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Assessing the Validity and Reliability of the Students' Attitude to Ecology Questionnaire (SAEQ) for Measuring Academic Achievement in Ecology Among Secondary School Students in Kano State, Nigeria: A Systematic Approach

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ABSTRACT
This paper presents a systematic approach to methodological processes of validity and reliability of Students' Attitude to Ecology questionnaire on Science Secondary School Students' Academic Achievement in Ecology, Kano State-Nigeria. Three research objectives and three research questions guided the study. 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 A and B: Section A comprises demographic data (name of school, Age and Gender) while section B consist of 20 items, five five-point Likert scales, ordinal, closed-ended questionnaire. 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: the researcher's salutation, address and coding of participants for easy identification. Lawshe's method and Scale items content validity (S-ICV/average) method were used to determine the Content Validity Ratio (CVR) and Content Validity Index (CVI). The 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 a probability of 0.05% level of significance. The result of SAEQ for CVR and CVI was +1.00 on the instrument indicating the perfect level of agreement among the panel of judges while the reliability of SAEQ was found to be 0.70. Based on these validity and reliability estimates, it was concluded that SAEQ is valid, reliable and can be used as a collecting instrument in ecology. Recommendations were also made on the use of SAEQ.

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INTRODUCTION

Complexity of modern biological phenomena along with increase in series of outcry of emanating from ecological consequences over the years, specifically, to ecology has continued to pose threat and disequilibrium to inter and intra relationship between organisms and their environment. In this regard, ecology has continued to be a topical societal issuefor 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. Obeka (2011), Mohajan (2017) and Ilya's and Shuaibu

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(2024) emphasized that, 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. In other words, it enhances repeatability, usability as regards to research objectives, hypotheses and questions of data collection instrument. Face validity, subjectively or informally assesses 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. (Mohammad *etal*., 2014; Ghazali 2016, Mangal, 2018). 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. Taherdoost (2016), Yusoff (2019) and Howitt and Cramer (2020) supported their view and maintained that, content validity assesses the degree to which all essential items in an instrument are included and reflected whereas undesirable items to a particular domain are eliminated. This is with the view of enhancing judgmental approach to collection of wide range of items from research literatures, established theories; follow ups with the panel of judges' evaluators in order to draw good conclusion from the sample of population on the scheme of concepts being assessed and studied measure the subject matter as well as instructional objectives of the test instrument.

Reliability on another hand according to Ghazali (2016) and 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. Test-re-test method of the reliability of the instrument on the order hand, according to Obeka (2011), Mohajan (2017), Howitt and Cramer (2020) maintained that,it is concerned with the consistency and stability of variables contained in the measuring instrument overtime .They further described it as the correlation between scores from a sample of participant on a test measured at a particular time with their scores on the same test given at a later time. This in other words is to establish the internal consistency reliability with a view of measuring the extent of consistency, stability repeatability of test scores that is free from measurement error in the test instrument. Hence, the instrument administered on different time dimension of equal variable preferably at a two weeks' interval measure the relativity association of the forms either relatively low or high.

Attitude has been described by different scholars in relation to students' academic achievement. Boiyo, Korch and Mangurin (2015) maintained that, students' attitude to ecology is their positive or negative feeling and predisposition to learn ecology. Langat (2015) and Mangal (2018) further described attitude as the mental and neural state of readiness to respond, organized through experience, exerting a directive and/or dynamic influence on behavior as determining acquired tendency that prepares a person to behave in a certain way towards a specific object or class of objects subject to the conditions prevailing in the environment which are influenced by factors of within the individual itself (physical, intellectual, emotional, social and moral development as well as factors within the individuals' environment (his home, and family, social environment outside his family.

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. (Chapman & Reiss, 2018). 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. Hence, the rational for the inclusion of ecology in secondary school biology curriculum is to facilitate the formation and development of positive attitude and improvement of academic achievement towards the environment among secondary school students. (Nigerian Educational Research and Development Council, (NERDC, 2009); Mbajiorgu, Reid &Ezeano, 2017).

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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. Nationally, students' academic achievement as reported by West Africa Examination Council Examination Report (WAEC, 2021) was generally low in Biology. Studies have attributed the decline to factors of students' poor attitude and perception of ecology as difficult and abstract concepts in biology, student's poor academic achievement in ecology and some see biology as a simple subject compared to other science subjects. (Kallas , Solovjeva &Minakowa ,2015 ;Mbajiorgu *et al*., 2017).Therefore the reason behind teaching biology at the secondary school level with a view of enhancing the needs and aspiration of the society as regards to ecology is yet to yield desired positive result. Hence there is the need for effective validity and reliability of students' attitude to ecology questionnaire, for efficient science secondary school academic achievement in ecology.

Statement of the Problem

Instrument validity and reliability 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 students' attitude to ecology. Ecology has persistently been a topical issue over decades to both researchers and educators due to the fluctuations in science secondary school students' attitude to ecology which from previous studies has been ascribed low significant progress in the attitudinal move of a more protective environment as well as the abstract and difficulty in ecological concepts, 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 Students attitude to ecology questionnaire assess its validity and reliability on science secondary school student academic achievement in Ecology, Kano State – Nigeria?

Purpose of the Study

This study is aimed at assessing the validity and reliability of students 'attitude to ecology on science secondary school student academic achievement in ecology, Kano State – Nigeria using a systematic approach. Specifically, with the following objectives:

1. Determine the face validity of Students' attitude to Ecology Questionnaire (SAEQ)
2. Examine the content validity of Students' attitude to Ecology Questionnaire (SAEQ)
3. Establish the reliability of Students' attitude to Ecology Questionnaire (SAEQ)

Research questions

1. How can the face valid of Students attitude to Ecology Questionnaire (SAEQ) be determined?
2. What is the coefficient Content Validity Ratio (CVR) and Content Validity Index (CVI) of Students attitude to Ecology Questionnaire (SAEQ)?
3. What is the alpha (**α**) coefficient reliability of students' attitude to Ecology Questionnaire (SAEQ)?

METHODOLOGY

Student Attitude to Ecology Questionnaire (SAEQ) was adapted from (Russell and Hollander, 1975; Scruba, 2006 and Adejimi*etal*., 2022) in the field of biology and chemistry and was modified specifically to students' attitude to ecology Questionnaire (SAEQ). A sample of 20 SSII students with similar attributes was pilot tested and used for the study. Ten students were selected from males' Science Secondary School, A were coded 01-10 while the other ten students were selected from Female school, B and were coded 11-20 for the validation exercise. The 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 20 items, five point Likert scale, ordinal,

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closed ended questionnaire measured by the key below in the order of (a) Strongly Agree =5 (b) Agree=4(c) Uncertain=3 (d) Disagree=2 (e) Strongly disagree= 1. The instrument has 16 positive items and 4 negative items 2, 10, 13 and 15. The negative items were reversely scored and respondents are to tick appropriately in each case.

RESULTS

Research Question 1: How can the face validity of Students' Attitude to Ecology be determined (SAEQ)?

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.

Students Attitude to ecology Questionnaire (SAEQ) was validated by five experts who are Professors in the faculty of Education, Science education from Bayero University Kano, Ahmadu Bello University Zaria 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 as well as coding of participants for easy identification. The criticisms and observations by the panels of judges were in-cooperated into the 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 $\frac{CVR=ne-(N/2}{N/2}$ 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: $\frac{S-CVI}{Average}$ = (Sum of I-CVI Scores) divided by number of Items ; where I-CVI = Agreed Item divided by number of experts. Results based on the Content Validity Ratio (CVR) Coefficient of +1.00 of all the instruments, it implies 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, all the instruments appear to be face valid and recommended for use.

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

Table 1: Summary of Content Validity Ratio (CVR) and Content Validity Index (CVI) for SAEQ

S/No	Instrument	Content Validity Ratio CVR Coefficient	Content Validity Index (CVI) Coefficient
1	Students Attitude to Ecology	+1.00	1.00

Results from the above observations made by the experts as in (table 1) Content Validity Ratio (CVR) Coefficient of +1.00 and Content validity index CVI of the instrument (SAEQ) means there is a perfect level of agreement between panel members at a

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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 on the Content Validity Index Coefficient values of S-CVI/Ave. was +1.00 for SAEQ it can be concluded that, the scale of the test items has met and achieved a satisfactory level of content validity (Polite & Beck, 2006; Mohammad *et* al., 2014; Ayre & Scally 2015; Taherdoost, 2016).

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

Table 2: Summary of Reliability Coefficient

S/No	Instrument	No of items	Alpha value (α)
1	Students Attitude to Ecology (SAEQ)	20	0.70

Result of the analysis as in table 2 showed that, the *r*-values of Students attitude to Ecology was 0.70. The alpha values of the data collecting instrument was 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.

DISCUSSION

Face and content validity of Students Attitude to Ecology Questionnaire (SAEQ) determination by experts was in line with the studies of Cetin *et al.* (2015) in Turkey, Hinneh (2017) in Gaborone, Botswana and Ahmad, Sultana and Jamil (2022) in Islamabad, Pakistan, Adejimi *et al.* (2022) in Oyo state, Nigerian terms of face validation technique. However, obtained values of CVR and CVI Coefficient of 1.00respectively from the findings of the researcher differs with their findings in terms of content validity as none of them provided a statistical index value on content validity index in determining the level of agreement or disagreement among the panels as obtained by the researcher.

Reliability coefficient of Students attitude to ecology instrument of 0.70 was found to be similar with that of Scrub, 2008 on science in Texas, who also found a reliability range value of 0.72-0.77. However, the result differs with that of Russell and Hollander (1975) in America who recorded 0.8. Cetin *et al.* (2015) in Turkey recorded 0. 83 while Adejimi *et al.* (2022) in Oyo, Nigeria also recorded 0.90 on students' attitude to biology, ecology and environment respectively.

CONCLUSION

Based on the findings from the validity and reliability of the pilot tested data collecting instrument, it can be inferred that, the Students' Attitude to Ecology Questionnaire is valid and reliable to be used as data collecting instrument on science secondary school students' academic achievement in ecology, Kano State -Nigeria.

RECOMMENDATIONS

The following recommendations are put forward based on the findings of the study:

1. Given the strong face and content validity, as well as the reliability coefficient of 0.70, the Students' Attitude to Ecology Questionnaire (SAEQ) should be adopted for use in similar educational contexts, particularly in secondary schools, to assess students' attitudes toward ecology. Its validity and reliability make it a suitable tool for measuring academic achievement in ecology-related studies.
2. While the SAEQ has demonstrated validity and reliability in Kano State, Nigeria, further studies should be conducted in other regions and countries to confirm its applicability across diverse cultural and educational settings. This will help establish its generalizability and strengthen its credibility as a universal tool for assessing ecological attitudes.
3. Researchers should consider comparing the SAEQ with other established instruments,

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such as those used by Russell and Hollander (1975) or Cetin et al. (2015), to identify areas for improvement. This could help enhance its reliability coefficient to align more closely with higher values (e.g., 0.80–0.90) observed in other studies.

4. Since the reviewed studies lacked statistical indices for content validity, future research should emphasize the use of statistical measures like the Content Validity Ratio (CVR) and Content Validity Index (CVI) to provide a more robust and quantifiable assessment of content validity. This will ensure greater transparency and consistency in evaluating the validity of research instruments.

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