSQ index fall within the acceptable range for multiple choice questions, $0.7 \leq MNSQ \leq 1.3$
3. The Z standard [ZSTD] values fall within acceptable range of $-2.0 \leq Z \leq 2.0$

The result showed that Items 31, Item 55 and Item 60 Outfit MNSQ were out of the acceptable range and have very low PTMEA CORR close to zero[12]. Further investigation revealed that, Items 48, 49, 50 and 58 were defective with their outfit MNSQ values exceeding the acceptable range and PTMEA CORR of 0.01, 0.05 and 0.06 were close to zero. Based on the information, all these seven [7] items as indicated should be removed, omitted or revised because of lack of fits to the model.

VI. CONCLUSION

This study provides construct validity and reliability of the developed EPT using Rasch Model which provides better estimates compared to the traditional approach. The results obtained according to the required indicators provided by[12]of Unidimensionality, Person-Map-Item and Item Fit Statistics [MNSQ, ZSTD and PTMEA CORR]. Overall result showed that EPT has measured a unidimensional construct and at least 50 items [83%] satisfied the requirement to be included by having good fits to the model. However, 10 items [17%] with poor fits to the model [Item 10, 19, 31, 48, 49, 50, 55, 58, 60 and 40] were deleted from the test because they were construct-irrelevant. According to this result, the EPT is proven to be valid and reliable. Thus, the EPT validated in this study can be used for assessing accurately the students' Economics knowledge, hence providing the true picture of students enrolling into the undergraduate programmes of Nigerian Universities.

CONFLICT OF INTEREST

We declare that, there is no conflict of interest

ETHICAL CLEARANCE

The ethical clearance was obtained from the Ministry of Education in Nigeria

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