



Test Taker Characteristics and ICT Variable as Predictors of Academic Achievement in Computer Based Test

Eteng-Uket, Stella¹ and Ezeoguine, Ebere Pearl²

¹Department of Educational Psychology, G/C, Faculty of Education, University of Port Harcourt, Rivers State, Nigeria

²Department of Curriculum Studies and Educational Technology, Faculty of Education University of Port Harcourt, Rivers State, Nigeria

*stella.eteng-uket@uniport.edu.ng

Abstract

The study investigated test taker characteristics and ICT variables as predictors of academic achievement in computer-based test. To direct the study, five research questions and five null hypotheses were developed. The study used a multiple prediction design within a correlational research design. All 1450 students in year four at the University of Port Harcourt's Faculty of Education made up the study's population. The sample size of 144 students was determined using a stratified sampling technique based on gender. Two instruments Student CBT Grade Sheet and the Computer attitude, Familiarly Accessibility, Availability and Self-efficacy Questionnaire were used for the study. The internal consistency method of Cronbach alpha was used to estimate the instruments' reliability and construct validity. The subsets of the questionnaire had Cronbach alpha coefficients of .637, .634, .611, .634, and .623, while the instrument as a whole had a Cronbach alpha reliability of .635. Beta values, simple, multiple regressions, ANOVA and t-test associated with simple and multiple regression were used to analyze data obtained. The result revealed that test taker characteristics and ICT variables jointly and independently predict academic achievement of students in CBT but not significantly.

Keywords; Computer-based test, test taker characteristic, ICT variables, Academic Achievement.

Introduction

Computer- Based test (CBT) a brainchild of information communication technological advancement has become an innovation intricately intertwined in the educational process and by extension in assessment method. Scheurermannard & Perelira (2008) posits that CBT is seen as a catalyst for change bringing transformation of learning pedagogy and curricula in educational institution. This technological advancement in the form of CBT has significantly reshaped the method of assessment. According to Piaw (2012), there is a growing interest in creating and utilising computer-based tests for educational assessment in schools and other educational settings. That is with the rising demand of efficiency, proficiency and accuracy, many educational sectors have adopted Computer-Based Testing in educational evaluation, test and assessment (Bandeled, 2019; Eteng-Uket & Chukwu 2020)

Computer-based exams also known as Computer Based Assessment, Computer based testing, Computerized testing or Computer-assisted testing is a technique for giving tests or exams in which the results of student learning are electronically recorded, evaluated, or both; It is the use of information technology for any assessment related activity or software of computer or organized systems on computers or the use of computer through technological devices that support test/exams papers to be presented electronically, (Abah et al., 2022; Bandeled, 2019; Eteng-Uket & Chukwu 2020; Efendi et al 2021; Emdas, & Alruwaili 2021; Frey, 2018; Kuzmina 2010). It is simply offering test or examination via computer; that is, it describes the use of computers in taking test or exam. An examination or test is an assessment designed to assess test takers' knowledge, skill, aptitude, physical fitness, or classification in any subject, and it can be administered on paper or on a computer.

CBT is administrated to assess student's achievement academically. Academic achievement is a measure of the degree to which a student, teacher, or institution has met its objectives, and it is commonly measured through exams or continuous assessment. Academic achievement can be defined as excellence in all academic disciplines; it is educational outcome. Academic

achievement in schools and universities is commonly measured by examination or continuous assessment. That students achieve excellent success is the goal of education irrespective of the mode of assessment. Academic achievement thus of students in computer – based test is of importance to all stakeholders in education.

Since their introduction in the 1970s, computer-based testing (CBT) has been gradually replacing paper-and-pencil tests in educational assessment. The pencil-and-paper exam has been plagued by a number of issues, including a lack of exam materials, impersonation-cheating in testing rooms, cases of missing test scripts, incorrect scoring of test takers' responses, delays in computing and processing results, and more. That is not to say that CBT does not have challenges of its own. However, despite these problems, there is a general consensus in the literature that CBEs will inevitably become a part of students' assessment everywhere as the use of CBT for testing purposes has a history spanning more than twenty years and still counting.

In comparison to their paper-based counterparts, CBTs are thought to have a number of benefits and appeals. These include improved reliability (machine marking does not "know" students so does not favour nor make allowances for minor error), the opportunity to give students immediate feedback on their performance, and the opportunity to automate marking and reduce the workload associated with marking, greater storage efficiency—tens of thousands of answered scripts can be stored on a server instead of taking up the physical space needed for paper scripts—a reduction in the cost of supplies and labour associated with conducting exams manually, higher accuracy, simplicity in test grading, just to mention but a few. (DeBoer et al., 2014; Efendi et al 2021; Hosseini, Abidin & Baghdarnia, 2014; Lehane, 2019; Lehane, Scully, & O'Leary, 2022; Hurley, 2017; Nugroho, Kusumawati & Ambarwati, 2018; Supriyati, Iriyadi, & Falani, 2021; Shilova, Artamonova & Averina, 2014).

The use of CBT is not without some limitations. There are a number of identifiable threats to the use of CBTs they include; high cost relating to the startup and maintenance of computer environment hard ware, software, networking and wiring, inadequate school-based infrastructure, possible technological failure, not being suitable for every type of assessment (such as extended response) server and power related issues, limited CBT centers, technical issues (like in the use of the mouse, font size, screen clarity, screen size, screen resolution, display and scrolling rate) state of mind of students, students' computer literacy and accessibility, insufficient computers and internet access, test taker characteristics like their self-efficacy, interest, personality, intelligence motivation, familiarity with and accessibility to computer, availability of computer and IT expert during test and the likes (Efendi et al 2021; Lehane, 2019; Lehane, Scully. & O'Leary,2022; Supriyati et al., 2021).

Some of these factors may influence the academic achievement of students in these examination. Some studies have revealed how these factors have influenced or are related with academic achievement of students. For instance student's familiarity with and accessibility to computer. This concept which refers to computer knowledge, usage and access to computer according to results from studies has been implicated as a factor that can influence academic achievement in CBT (Chan, Bax, & Weir, 2018; Cheema and Zharg 2013; Goldberg & Pedulla, 2002; Jackson et al., 2006; James et al.,2016; Krentler & Willis-Flurry 2005; Odo, 2012; Yu & Iwashita 2021) of). Some studies, however, observed no statistically significant links between computer familiarity and academic achievement. in CBT (Hosseini et al. 2013; Khoshsima et al., 2019). Although according to Ololube (2009), many students in Nigeria higher educational institutions find it very difficult to effectively integrate and diffuse computer products and process into their academic activities and overall, African ICT/CC readiness is not so at par with other nations.

Other factors that have been investigated like test takers attitude towards computer has revealed some findings. Attitude is a belief that predisposes one to act and feel in certain way (Lahey, 2004). In relation to computer, computer attitude is one's disposition or belief towards computer. It is a complex mental state that affects a human choice of action or behaviour towards computer and computer related task either positively or negatively. Attitude has been linked to performance and appears to impact computer utilization and technology-based accomplishments significantly. Kadjevish (2002) viewing along this line opined that, computer attitude affects not only whether or not computers are accepted, but also whether or not they are used as professional tools. This is further collaborated by the assertion of Larbi-Apau & Moseley (2012), where they revealed that with very few exceptions, the general finding on both students and teachers suggest attitude is related to performance and appears to have substantial influence on computer utilization and technology-based performance in education. Thus, attitude towards computer be it positive or negative could influence performance on CBT. Although Studies test takers' attitudes towards computer in CBT have yielded inconsistent results. Higgins et al. (2005), for instance, looked into how primary school students felt about CBT reading comprehension tests. The test results for the two modes were the same, despite the fact that participants preferred CBT to PBT. Same with that of Cazares (2010), Ebrahimi et al. (2019), and Khoshsima et al. (2017) whose studies revealed that CBT test takers who had favourable attitudes towards the format did not succeed in getting higher test scores. Just like the findings of Yu & Iwashita (2021) that revealed that test results were unaffected by participants' attitudes towards CBT.

Another factor that has been identified in literature that may influence Students academic achievement in CBT is the test-taker variables like self-efficacy. Self-efficacy is the self-perceived ability to act successfully and exert some control over external circumstances that

affect our lives. (Bandura cited in Ogbogo & Amadi 2019). While Schneider (2011) cited in Ogbogo 2018, saw self-efficacy is a person's level of certainty in his capacity to carry out particular tasks in particular situations. It is the perception of being capable of achieving one's goal. It contributes to performance since they influence thought process, motivation and behavior. Thus, with regard to CBT, it is a belief of one's ability to use computer for examination. Students with high self-efficacy may have high efficacy towards computer and thus perform well academically on CBT. Tenaro (2013) in a study reveals that academic achievement and self-efficacy are positively significantly related thus self-efficacy and academic achievement are highly correlated. However in a survey by Sam, Othman and Nordim (2005) it revealed that medium attitude towards the internet high self-efficacy and increased internet usage did not result in increased computer self-efficacy. among undergraduate.

Other factors that has been introduced in literature that could affect CBT are ICT variables like availability of computer and availability of IT experts during CBT to handle technical challenges. Availability of computers and IT experts during CBT refers to the provision of IT experts' assistance to students during CB test or examination to those who are encountering technical difficulties and the availability of functional computers to easily accommodate the large number of students. Just like Bandele 2019 pointed out that the areas of concern are technical problems in CBT that may influence students' responses to designed questions.

From the foregoing, challenge of CBT to test designers and administrators is to design CBT so that it is reliable, fair, and produces accurate test results. that has the above limitations discussed reduced to barest minimum. More so, they have to be fashioned to reduce examinees' difficulties that may stem from the above possible factors. This is because these factors are important in determining student's achievement; if they are disregarded, there may be unpleasant effects on test outcome in the form of students having low achievement scores

which may not be a true reflection of their abilities. Thus additional steps are well worth taking in the form of further investigations as to how some of these factors influence achievement in CBT so their findings can inform all educational stallholder's decision as it relates to CBT

Although research has shown how some of these factors influences academic performance in Computer based test, they have not been jointed studied to determine how they predict student's academic performance in Computer based test. Therefore, providing empirical findings about the predictive power of some of these factors CBT in may bring about improvement in the current use of CBT as it influences the academic achievement of students. This thus provided the premises for the research which is aimed at examining certain variables that has not been studied jointly but has been presented in past studies. The aim thus of this study is to examine test taker characteristic and ICT variables as predictors of students' academic performance in Computer based test.

The research was guided by the following questions:

1. To what extent does test taker characteristic (student familiarity and accessibility to computer, self-efficacy, computer attitude) independently predict student academic achievement CBT
2. To what extent does test taker characteristics (student familiarity and accessibility to computer, self-efficacy and computer attitude) jointly predict student academic achievement in CBT.
3. To what extent does ICT variables (availability of computer and IT experts during CBT) independently predict student academic achievement in CBT
4. To what extent does ICT variables (Availability of computer and IT experts during CBT) jointly predict student academic achievement in CBT.

5. To what extent does test taker characteristics and ICT variables predict student's academic achievement in CBT.

The following null hypothesis (Ho) were tested at 0.05 level of significance

1. Test taker characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy) independently do not significantly predict academic achievement) of student in CBT
2. The joint influence of test taker characteristics (familiarity accessibility to computer, self-efficacy, computer attitude) do not significantly predict student academic achievement in CBT.
3. ICT variables (availability of computer and IT experts during CBT) independently do not significantly predict academic performance of students in CBT.
4. ICT variables (availability of computer and IT experts during CBT) jointly do not significantly predict academic performance of students in CBT.'
5. Joint influence of test taker characteristics and ICT variable, do not significantly predict student academic achievement in CBT.

Methodology

The research designs for the study was the correlation design by multiple prediction. According to Kpolovie (2010), is the method used to examine the strength and direction, as well as the nature (positive or negative), of any relationship that may exist between a dependent variable (also known as a criterion variable) and one or more independent variables (also known as predictor variables).

All 1450 year four (years 4) students enrolled in the University of Port Harcourt's Faculty of Education during the 2016/2017 academic year made up the study's population. This

was because these are the category of students who have been assessed / taken exam in entrepreneurship (GES 300) using computer-based test as delivery mode. The researchers employed a gender-based stratified random sampling technique. to obtain 144 year four students ((male 66 and female 88).

The study employed two instruments to gather its data. They were the Student CBT Grade Sheet (SCGS) which was designed to collect scores of students in GES 300.2 where CBT was used as delivery mode. The second instrument was the Computer Attitude, Familiarly, Accessibility, Availability and Self-efficacy Questionnaire (CAFASQ). The questionnaire was broken down into six sections, with the first section collecting demographic data. the second section elicited information on self-efficacy, the third on computer attitude, the forth on familiarity and accessibility to computer, the fifth on availability of computer during CBT and the sixth on availability of IT experts during CBT. The questionnaire contained 35 items answered on a four point Likert scale.

The Cronbach alpha method of internal consistency was used to estimate the instrument's reliability and construct validity. These instruments were pilot tested on 30 respondents. Every item in the instrument was analyzed for quality and selection using the Cronbach alpha method. Item inclusion for the final instrument was based on inter item analysis and item total statistics. Items deemed insufficient were removed based on their low coefficient position in comparison to other items in the pool, a system that ensured the construct validity as well as reliability of the items in the instruments. For Computer attitude subset of the questionnaire, Cronbach Alpha reliability was .637, for self-efficacy, it was .634, for Computer accessibility and familiarity Subscale, it was .611, for Availability of expert during CBT Subscale, it was .634, for availability of computers during CBT Subscale, it was .623 and for the instrument as a whole Cronbach Alpha reliability of .635 was obtained. The aforementioned provided ample and clear proof that the scales' psychometric validity and reliability were good. The data

obtained were analysed using beta values, simple and multiple regressions, ANOVA associated with multiple regression, and t-test associated with simple regression.

Result

Research Question 1: To what extent does test taker characteristic (student familiarity and accessibility to computer, self-efficacy, computer attitude) jointly predict student academic achievement CBT?

Table 1: Multiple Regression Analysis

Model	R	R square	Adjusted R ²	Std. Error of the estimate
1	.092 ^a	.008	-.013	10.95017

The table 1 shows a multiple regression (R) value of .092, regression squared (R²) of .008; and Adjusted R square -.013. This table shows R² change of .008 which means that only .08% of the proportion of variation in academic achievement in CBT can be accounted for by the joint prediction of test taker characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy).

Hypothesis 1: Test taker characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy) jointly do not significantly predict academic achievement of student in CBT.

Table 2: ANOVA associated with multiple regression analysis

Model	Sums of square	Df	Mean square	F	Sig
Regression	142.943	3	47.648	.397	.755

Residual	16786.884	140	119.906
Total	16929.826	143	

ANOVA associated with multiple regression as shown in table 1.2 reveals that F – value of .397 df = (140) $P > .05$. Thus null hypothesis that test taker characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy) jointly do not significantly predict academic achievement of student in CBT is accepted and the alternate rejected.

Research Question 2: To what extent does test taker characteristic (student familiarity and accessibility to computer, self-efficacy, computer attitude) independently predict student academic achievement CBT?

Hypothesis 2: Test taker characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy) independently do not significantly predict academic achievement of student in CBT.

In order to answer research question 2, and test its corresponding hypothesis 2, Beta value and t – test associated with multiple regression was employed in order to determine the relative prediction of each of the independent variable. Beta and associate t-values of the independent variables were computed and presented in table 3 below

Table 3: T-test Associated with Multiple Regression Analysis

	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B	Std. Error	Beta	T	
(Constant)	67.673	7.911		8.555	.000
SE	-.167	.196	-.073	-.852	.396
CA	-.004	.137	-.003	-.030	.976
CF	.055	.109	.045	.509	.612

Table 3: results showed that Beta value of student’s accessibility and familiarity with computer was .045, computer attitude was -.003 and self-efficacy was .073 respectively. This indicates that student’s self-efficacy has the highest prediction on student’s achievement in CBT, followed by student’s accessibility and familiarity with computer and then computer attitude.

Revealed also in the table is the computed t-test value associated with multiple regression of the independent contribution of test takers characteristics. For test taker characteristics of self-efficacy $B = -.075$, $t = -.852$ $P .396 > .05$ (not significant), for computer attitude $B = -.003$, $t = -.030$ $P .976 > .05$ (not significant), for students accessibility and familiarity with computer, $B = .045$; $t = .509$ $P .652 > .05$ (not significant). This result shows that test taker characteristics of self-efficacy, computer attitude and accessibility and familiarity with computer does not significantly predict students achievement in CBT

Research Question 3: To what extent does ICT variables (Availability of computer and IT experts during CBT) jointly predict student academic achievement in CBT.

Table 4: Multiple Regression Analysis

Model	R	R square	Adjusted R ²	Std. Error of the estimate
1	.122 ^a	.015	.001	10.87515

The table 4 shows a multiple regression (R) value of .122, regression squared (R²) of .015; and an Adjusted R square .001. This shows R² change of .015 which implies that only .01% of the proportion of variation in academic achievement in CBT can be explained by the joint prediction of availability of computer and IT experts during CBT).

Hypothesis 3: ICT variables (availability of computer and IT experts during CBT) jointly do not significantly predict academic performance of students in CBT.

Table 5: ANOVA associated with multiple regression analysis

Model	Sums of square	Df	Mean square	F	Sig
Regression	253.908	2	126.954	1.073	.345
Residual	16675.919	141	118.269		
Total	16929.826	143			

ANOVA associated with multiple regression as shown in table 1.2 reveals that F – value of .1.073 df = (141) $P > .05$. Therefore the null hypothesis that ICT variables (availability of computer and IT experts during CBT) jointly do not significantly predict academic performance of students in CBT is accepted and the alternate rejected.

Research Question 4: To what extent does ICT variables (availability of computer and IT experts during CBT) independently predict student academic achievement in CBT?

Hypothesis 4: ICT variables (availability of computer and IT experts during CBT) independently do not significantly predict academic performance of students in CBT

Table 6: T-test analysis associated with multiple analysis

	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B4	Std. Error	Beta	T	
(Constant)	64.412	4.655		13.838	.000
IT	-.281	.221	-.120	-1.274	.205
AV	.248	.202	.116	1.231	.220

Table 6 results showed that Beta value of availability of computer was -.120 and availability of IT experts during CBT was .116 respectively. This implies that availability of computer to

student has the highest prediction on student’s achievement in CBT, followed by availability of IT experts during CBT

Also contained in the table is the computed t-test value associated with multiple regression of the independent contribution of ICT Variables. For availability of computer to student, $B = -122$, $t = -1.274$ which was not significant at 0.05 alpha level, as $t = -1.274$, $p = .205$ ($p > .005$). While for availability of IT experts during CBT, $B = .116$, $t = 1,231$ which was not significant at 0.05 alpha level, as $t = 1.231$, $p = .220$ ($p > .005$). This result shows ICT variables (availability of computer and IT experts during CBT) independently do not significantly predict academic performance of students in CBT

Research Question 5: To what extent does test taker characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy) and ICT variables (availability of computer and IT experts during CBT) jointly predict students’ academic achievement in CBT

Table 7: Multiple regression Analysis

Model	R	R square	Adjusted R ²	Std. Error of the estimate
1	.153 ^a	.023	-.012	10.94558

The table shows a multiple regression (R) value of .153, regression squared (R²) of .023; Adjusted R square -.012. This table shows R² change of .023 which implies that .23% of the proportion of variation in academic achievement in CBT can be explained or accounted for by the joint prediction of test taker characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy) and ICT variable, (availability of computer and IT experts during CBT) on academic performance of students in CBT

Hypothesis 5: Joint influence of test taker characteristics characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy) and ICT variable, (availability

of computer and IT experts during CBT) jointly do not significantly predict academic performance of students in CBT.

Table 8: ANOVA associated with multiple regression analysis

Model	Sums of square	Df	Mean square	F	Sig
Regression	396.650	5	79.330	.662	.653
Residual	16533.176	138	119.806		
Total	16929.826	143			

The ANOVA in table 1.8 reveals that F – value of .662 df = (5, 138) $P > .05$. So, the null hypothesis that test taker characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy) and ICT variable, (availability of computer and IT experts during CBT) jointly do not significantly predict academic performance of students in CBT is accepted and the alternate rejected.

Discussion and Conclusion

The finding of the present study shows that test taker characteristics (student familiarity and accessibility to computer, computer attitude, self-efficacy) and ICT variables (availability of computer and IT experts during CBT) as variables both independently and jointly predicts academic achievement of student in CBT but not significantly as $P < .05$. Also when these two were combined, there was joint prediction of academic achievement of student in CBT but not significantly. Possible reason that there was a prediction of these variables on the academic achievement in CBT although not significant could be that students are beginning to be having

more access to computers or owning personal computers or having more access to digital devices that function more or less like computer therefore becoming more familiar with computers resulting in a more positive attitude and possibly higher self-efficacy but not as highly as expected. Also, ICT variables like computer being available more in exams halls and ICT experts more readily available to assist students with technical issues could be a possible cause for this result. These findings are in tandem with that of findings of the study of Yu & Iwashita (2021) that showed that the performance of CBT participants and their familiarity with computers are positively correlated. This was also supported by that of Chan, et al., (2018), Krentler & Willis-Flurry (2005) and also in sync with the findings of Goldberg and Pedulla (2002) where their results demonstrated that those who were more familiar with computers scored higher than those who were not. Likewise, Odo (2012) study showed that participants' familiarity level has a small but significant effect on test results. Also, in consonant with this is the study of Cheema and Zhang (2013), whose results showed that computer use, both in terms of quantity and quality, was a significant predictor of success. However, this result is at variance with that of Hosseini et al. (2013) and Khoshsima et al. (2019) whose findings showed no statistically significant correlation nor significant influence between computer familiarity and experience and CBT result scores. Also, not in tandem with this finding are the findings of Higgins et al (2005) which revealed that attitudes of school students towards CBT had no influence over their performance. This is also same for the studies of Khoshsima et al. (2017) and Ebrahimi et al. (2019) who revealed that CBT test takers who had favorable attitudes towards the format did not succeed in getting higher test scores. Similar to how Yu & Iwashita (2021) findings that showed that participant attitudes towards CBT had no impact on test outcomes. The different demographics of the study samples, the researcher's angle and the measuring tools could be the causes of this inconsistent finding. Furthermore, in contrast to

previous studies in the literature, the current study concentrated on the prediction of the identified variables.

Recommendation

It is recommended that students should acquire personal computers the more and most importantly, get to use it in their course work which makes them more familiar in the course of their being examined using computer in some of their exams and also in future as most examinations are now CBT based. It is also recommended that teachers should engage students in task that would require them to use computers so that they develop more positive attitude towards it, become more familiar and also develop competencies that would make them handle technical issues that might even arise in the course of exams taking exams which uses CBT as a delivery mode without having to wait on technical staff to resolve problems that is within their powers. It is also recommended that schools and examining bodies that gives examination or test using CBT as a delivery mode should have centers or hall where students can have access to computers to take practical classes prior to their assessment as well as having ample technical staffs on ground to resolve technical issues that might arise before, during and after test takers taking CBT.

References

Abah, J. A., Honmane, O. Age, T. J. & Ogbule, S. O. (2022). Design of single-user-mode computer-based Examination system for senior secondary schools in onitsha north local government area of anambra state, Nigeria. *VillageMath Educational Review* 3(1), 108-134. <https://ngsme.villagemath.net/journals/ver/v3i1/abah-honmane-ageogbule>

- Bande, S.O. (2019). Evaluation of general studies computer based tests in universities in south west Nigeria. *International Journal of Interdisciplinary Research Methods* 6(3), 19-28.
- Chan, S., Bax, S., & Weir, C. (2018). Researching the comparability of paper-based and computer-based delivery in a highstakes writing test. *Assessing Writing*, 36, 32-48. <https://doi.org/10.1016/j.asw.2018.03.008>.
- DeBoer, L (2014). A Web-based learning and assessment system to support flexible education. *Journal of Computer Assisted Learning*, 18, 125–136.
- Cheema, J.R., & Zhang B., (2013). Quantity and Quality of computer use and academic achievement: Evidence from a large scale international test program. *International journal of education and development using information and communication technology*. 9 (2), 95-106
- Eteng-Uket, S. & Chukwu B. (2020). Test anxiety, computer experience and computer ownership as predictors of computer anxiety. *Nigerian Journal of Empirical Studies in Psychology and Education*. 18(1), 278-289
- Ebrahimi, Mohammad Reza & Hashemi Toroujeni, Seyyed Morteza & Shahbazi, Vahide. (2019). Score Equivalence, Gender Difference, and Testing Mode Preference in a Comparative Study between Computer- Based Testing and Paper-Based Testing. *International Journal of Emerging Technologies in Learning* 14, 128-138. 10.3991/ijet.v14i07.10175.
- Emdas, R. & Alruwaili, A, (2021). Online Learning During COVID-19 Pandemic, and Possibility of Adopting Computer-Based Test. *International Journal of Computer Science & Information Technology* 13(4), 1-7.
- Efendi R., Lesmana, L. & Putra, F., Yandani, E. & Wulandari, R.. (2021). Design and Implementation of Computer Based Test (CBT) in vocational education. *Journal of Physics: Conference Series*. 1764. 012068. 10.1088/1742-6596/1764/1/012068.
- Frey, B. (2018). *The SAGE encyclopedia of educational research, measurement, and evaluation (Vols. 1-4)*. Thousand Oaks,, CA: SAGE Publications, Inc. <https://doi:10.4135/9781506326139>

- Goldberg, A. & Pedulla, J. (2002). Performance Differences According to Test Mode and Computer Familiarity on a Practice Graduate Record Exam. *Educational and Psychological Measurement - Educ Psychol Meas.* 62, 1053-1067. <https://doi.org/10.1177/0013164402238092>.
- Hartono, D. A. (2019). Investigating the relationship between test-taking anxiety and test-takers' performance on the IELTS test. *Script Journal: Journal of Linguistic and English Teaching*, 4(1), 1-11. <https://doi.org/10.24903/sj.v4i1.282>.
- Hosseini, M., Abidin, M.J.Z., & Baghdarnia, M. (2014). Comparability of Test Results of Computer-Based Tests (CBT) and Paper and Pencil Tests (PPT) among English Language Learners in Iran. *Procedia - Social and Behavioral Sciences*, 98(1). 659-667. <https://doi.org/10.1016/j.sbspro.2014.03.465>
- Hosseini, M., Abidin, M.J.Z., Kamarzarrin, H. & Khaledian, M. (2013). The Investigation of Difference between PPT and CBT Results of EFL Learners in Iran: Computer Familiarity and Test Performance in CBT. *International Letters of Social and Humanistic Sciences*, 11. 66-75. <https://www.learntechlib.org/p/177180/>.
- Higgins, J., Russell, M., & Hoffmann, T. (2005). Examining the effect of computer-based passage presentation on reading test performance. *Journal of Technology, Learning, and Assessment*, 3(4), 1-36.
- Hurley, A. 2017. Exploring the Use of Computer Based Exams for Undergraduate Accounting. *Irish Journal of Academic Practice*. 6(1), 1-23
- Khoshsima, H., Toroujeni, S. M. H., Thompson, N., & Ebrahimi, M. R. (2019). Computer-based (CBT) vs. paper-based (PBT) testing: mode effect, relationship between computer familiarity, attitudes, aversion and mode preference with CBT test scores in an Asian private EFL context. *Teaching English with Technology*, 19(1),86–101
- James, A., Yuguda, H., Moses, H. G., Jeremiah, P., & Bitrus, I. (2016). Comparison Between computer Based Test (CBT) and paper Pencil Test (PPT) in Joint Admission Matriculation Board (JAMB): Case of Yola North Senatorial Zone of Adamawa State, Nigeria. *IJRDO - Journal of Computer Science Engineering* 2(12), 01-14.

- Jackson, L.A., Eye, A.V. Biocca, F.A. Bartatsis, G., Zhao & Fitzgerald, (2006) Does Home internal use influence the academic performance of low income children? *Developmental psychology*. 42 (3), 429-435.
- Kadijevish D.J. (2002). Four critical Issues of applying educational technology standards to professional development of mathematics tech. *Proceeding of the 2nd international conference on the techy of mathematics at the undergraduate level. University of Crete.*
- Kpolovie, P.J. (2010) *Advanced Research methods*. Owerri: Springfield publishers, Ltd.
- Krentler, K. & Willis Hurry, L. (2005). “Does technology enhance actual student learning”? The case of online discussion boards. *Journal education for business* 80 (6), 316 – 521.
- Kuzima, I (2010). Computer-Based Testing: advantages and disadvantages. *Bulletin of the National Technical Unviversity of Ukraine, (28)*, 192-196
- Larbi-Apau, J. A., & Moseley, J. L. (2012). Computer attitude of teaching faculty: implications for technology-based performance in higher education. *Journal of Information Technology Education, 11*, 221-233.
- Lehane, P. 2019. Leaving certificate computer science: factors to consider when developing computer-based examinations. Dublin: *National Council of Curriculum and Assessment*.
https://www.ncca.ie/media/4081/lccs_cbe_factorstoconsider_lehane2019-for-ncca-website.pdf.
- Lehane, P., Scully, D. & O'Leary, M. (2022) ‘Time to figure out what to do’: understanding the nature of Irish post-primary students’ interactions with computer-based exams (CBEs) that use multimedia stimuli. *Irish Educational Studies*, 41(1), 5-25.
<https://doi.org/10.1080/03323315.2021.2022517>
- Lahey, B. (2004). *Psychology: An introduction*. New York: McGraw Hills.
- Nugroho, R.A., Kusumawati, N. S., & Ambarwati, O.C. (2018, February). Students perception on the use of computer-based test. *IOP Conference Series: Materials Science and Engineering, 306(1)*,1-6. <https://doi.org/10.1088/1757-899X/306/1/012103>

- Odo, D. M. (2012). Computer familiarity and test performance on a computer-based cloze ESL reading assessment. *Teaching English with Technology*, 12(3), 18–35
- Ogbogo S., (2017). Relationship Between Statistics Self-Efficacy and Learning styles. *Nigerian Journal of Educational Research and Evaluation*, 16(1),130-139.
- Ogbogo S., & Amadi, G.N. (2018). Statistics Self-efficacy and learning Styles as Predictors of Statistics Anxiety. *International Journal of Scientific Research and Management*. 6(4), 240-248.
- Ololube. N.P, (2009). Computer Communication and ICT attitude and anxiety among higher education students. In A, Carteilli & M. Palma (Eds). *Encyclopedia of Information Technology*, Hersh, PA; Information Science Reference <https://doi.org/10.4018/978-1-59904-845-1.ch014>.
- Piaw, C. Y. (2012). Replacing Paper-based testing with computer – based testing in assessment; are we doing wrong *Procedia – social and behavioral sciences* 64, 655-664.
- Rabiu, N., Kehinde, A., Amuda, H. O., & Kadiri, K. K. (2020). University of Ilorin undergraduate students’ perceptions of the usefulness and challenges regarding computer-based testing. Mousaion: *South African Journal of Information Studies*, 37(4).1-19 <https://doi.org/10.25159/2663-659x/7305>.
- Shilova, TV., Artamonova, LV., Averina, SY., 2014. Computer-based Tests as an Integral Component of an EFL Course in Moodle for Non-linguistic Students. *Procedia-Social and Behavioral Sciences*. 154, 434-436
- Supriyati, Y., Iriyadi, D., & Falani, I.. (2021). The development of equating application for computer-based test in physics hots category. *Journal of Technology and Science Education*, 11(1), 117-128. <https://doi.org/10.3926/jotse.1135>
- Sam, H.K. Othman, A.E.A., & Nordin, Z.S. (2005). Computer Self-efficacy computer anxiety and attitudes towards the internet: A study among undergraduates in Unimas. *Education Technology & Society*, 8 (4), 205-219.

- Scheuermann, F., & Pereira, A.G. (2008). Towards a Research Agenda on Computer-based Assessment-Challenges and Needs for European Educational Measurement. *TRC. Scientific and Technical Report*, 23306 EN.
- Tenaro, I.A. (2013). Relationship Between Self-efficacy, Academic Achievement and gender in analytical chemistry at Debre Marker College of Teacher education *AJC Journal*. 2013. 3(1), 3-28.
- Yu, W., Iwashita, N. (2021) Comparison of test performance on paper-based testing (PBT) and computer-based testing (CBT) by English-majored undergraduate students in China. *Lang Test Asia* 11(32), 1-22 <https://doi.org/10.1186/s40468-021-00147-0>
- Zheng, Y., & Cheng, L. (2018). How does anxiety influence language performance? From the perspectives of foreign language classroom anxiety and cognitive test anxiety. *Language Testing in Asia*, 8(1), 1-19. <https://doi.org/10.1186/s40468-018-0065-4>.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

