

VALIDATION OF ECOLOGY ACHIEVEMENT TEST (EAT) ON SECONDARY SCHOOL SCIENCE STUDENTS' ACADEMIC ACHIEVEMENT IN ECOLOGY, KANO, NIGERIA: A SYSTEMATIC APPROACH

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Abstract

This paper presents methodological processes of validation of Ecology Achievement Test (EAT) on Secondary School Science Students Academic Achievement in Ecology, Kano-Nigeria. Three research objectives and three research questions guided the study. A sample of Twenty SSII students were selected and pilot tested from two schools for the study and coded 1-10 for males and 11-20 for females. The instrument consists of two sections: section A consist of student personal data while section B consist of forty five minutes, 30-items multiple choice objectives questions options A-E adapted from WAEC (2011-2021) past question was used. The validation was determined by five experts in biology and education for face and content validity. Corrections were made on some of the contents for editing, spellings across the items to be corrected include: researcher's salutation, address and coding of participants for easy identification. Lawshe's method and Scale items content validity (S-ICV/average) method was used to determine Content Validity Ratio (CVR) and Content Validity Index (CVI). Test re-test method was used for reliability and Pearson Product Moment Correlation Coefficient (PPMC) was used for data analyses using SPSS Ver.20 at probability of 0.05% level of significance. Result of EAT for CVR and CVI was +1.00 on the instrument indicating perfect level of agreement among the panel of judges while reliability of EAT was found to be 0.81. Based on these validity and reliability estimates, it was concluded that EAT is valid, reliable and can be used as data collecting instrument for ecology.

Keywords: Validation, Ecology Achievement Test, Content validity index and validity ratio, Reliability

Introduction

The risen trend in the general global adventure of complex modern biological phenomena over the years, specifically, to ecology has continued to pose threat both, academically, biologically, environmentally, socially and economically to inter and intra relationship between organisms and their environment. Ecology has continued to be a topical societal issue for researchers' and educators and therefore cannot be over emphasized (Mohammed *et al.*, 2017; McCallen *et al.*, 2019). Validation in quantitative research is the extent to which any measuring instrument measures what it intends to measure. It is an essential measuring construct in the field of research which considers an evident support and a systematical way of ensuring the measurement of pool of items, attributes, domains, contents in a questionnaire or scale measures what its suppose to measure to enhance its repeatability, usability as regards to research objective, hypothesis and questions of data collection instrument. (Mohajan, 2017; Howitt & Crammer, 2020).

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Face validity, subjectively or informally assessed the instrument by inspecting the presentation of the content of test items on the subject matter in order to assess the face of things for relevance, reasonable, unambiguous, clarity and logical context of the instrument. (Obeka, 2011; Mohammad *et al.*, 2014). On the other hand, content validity is the extent to which the question on the instrument and their scores from the question represent all possible questions about the content or the skills that could be asked. It also assesses the degree to which all essential items in an instrument are included and reflected whereas undesirable items to a particular domain are eliminated. (Ghazali, 2016; Taherdoost, 2016). This is with the view of enhancing the judgmental approach to collection of wide range of items from research literatures, established theories; follow ups with the panel of judges' evaluators. Reliability on another hand according to Haradhan (2017) measure the extent of consistency, stability and repeatability of result test scores that is free from measurement error for stability and internal consistency.

Moreover, ecology has been viewed by different scholars and can be defined as a branch in biology that deals with the scientific study of the interaction among organisms and between organism and their environment. (Haruna & Bulama, 2014; Chapman & Reiss, 2018). Technically, the Cary Institute of Ecosystem and Environmental studies (2018) and British Ecological Society Organization (2019) define ecology as the scientific study of interaction among and between organisms; the processes influencing the distribution and abundance of the organisms, and the transformation of energy flow and matter. Ecology forms the core content of the secondary school modern biology curriculum that provides student with meaningful scientific knowledge and application to everyday life in matters of environment, personal community health and agriculture. (NERDC 2009; Ogundiwin *et al.*, 2015; Mbajiorgu *et al.*, 2017).

In addition, academic achievement according Steinmayr *et al.* (2020) can be described as a representation of performance out comes that indicates the extent to which a person has accomplished short or long term goals which focuses on activities in instructional learning environment that specifically occur in school and measured through examination or continuous assessment. Kpolovie *et al.* (2014) supported this view and maintained that, it is an observed and measured aspect of a students' mastery of skills and subject contents measured with valid and reliable tests. Hence there is the need for effective validation of ecology achievement test instrument for efficient science secondary school academic achievement in ecology.

Research studies have shown that, empirical data on the present study in question on secondary school science students' level on ecology in Kano State is scanty. Data only generally exist either in the field of integrated science, physics, languages, biology, mathematics, humanities, chemistry, either at kindergarten, junior and senior secondary schools, higher institutions level of learning or particularly on teacher training students. (Ogundiwin *et al.*, 2015; Oyovwi, 2019; Andamon & Tan, 2018; Duru & Okeke, 2021). Nationally, students' academic achievement as reported by West Africa Examination Council Examination Report (WAEC, 2021) was generally low in Biology. Trends in academic achievements, in biology as shown in documented Science and Technical Schools Board, Kano Statistical Report over 5 years was declining (STSB, 2020). It shows that, out of the total number of Ten thousand and sixteen (10,016) that sat for (WAEC) examination from 2016-2020 only five thousand, two-hundred and thirty-six (5236) students earned credit and above in biology.

Studies have attributed the decline to factors of students' poor perception of ecology as difficult and abstract concepts in biology, student's poor academic achievement in ecology and

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some see biology as a simple subject compared to other science subjects. (Agboghoroma & Oyovwi, 2015; Etobro & Fabinu, 2017; Mbajiorgu *et al.*, 2017). Instrument validation in quantitative research has continued to be crucial element of research methodological processes of measurement construct for efficient repeatability and usability of data collection in ecology. Ecology has persistently been a topical issue over decades to both researchers and educators due to the decline in secondary school science students' academic achievement in ecology which from previous studies has been ascribed to abstract and difficulty concepts in biology, but then, the processes of instrument validation appears to be inadequate. Therefore, the problem of the study posed as a question "Do the systematic approach of Ecology Achievement test assess its validity on secondary school science students' academic achievement in Ecology, Kano-Nigeria"?

The Purpose of the Study

This study is aimed at assessing the validity and reliability on Ecology Achievement Test on secondary school science students' academic achievement in ecology, Kano-Nigeria using a systematic approach. Specifically, with the following objectives:

1. Determine the face validity of Ecology Achievement Test (EAT)
2. Examine the content validity of Ecology Achievement Test (EAT)
3. Establish the reliability of Ecology Achievement Test (EAT)

Research questions

1. How can the face valid of Ecology Achievement Test (EAT) be determined?
2. What is the coefficient Content Validity Ratio (CVR) and Content Validity Index (CVI) of Ecology Achievement Test (EAT)?
3. What is the alphas (α) coefficient reliability of Ecology Achievement Test (EAT)?

Methodology

Ecology Achievement Test (EAT) was developed by the researcher from adapted ecological syllabus topic units drawn from Past Questions of Senior Secondary Certificate Examination/ West African Examination Council SSCE/WAEC (2011-2021) as enshrined in the 2nd - 5th, 1st - 5th as well as 4th -10th weeks of SSI first, second and third term respectively were used. (SSCE/ WAEC, 2019; Kano Educational Resource Department KERD 2018). A sample of 20 SSII students with similar attributes were pilot tested and used for the study. Ten students were selected from males' Science Secondary School A and were coded 01-10 while the other ten students were selected from Female school B and were coded 11-20 for the validation exercise. EAT instrument consists of two sections, A and B respectively, section A consist of Students' Personal Data (Age, Class, name of school and Gender), whereas, section B consist of a forty five minutes, Thirty (30) multiple choice test items questions with five (5) options A-E. Respondents are to indicate their responses by ticking appropriately the correct answer of their choice with reference to the marking scheme test option.

A Table of specification for the development of the test as in (table 1) on the six cognitive level of Blooms taxonomy was reduced to three knowledge, comprehension and application for multiple choice items as described by (Obeka, 2011; Oguniwin *et al.*, 2014; Alade & Omoniyi, 2014). Correct answer was awarded one (1) score, while incorrect response or un-attended item was recorded as zero (0). The score ranged from 0-30 which was aggregated when computing the final score. A difficulty index and Discrimination Index was determine as describe by Obeka (2011) yielded range value of 0.33-0.67 and Discrimination Index of 0.21-0.50 respectively.

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However, the obtained range values of 0.2-067 according to Sa'D and Visbal –Dionaldo (2017) is good and acceptable for difficulty and discriminating indices respectively.

Table 1:
Table of Specification of Academic Achievement Test

S/No	Topics	Content	Knowledge no. and % 40%	Understanding no. and %; 40%	Application no. and %; 20%	Total
1	Basic Ecological Concepts	Ecological concepts, ecosystem, biotic and abiotic ecological factors of the ecosystem	3	3	1	7
2	Functioning of the Ecosystem	Autotrops and heterotrops, food, chains, webs, pyramid and energy flow and transformation, non-cyclic Nutrient movement	4	4	2	10
3	Ecological Managements	Pollution- nature, sources and effects of air, water, noise, soil, land)	3	3	1	7
4	Conservation economical and social Development	Conservation of water, Forest and wildlife and laws	2	2	2	6
Total			12	12	6	30

Results

Research Question 1: How can the face valid of Ecology Achievement Test be determined (EAT)?

In the face validity, the instruments were subjectively assessed informally by inspecting presentation of the content of test items on the subject matter in order to assess the face of things for relevance, reasonable, unambiguous, clarity and logical context of the instruments. The processes occurred in the presence of the researcher as some of the experts were within the same geopolitical zone with the researcher. This in other words was to facilitate the drawing of a good conclusion from the sample of population on the scheme of concepts being assessed and studied. (Mohammed *et al.*, 2014). Ecology Achievement Test (EAT) was validated by five experts of biology and education from the Faculty of Science and Science education from Bayero University Kano, Ahmadu Bello University Zaria and Aliko Dangote University of Science and Technology, Wudil, along with a science secondary school biology teacher with more than 15years teaching experience respectively. These experts reviewed the data collecting instrument base on the research objectives, questions, hypotheses and method of data analysis of the main study.

They made some suggestions on how to improve the scale for a successful data collection as follows: All the items appear to be culture fair as no item has been modified, discarded or recast. However, some corrections were made with regards to the following: spellings across the items to be corrected, researcher's salutation, address, as well as coding of participants for easy identification. The criticisms and observations by the panels of judges were in-cooperated into the

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modified test items. The justification for the selection of at least five experts as regards to instrument validation was to gain a wider input of the contents in the instrument to enhance efficiency on content validity ratio and content validity index respectively. (Taherdoost, 2016). Lawshe's (1975) method was used to determine the content validity ratio using the formula

$$CRV = \frac{n_e - (N/2)}{N/2}$$

Where CRV=Content Validity Ratio; n_e =Number of Panel members indicating essential and N= Total number of panel members. On another hand, Content Validity Index CVI for Congruency was determined by Scale level Content Validity Index (base on Average method) as described by (Pollit & Beck, 2006; Ayre & Scally, 2015; Yusoff, 2019) Using the formula: S-CVI/ Average = (Sum of I-CVI Scores) divided by number of Items ; where I-CVI = Agreed Item divided by number of experts.

Research Question 2: What is the Content Validity Ratio and Content Validity Index of the instruments?

Table 2:

Summary of Content validity Ratio (CVR) and Content validity Index (CVI) for EAT

S/No	Instrument	Content Validity Ratio CVR Critical Coefficient	Content Validity Index (CVI) Coefficient
1	Ecology Achievement Test (EAT)	1.00	1.00

Results from the above observations made by the experts as in (table 2) Content Validity Ratio (CVR) Coefficient of +1.00 and Content validity index CVI of the instrument (EAT) means there is a perfect level of agreement between panel members at a probability of 0.5 CVR Critical proportion agreeing is essential from the five panels. Therefore, the instrument appears to be face valid and recommended for use in the main study. So also, results based on the Content Validity Index Coefficient values of S-CVI/Ave. was +1.00 for EAT it can be concluded that, the scale of the test items has met and achieved a satisfactory level of content validity (Polit & Beck, 2006; Mohammad *et al.*, 2014; Ayre & Scally 2015; Taherdoost, 2016).

Research Question 3: What is the alpha coefficient of the instruments?

Table 3:

Summary of Reliability Coefficient

S/No	Instrument	No of items	Alpha value (α)
1	Academic achievement (EAT)	30	0.81

Result of the analyses showed that, the *r*-values were as follows: Ecology Achievement Test was 0.81. The alpha values of the data collecting instruments were sufficient enough, reliable and can be supported with the values suggested by Cetin *et al.* (2015), Mohammad *et al.* (2014), Mohajan (2017) and Harvey, (n. d.), that a value of 0.7 and above is good an acceptable value for reliability test

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Discussion

Face and content validity of Ecology Achievement Test (EAT) determination by experts was in line with the studies of Obormanu *et al.* (2014) in Port-Harcourt, Rivers state, Nigeria, Agboghroma and Oyovwi (2015), Delta State, Nigeria and Cetin *et al.* (2015) in Ankara, Turkey in terms of face validation technique. However, it differs with the study of the researcher in terms of content validity as they did not establish a statistical value to determine the level of agreement or disagreement among the panels.

Reliability coefficient of 0.81 Ecology Achievement Test was found to be similar with that of Obomanu *et al.* (2014) in Port-Harcourt, Rivers State, Nigeria, Ogundinwin *et al.* (2014) in Ibadan, Nigeria and Cetin *et al.* (2015) in Ankara, Turkey who recorded a reliability of 0.8 on students' academic achievement in environmental related concepts in biology respectively.

Conclusions

Based on the findings from the validity and reliability of the pilot tested data collecting instruments, it can be inferred that, the instrument, Ecology Achievement test is valid and reliable for data collection on secondary school science student academic achievement in ecology, Kano-Nigeria.

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