

**CONSTRUCTION AND STANDARDIZATION OF PHYSICS ACHIEVEMENT  
TEST FOR SENIOR SECONDARY SCHOOL STUDENTS IN KADUNA STATE,  
NIGERIA**

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**Abstract**

The study focused on Construction and Standardization of Physics Achievement Test for Senior Secondary Schools in Kaduna State, Nigeria. The study is concerned about the inconsistency and low psychometric quality of teacher-made tests commonly used for school-based assessments. Four objectives were raised and translated into research questions and two hypotheses were formulated and tested for this study. Population of the study consisted of 1735 SSII Physics students from eight (8) public secondary schools in Zaria and Giwa local government area of Kaduna state, from which a sample of 317 students was selected using proportionate and cluster sampling techniques. The study adopted an instrumentation research design and followed established measurement procedures, including test blueprint development, item writing, expert validation, pilot testing, and item analysis. Content and face validity were established through expert review, while reliability was determined using the Kuder-Richardson 20 (KR-20) formula, yielding a coefficient of 0.89. Item analysis indicated that all 50 retained items exhibited acceptable difficulty indices (0.40–0.62) and discrimination indices (0.30–0.53). Mean and standard deviation were used to answer research questions on performance differences, while ANOVA and independent t-tests tested hypotheses at the 0.05 significance level. Findings showed that students' performance on the standardized test was generally below average across school types, though students in urban school significantly outperformed those in rural schools. The study concludes that the newly developed test demonstrates strong psychometric properties and can serve as a reliable tool for assessing physics achievement. It recommends increased use of standardized tests in school-based assessment and capacity-building for physics teachers in test development and standardization procedures.

**Keywords:** Standardized Test, Physics Achievement, Item Analysis.

## Introduction

The construction of standardized achievement test involves proper planning. This plan entails review and coverage of test contents, used of test blue print, expert validation, trial testing, items validity or analysis, test assembly, norming and many other important procedures that can help the test developers in the test construction and standardization processes. Moreover, Standardized tests are constructed by test construction specialists, usually with the assistance of curriculum experts, teachers, and school administrators for the purpose of determining a student's level of achievement, relative to the achievement of other students of similar age and grade. This type of test are administered and scored according to specific and uniform procedures. In other words, a standardized test administered and scored in a school would be administered and scored exactly the same manner as anywhere else in the country.

Physics occupies a central position in the Nigerian senior secondary school curriculum because of its direct relevance to national development and technological advancement. As a discipline, it equips learners with essential competencies needed for fields such as engineering, information technology, medicine, and other applied sciences. Beyond content knowledge, physics promotes analytical reasoning, problem-solving, and scientific inquiry skills, which are crucial for innovation and economic growth (Achor & Shaibu, 2012). Despite these benefits, students' performance in physics at both internal and external examinations has remained below expectation. Reports from the West African Examinations Council (WAEC, 2018; 2021) continue to highlight recurring weaknesses in students' understanding of fundamental concepts such as measurement, motion, energy, and quantitative problem solving.

Multiple factors contribute to these performance challenges, including inadequate instructional resources, ineffective teaching strategies, and poor assessment practices. One recurring concern is the reliance on teacher-made tests that are often developed without strict adherence to standardized test construction procedures such as blueprint preparation, systematic item writing, expert review, and empirical item analysis (Emaikwu, 2012; Alausa, 2015). As a result, these assessments frequently vary in content coverage, cognitive demand, difficulty level, and reliability. This inconsistency affects the accuracy of performance judgments and limits the ability of teachers and schools to make valid decisions about student learning. The persistent gap between high scores in school-based examinations and low performance in standardized national examinations suggests that many teacher-made tests do not reflect acceptable measurement standards (Amoo & Rahman, 2014).

In Kaduna state, as in other parts of Nigeria, the poor performance of students in physics has raised serious concerns among educators, policymakers, and parents. Studies consistently report low achievement levels, inadequate conceptual understanding, and poor application of physics principles among senior secondary school students (Ogbeba, 2018). These challenges underline the need for a standardized, psychometrically sound physics achievement test that accurately measures students' competencies. Developing such an instrument for senior secondary school II (SSII) students is essential for enhancing the quality of assessment, improving instructional feedback, and preparing students adequately for high-stakes examinations such as WAEC and NECO.

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Test construction is a systematic, evidence-based process that involves defining the construct to be measured, reviewing curriculum content, and developing test items aligned with instructional objectives. An essential step in the process is the preparation of a test blueprint or table of specification, which ensures proportional coverage of content areas and cognitive levels (Nworgu, 2015). This enhances content validity and ensures that the assessment reflects the curriculum. After item writing, subject-matter experts review the items for clarity, relevance, and alignment with learning outcomes. This validation process is critical to ensuring that items measure what they are intended to measure (Okwilagwe & Igbinoghene, 2016).

Following expert review, items are pilot-tested to collect empirical data for psychometric analysis. Statistical indices such as item difficulty, discrimination power, and distractor efficiency are then computed to determine the quality of each test item. Items that fail to meet accepted measurement criteria are revised or discarded. This process enhances the reliability, validity, and overall fairness of the test (Alausa, 2015). A test developed through such rigorous procedures provides a more accurate representation of students' abilities and reduces measurement error. Standardization is an equally critical aspect of test development. It involves establishing uniform procedures for test administration, scoring, and interpretation to ensure that test results are comparable across individuals and groups (Olatunji, 2020).

A standardized test requires clear administration guidelines, objective scoring criteria, and consistent testing conditions. After constructing the test, it is administered to a representative sample of the target population to generate normative data. Norms, such as percentile ranks, stoniness, and standard scores, provide meaningful reference points for interpreting individual test scores relative to the broader population (Miller et al., 2013). This enhances the utility of the test for decision-making in educational settings. In summary, the poor performance of students in physics and the limitations of teacher-made assessments highlight the urgent need for a standardized physics achievement test for SSII students in Kaduna state. A test developed and standardized using established measurement procedures will enhance the validity and reliability of assessment outcomes, improve instructional planning, and contribute to better learning achievements in physics.

### **Statement of the Problem**

Conventional education requires passing through the processes of testing before qualification is obtained. Any student of conventional education must have passed through testing processes at different levels of learning. However, very few test administrators pay attention to construction and standardization of test instruments whereby there are variations in standard from school to school. Each and every school developed its own different instrument which on many occasions lacks the basis of test development procedures which include review and coverage of test contents, used of blue print, expert validation, trial testing, items validity or analysis, test assembly and norming and many other important procedures that can add more value to the instrument. Moreover, test construction, standardization and administration procedures are developed for examination programmes in order to help reduce measurement errors and to increase the likelihood of fair, valid and reliable assessment. Educational measurement experts emphasize that tests lacking systematic construction procedures such as

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blueprints, validation, and item analysis produce unreliable and invalid scores, leading to misinterpretation of students' actual achievement levels and inconsistency in reporting across schools" (Alausa, 2015). Therefore, this lack of uniformity and sameness on the procedures of test development among schools in Kaduna State may result in poor reporting of students' academic achievement status.

The researcher also observed that, most students passed school based assessment but failed external examination (SSCE), this might be due to lack of content coverage from the curriculum by the teachers and/or lack of familiarity with standardized instrument. This implies that, testing, measuring, assessing and evaluating is a way to ascertain whether desirable change in learner's behaviors have been achieved. This implies that, the mastery of physics concepts might not be fully achieved without the use of standardized achievement test for school based assessment.

### **Objectives of the Study**

The objectives of this study were to determine:

1. The validity and reliability of the constructed-standardized physics achievement test (CSPAT) for senior secondary school students in Kaduna state.
2. Estimate items parameters (difficulty and discrimination indices) on constructed-standardized physics achievement test (CSPAT) for senior secondary school students in Kaduna state.
3. The difference between the mean scores of co-education, boys and girls only SSII students in constructed-standardized physics achievement test (CSPAT) for senior secondary school students in Kaduna state.
4. The difference between the mean scores of rural and urban SSII students in constructed-standardized physics achievement test (CSPAT) for senior secondary school students in Kaduna state.

### **Research Questions**

The following research questions were raised and answered:

1. What is the validity and reliability of the constructed-standardized physics achievement test (CSPAT) for senior secondary school students in Kaduna state?
2. What are the psychometric properties (difficulty and discrimination indices) of each item on the constructed-standardized physics achievement test (CSPAT) for senior secondary school students in Kaduna state?
3. What is the difference between the mean scores of co-education, boys and girls only SSII students in constructed-standardized physics achievement test (CSPAT) for senior secondary school students in Kaduna state?
4. What is the difference between the mean scores of rural and urban SSII students in constructed-standardized physics achievement test (CSPAT) for senior secondary School students in Kaduna state?

### **Hypotheses**

The following hypotheses were formulated and were tested for the study:

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1. There is no significant difference between the mean scores of co-education, boys and girls only SSII students in constructed-standardized physics achievement test (CSPAT) for senior secondary school students in Kaduna state.
2. There is no significant difference between the mean scores of rural and urban SSII students in constructed-standardized physics achievement test (CSPAT) for senior secondary school students in Kaduna state.

### Methodology

This study adopted an instrumentation research design. According to Mehrens and Lehmann (1975), an instrumentation research is a type of design aimed at development and certification of efficacy of an instrument for the measurement of a given behavior of construct. Also, the International Centre for Education Evaluation (ICEE, 1982) defined instrumentation research design as a study which aims at investigating and introducing new or modified contents, procedures, technologies or instruments for educational practices. Further, Ali (2004) defined instrumentation research as a study which is geared towards the development and validation of measurement instruments or the investigation and introduction of new techniques for use in education. The Population of this study comprised of all public senior secondary school students from 8 schools offering physics in Zaria and Giwa Education zones of Kaduna state, Nigeria. This consist of eight hundred and thirty-five (835) male and nine hundred and (900) female students making a total of one thousand seven hundred and thirty-five (1735) senior secondary (SSII) physics students. The researcher used Krejcie and Morgan (1970)’s table of determining sample size to determine the sample size. Proportionate sampling technique were used to sampled three hundred and seventeen (317) students The eight (8) schools were selected using cluster sampling technique to ensure that a school from each local government of a zone was represented in the sample. The instrument is “Constructed-Standardized Physics Achievement Test (CSPAT), it comprised of 50 multiple choice A-D with three (3) distractors and one (1) key answer and the reliability coefficient was found to be 0.89 using K-R20. Item analysis indicated that all 50 retained items exhibited acceptable difficulty indices (0.40–0.62) and discrimination indices (0.30–0.53). For testing the formulated null hypotheses, parametric statistic was adopted. ANOVA was used to test hypothesis one while, t-test was used to test hypotheses two. All the entire null hypotheses were tested at  $p \leq 0.05$  levels of significance.

### Results

**Research Question One:** What is the validity and the reliability of constructed-physics achievement test developed for senior secondary school students in Kaduna state?

**Table 1: Kuder–Richardson (KR20) Analysis on Constructed-Standardized Physics Achievement Test (CSPAT)**

No. of Students	No. of Items	$\sum pq$	X	SD	SD <sup>2</sup>	R	SEM
52	50	12.3	23.27	10.02	100.39	0.89	3.32

Table 1: revealed the distribution of constructed physics achievement test (CPAT) reliability of 50 items using KR<sup>20</sup> the calculated  $\sum pq$  was found at 12.3 and the variance was also

calculated at 100.397. The coefficient of reliability (internal consistency) was found at 0.89 using 52 students as a sample. The calculated standard error of measurement was also found at 3.32 this indicated that the instrument achieves a reliable coefficient.

**Research Question Two:** What are the psychometric properties on each item of the constructed physics achievement test (CPAT) for senior secondary school students in Kaduna state?

**Table 2: Psychometric Analysis of Constructed-Standardized Physics Achievement Test (CSPAT)**

No. of Items	Facility index			Discrimination index		
	Lower	X	High	Lower	X	High
50	0.62	0.47	0.40	0.30	0.34	0.53

Table 2: show the item facility index and discrimination index of each of the items of the instrument. In terms of item facility, all of the items of the achievement test instrument had item facilities between 0.40 to 0.62 and the mean of 0.47. This showed that the items are mostly ideal items in terms of the degree of easiness or difficulty of the items. In terms of discrimination index of the items, 21 items had their discrimination indices between 0.30 – 0.53. The mean of discrimination index was found at 0.34. This implies that most of the items are also ideal items in terms of item’s ability to discriminate between the lower and higher achievers. Thus, the constructed physics achievement test (CPAT) instrument had high item facility as well as discrimination index. The results of the item analysis showed the survival of 50 items of (CPAT). All the selected items had moderate measure of difficulty and discrimination indices.

**Hypothesis One:** There is no significant difference between the mean scores of co-education, boys and girls only SS-II students in constructed-standardized physics achievement test (CSPAT) in Kaduna state. Hypothesis one was formulated to establish if the difference in the mean scores of students from coeducation, boys and girls only schools is statistically significant. This is to avoid erroneous generalization of students’ achievement in CSPAT which could vary based on school types.

**Table 3: Analysis of Variance (ANOVA) on School Types and Scores in CSPAT**

School Types	N	Mean	SD		Sum of Squares	Df	Mean Square	F	P
Girls Only	110	23.41	1.95	Bet. Groups	18.009	2	9.004		
Boys Only	60	23.30	2.17	Within Groups	1594.606	309	5.161	1.745	.176
Mix-Sch.	142	22.89	2.53	Total	1612.615	311			

Table 3 shows the mean score of the 3 categories of students in constructed-standardized physics test. The Girls only schools had a mean score of 23.41 with standard-deviation of 1.95, the Boys only schools had a mean score of 23.30 with standard-deviation of 2.53 while the mixed-school schools had a mean score of 22.89 with standard-deviation of 2.17. None of the

three groups had a mean score above average, although, a slight difference was observed in their means. Analysis of Variance (ANOVA) show that there is no significant difference in the means scores of the students from Girls-only, Boy Only and Mixed-schools;  $F(2,309)=1.745$ ;  $p\text{-value} > 0.05$ . This implies that school type has no significant impact on the observed differences in the means score of the three groups. Thus, the hypothesis that says, there is no significant difference between the mean scores of co-education and single-sex SS-II students in constructed-standardized physics achievement test (CSPAT) in Kaduna state is retained.

**Hypothesis Two:** There is no significant difference between the mean scores of rural and urban students in constructed-standardized physics achievement test (CSPAT) in Kaduna state. Hypothesis two was formulated to establish if the difference in the mean scores of students from urban and rural schools is statistically significant. This is to avoid erroneous generalization of students' achievement in CSPAT which could vary based on school location.

**Table 4: Independent Sample t-test on School Location and Scores in CSPAT**

Location	N	Mean	SD	Df	T	P
Urban	232	23.50	2.16	1	4.555	0.00**
Rural	80	22.15	2.32	310		

Table 4 shows the mean scores of 2 categories (Urban and Rural Students) in constructed-standardized physics test (CSPAT). The urban students had a mean score of 23.50 with standard-deviation of 2.16, the rural schools had a mean score of 22.15 with standard-deviation of 2.32. None of two groups had a mean score above average, however, a slight difference was observed in their means. Independent sample t-test conducted show that there is significant difference in the means scores of the students from rural and urban areas  $t(1,311)=4.55$ ;  $p\text{-value} < 0.05$ . This implies that school location has significant impact on the observed means score of the three groups. Thus, the hypothesis that says there is no significant difference between the mean scores of rural and urban students in constructed-standardized physics achievement test (CSPAT) in Kaduna state is rejected.

### Discussion of Findings

The constructed standardized physics achievement test was revealed valid and had a reliability coefficient of 0.89. This value was similar to value of reliability coefficient calculated by Adonu (2016), who conducted an intensive study of development and preliminary validation of an instrument for assessment of psychomotor skills in Physics which was found at 0.87. Onah (2014) also conducted a research on development and standardization of agricultural science achievement test for senior secondary school students and the reliability coefficient was found at 0.78. These value of reliability indices were considered reliable, thus the present study is equally considered to have construct/developed a reliable instrument. The instrument equally had face and content validity before administration.

All the test items of the constructed standardized physics achievement test had item facility index of 0.40 – 0.62. This implies that the item are mostly ideal items in terms of the degree of easiness or difficulty of the items. In terms of discrimination index, 28 of the items has discrimination index of 0.30 – 0.47. This implies that most of the test items were also ideal items in terms of ability to discriminate between the lower and higher achievers. Thus, the

constructed standardized physics achievement test had high test items difficulty and discrimination index. This finding is similar to the findings of Osadebe (2015) who carried out a research on construction of valid, the difficulty index of 0.4 to 0.5 for each items was considered reliable in commerce test for secondary school students.

The research questions four and the corresponding hypotheses shows that the mean achievement score of coeducation, boys-only and girl's only students is below average, but there was no significant difference in their achievement. This show that the observed poor performance of students in CSPAT is not bias of school types. This finding is in alignment with the findings Olakunle (2018) who analyzed the achievement in Physics WAEC of different school types (Coeducation, boys-only and girls-only) students of pubic secondary schools in Bauchi and found no significant relationship. This implies that public senior secondary school students irrespective of school types (boys-only, girls-only and mixed schools) will find it difficult to correctly answer standardized physics achievement tests.

The research questions five and the corresponding hypotheses shows that the mean achievement score of urban and rural students is below average and there was significant difference in their achievement with urban students slightly performed better than rural students. This show that the observed poor performance of students in CSPAT is bias of school location. This finding is in alignment with the findings of Ofumarin (2014) who conducted a similar study in biology and found that the urban student's performed better than rural students in biology standardized-test. Similarly, Onah (2014) reported a significant difference in the mean achievement scores of urban school and rural school in a set of standardized tests. This implies that both rural and urban senior secondary school students will find it difficult to correctly answer standardized physics achievement tests.

### **Conclusion**

Based on the findings of this study, the researcher concluded that the study successfully constructed and standardized a 50-item Physics achievement test (CSPAT) for SSII students in Kaduna state. The test demonstrated strong psychometric properties, with high reliability ( $KR-20 = 0.89$ ) and good item quality, making it a valid and reliable tool for assessment. However, the administration of the test revealed two critical issues such as the overall performance of students was below average and a significant disparity in achievement exists between urban and rural students. This suggests that current school-based assessment practices are insufficient in preparing students for external examinations like WAEC and NECO, and that location-based educational disparities require urgent attention.

### **Recommendations**

Based on the findings of this study, the following recommendations are given:

1. Physics teachers in Kaduna state should be encouraged to adopt or adapt the constructed-standardized physics achievement test (CSPAT) for use in their school-based assessments (both mid-term and mock examinations). This will expose students to a standardized testing format early, thereby improving their familiarity and readiness for high-stakes external examinations like WAEC and NECO.

2. Physics teachers should receive mandatory in-service training on standardized test construction and item analysis. Workshops led by measurement and evaluation experts should focus on developing table of specifications, writing questions that assess higher-order thinking, and analyzing items for difficulty and discrimination to improve their own assessment practices.
3. The state government and educational districts should develop and fund a targeted intervention program for rural schools. This should include the deployment of master physics teachers, provision of laboratory equipment, and digital learning resources to bridge the identified rural-urban achievement gap.
4. School administrators and heads of science departments should systematically use the data from standardized tests like the CSPAT for instructional planning. The results should be analyzed to identify difficult topics and concepts, guiding the allocation of more teaching time and resources to those areas to improve overall learning outcomes.

## References

- Achor, E. E., & Shaibu, J. O. (2012). Students' difficulties in physics concepts. *International Journal of Science Education*, 4(2), 112–120.
- Adonu, V. C. (2016). Development and preliminary validation of an instrument for assessment of psychomotor skills in physics. *International Journal of Education and Evaluation*, 2(3), 45–56.
- Alausa, Y. A. (2015). Test development procedures and the quality of teacher-made tests in Nigerian schools. *African Research Review*, 9(4), 62–73. <https://doi.org/10.4314/afrev.v9i4.5>
- Ali, A. (2004). *Instrumentation in educational research*. Enugu: Tashiwa Networks.
- Amoo, S. A., & Rahman, A. A. (2014). Teacher-made tests and the credibility of school-based assessment in Nigeria. *IOSR Journal of Research & Method in Education*, 4(3), 1–8.
- Emaikwu, S. O. (2012). Assessing the relative effectiveness of test formats in students' achievement in mathematics. *Journal of Emerging Trends in Educational Research and Policy Studies*, 3(2), 149–153.
- International Centre for Educational Evaluation (ICEE). (1982). *Instrumentation in educational evaluation*. University of Ibadan.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30, 607–610. <https://doi.org/10.1177/001316447003000308>
- Mehrens, W. A., & Lehmann, I. J. (1975). *Measurement and evaluation in education and psychology*. New York, NY: Holt, Rinehart and Winston.
- Miller, M. D., Linn, R. L., & Gronlund, N. E. (2013). *Measurement and assessment in teaching* (11th ed.). Pearson.
- Ofumarin, O. A. (2014). Differential performance of urban and rural students in biology standardized tests in Nigeria. *International Journal of Science and Research*, 3(6), 231–236.
- Ogbeba, J. E. (2018). Factors influencing students' low achievement in senior secondary school physics. *Journal of Science Education*, 8(2), 34–42.

- Okwilagwe, E. A., & Igbinoghene, V. O. (2016). Construct validation of classroom achievement tests in Nigerian secondary schools. *Journal of Educational and Social Research*, 6(2), 79–87. <https://doi.org/10.5901/jesr.2016.v6n2p79>
- Olakunle, I. T. (2018). School type and students' achievement in physics: A study of public secondary schools in Bauchi State. *International Journal of Innovative Research and Advanced Studies*, 5(4), 20–27.
- Olatunji, M. O. (2020). Standardization of classroom tests: Implications for teacher-made assessments. *African Journal of Educational Measurement*, 15(1), 82–95.
- Onah, A. O. (2014). Development and standardization of agricultural science achievement test for senior secondary school students. *Journal of Education and Practice*, 5(28), 15–23.
- Osadebe, P. U. (2015). Construction of valid and reliable test in commerce for secondary school students. *British Journal of Education*, 3(1), 21–31.
- West African Examinations Council. (2018). Chief examiners' report. WAEC.
- West African Examinations Council. (2021). Chief examiners' report. WAEC.