EFFECT OF COMPUTER ADAPTIVE TEST ON STUDENTS' RETENTION IN EDUCATIONAL RESEARCH

Christian, Ngozi[1]; Akamigbo, Izuchukwu Stephen[2] & Ugwuanyi, Christian Sunday[1].
[1]Department of Science Education, University of Nigeria, Nsukka Nigeria.
ngozi.christian.pg00252@unn.edu.ng
[2]Department of Educational Psychology, Nwafor Orizu College of Education, Nsugbe.
steveizunna@yahoo.com

Abstract

The growth of artificial intelligence (AI) has ignited significant concern regarding their effect on universal development in education. Nevertheless, the scarcity of research addressing the effects of AI tools on evaluating students' educational retention, particularly within the Nigerian educational landscape, is disconcerting. Hence, the purpose of the study was to determine the effects of Computer adaptive test on students' retention in Educational Research. The study employed a quasi-experimental post-test-only design with non-equivalent groups, focusing on a population of 698 students at 300-level from the Faculty of Education. The researcher utilized a convenience sampling technique to select 44 volunteers as study participants. Data were collected through the administration of the ERT retention test, which underwent validation by three experts from the Department of Science Education. The instrument was trial tested on 50 respondents and was found with an estimate of ($\alpha = .76$) using Kuder-Richardson (KR-20) statistics which shows a high degree of reliability. The experimental group received the computer adaptive test treatment, while the control group underwent the traditional computer-based test. Statistical analyses were conducted using the Mean and standard deviation to address the research question, and a two-way Analysis of Variance (ANOVA) was employed to test the statistical hypothesis. The Statistical Package for Social Sciences (SPSS) version 25 facilitated the data analysis. This comprehensive research design and methodology ensure the reliability and validity of the study's findings regarding the impact of computer adaptive testing on student retention. The findings of the study showed that the students assessed using Computer Adaptive test had posttest mean retention score of ($M = 71.45$, $SD = 7.22$) while the students assessed using the Computer-based test had posttest mean retention score of ($M = 31.82$, $SD = 14.52$), There was a significant mean difference between Artificial intelligence mode of assessment and computer-based test on students' retention,($F(1,40) = 135.005$, $p = .000$. Educational institutions are advised to contemplate the integration of AI-driven assessments such as CAT for an improved learning retention for students in the learning of educational research.

Keywords: Computer adaptive test, Computer based test, knowledge retention & Educational research

Introduction

Educational research is relevant to bring about the desired change in the educational sector of country. On this note, it is imperative to improve student learning retention in educational research through the usage of artificial intelligence mode of assessment such as the computer adaptive test. Wani (2021) explains that Educational research refers to a systematic attempt to gain a better understanding of the educational process, generally with a view to improve its efficiency. Educational research is a field of study that embraces the full spectrum of rigorous methods appropriate to the questions being asked and also drives the development

of new tools and methods (American Education Research Association, 2019). Several problems captured in educational research as noted by Mcwilliam (2016) include low funding, reliability shortfalls in publications, inability to systematically move to mainstream those innovations in the interests of educational stakeholders (linking research to industry), and inability to reliably assess students' performance. Moreover, educational research as a teaching subject in higher institutions of learning has suffered challenges in the areas of student retention and among the factors that could be responsible for students' poor retention may include the prevalent assessment practice (Omwirhiren, 2015; Umar, 2018).

It is necessary to assert that retention is equally as important as achievement in the learning institution. Andrew and Rebello (2013) explains that the retention of learned information can be defined as holding the information preserved in long-term memory in a kind of manner that it can be willingly recalled at ease without delay. Retention in this context refers to the ability of students to recall what they have been taught in educational research. The examination of retention unmistakably has common characteristics with the study of memory, but it be at variance on the note that for knowledge to be considered as retained, students ought to be capable to recall the information when suitable in reaction to prompts. Researchers such as Jones et al. (2014), Custers (2020) and Custers and Cate (2017) posits a low rate of knowledge retention in high-rate professional programs where students are traditionally expected to gain mastery. Teachers correctly focus their work on supporting students to gain fresh knowledge and skills, nevertheless recently acquired knowledge is at risk and without difficulty slide absent from the memory (Ferreira et al.,2016). Onyenma and Olele (2020) put it that, what is important in education is not what students know the day of the final exam, but rather what learning they retain and can apply months and years later. Nevertheless, on the worries of educational retention, Al-Tameemi et al. (2023) argues that four main causes were identified to affect student retention being academic, personal, social and demographic factors. Makondo (2012) posits that the caliber, attitude, and perspectives of instructors do affect student retention; Seibert et al. (2017) faulted health issues; while Zoubi and Younes (2015) argues that poor student-teacher relationships could lead to the lack of students' acceptance of the learning process and affects student retention. Their studies did not show if computer adaptive test mode of assessment could affect undergraduate student retention positively, but it was rather concerned with prevalent assessment practices as well as their challenges that could negatively impede assessment for learning.

The assessment practice that characterized universities in Nigeria is a gradual decline of paper-based assessment and the emergence of Computer based test. The system for CBT comprises of two components: an assessment engine and an item bank. An assessment engine consists of hardware and software required for creation delivery of test. Most e-testing engines run on standard hardware so the key characteristic is the software's functionality (Nikolova, 2012), CBT can be defined as a simple electronic assessment. Bridge (2015) further argues that due to the structured nature of CBT, it may not be suitable for people with more complex learning difficulties. It was further posited that CBT increases emotions and anxieties, as well as feelings of fear of failure owing to lack of intelligent feedback mechanism during the process of assessment. Doctoral students are also expected to fill in these gaps of aiding assessment to provide specific details to enable them to deliver feedback, therefore supporting the lecturers and learners (Walker, 2018; Deutscher, Akademischer, Autausch Dienst [DAAD], 2021; Lunds University, 2022). Addressing this issue is crucial for enhancing the effectiveness of computer-based testing and promoting a more adaptive and student-centered assessment approach. Hence, there is need to create an intelligent computer assessment that provides feedback and tailor learning to the ability of the learner. City and Guilds (2015) therefore identified a move

from what is characterized as assessment of learning, through the currently popular idea of assessment for learning, to assessment as learning, where assessment procedures and practices may come completely to dominate the learning experience. This could be achieved through the instrument of computer adaptive test.

However, the computer adaptive test mode of assessment can be operationally defined in this study as the administration of test instruments by the computer in such a way that the choice or order of test items presented to the test taker is independent of the teacher and that feedback is utilized in the process of assessment to accurately measure learner ability and aid learning, depending on the interaction between the test taker and the computer. Adaptive testing is: items are selected according to the ability of each examinee. Testing starts with less difficult item. If an examinee answers an item correctly, the next item that is administered to the examinee will be more difficult, if not, easier item is administered. Testing will continue until meet the stopping criterion, and then the testing will stop (Kanjanawasee, 2012). Hence the computer Adaptive tests can be designed to stop when certain psychometric criteria are reached, such as a specific level of score precision, the maximum test length is reached or when the CAT test stops when the item bank is exhausted. It is argued by Fetzer et al (2019) that the test process continues until either the computer has enough information to produce a reliable test score or the test taker has reached the maximum number of items to be administered. The study have both theoretical significance and practical significance. Theoretically, the findings of this study were anchored on the Feedback theory by Butler and Winne (1995) and the General Artificial Intelligence theory developed by McCarthy (1974). The feedback theory demonstrates that assessment becomes effective as applicable in computer Adaptive tests, feedback is central for improved learning in areas of student retention among university students especially in areas of educational research. In addition, the Artificial Intelligence theory through the computer adaptive test expresses that computers can assess students by adapting the assessment process to be tailored to each student's ability. Ramadam and Aleksandrovna (2018) further argue that Computerized adaptive testing can be said to be of great importance in the instructional process, especially in student-centered learning. This type of tests saves time and effort, also takes into account the individual differences of students, increase the motivation they have, completely reverse the traditional tests, which only encourage memorization and indoctrination.

It appears that little or no literature have presently been able to specifically discuss the effect of computer adaptive test mode of the assessment on students' retention on Educational research at the University of Nigeria, Nsukka. However, the study explores if computer adaptive test mode of assessment could influence student knowledge retention during their academic pursuit. This informs the gap that the present research intends to fill. Thus, the present investigation intends to see how CAT can effectively be used to administer tests to measure students' ability as specific to their knowledge retention.

Research Question

i. What are the mean retention scores of students assessed using CAT in educational research and those assessed using CBT?

Hypothesis

Ho1: There is no significant difference in mean retention scores of students assessed using Computer Adaptive tests educational research and those assessed using Computer Based test.

Methodology

Research Design

The study adopted a post-test-only non-equivalent groups quasi-experimental research design. In this post-test-only design there were two groups, Computer Adaptive test (CAT) group was the experimental group and Computer Based Test (CBT) group was the control group. This procedure was employed to measure the effect of computer adaptive test mode of assessment on the student's achievement and retention in educational research. According to Thomas (2022), it is useful when the study does not rely on random assignment to select subjects into treatment conditions.

Participants for the study

The population of the study is 698 300-level students from the Faculty of Education. The Faculty of Education has 7 Departments including Adult Education and extra-mural studies, Arts Education, Educational foundations, Human Kinetics, Library and Information Science, Science Education, and Social Science Education where 28 academic programs were implemented. The researcher adopted the convenience sampling technique to select 44 volunteers as subjects for the study.

Measure

The researcher made use of the Educational Research Retention Test (ERRT) to collect data. The instrument was validated by three experts from the Department of Science Education. The ERRT is a 50-item multiple choice objective test with options lettered A – D. The items will be scored in such a way that each correct answer attracts two (2) marks giving a minimum score of 0 mark and maximum score of 100 marks. The instrument was trial tested on 50 respondents and an estimate of .76 was obtained using Kuder-Richardson (KR-20) statistics which showed a high degree of reliability.

Experimental Procedure

The experiment was carried out in the Faculty of Education Lecture Hall. Prior to the commencement of the experiment, the researcher prepared the computer facilities and administered the ER-CAT to experimental group 1 and ER-CBT to the experimental group 2. After three weeks of the experiment, the students were gathered, and ERT-CAT and ERT-CBT were administered to the two groups respectively. However, in these tests, the questions of the CBT were re-arranged/reshuffled to avoid familiarity with the items of the instrument by the students. The results obtained after the experiment were collected from the CAT and CBT system. Participants' retention test scores were compared between the computer modes of assessment.

Ethical approval

Approval for the conduct of this research was obtained from the research ethical committee of the researchers' university. Besides, the participants were issued informed consent to fill and sign before the commencement of the treatment.

Analysis

The Statistical Package for Social Sciences (SPSS) version 25 was used for the statistical analysis of data collected for this study. Specifically, the data were analyzed using 2-way analysis of variance (2-way ANOVA) to provide the main effect alongside the effect size of the treatment.

Results

Research Question: What are the mean retention scores of students assessed using CAT in educational research and those assessed using CBT?

Table 1: Mean and standard deviation of retention test of the experimental CAT and the control group (CBT) on Educational research.

Retention test	N	Mean	Std. Deviation
CAT	22	71.45	7.23
CBT	22	31.82	14.52

Table 1. shows that the students assessed using Computer Adaptive test had posttest mean retention score of ($M = 71.45$, $SD = 7.22$) while the students assessed using the Computer-based test had posttest mean retention score of ($M = 31.82$, $SD = 14.52$). This implies that the students assessed using Computer Adaptive test had higher retention in Educational research with a mean score difference of 39.64. However, the standard deviations of 7.22 and 14.52 for the CAT and CBT groups respectively indicate that the individual scores of the experimental group participants are less spread across their group mean when compared to those of the control group.

Ho: There is no significant difference in mean retention scores of students assessed using Computer Adaptive tests educational research and those assessed using Computer Based test.

Table 2: Analysis of variance (ANOVA) of the effect of Computer Adaptive test on students' retention in educational research

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	17791.925[a]	3	5930.642	47.291	.000	.780
Intercept	107488.673	1	107488.673	857.123	.000	.955
Treatment	16930.522	1	16930.522	135.005	.000	.771
Error	5016.257	40	125.406			
Total	140126.000	44				
Corrected Total	22808.182	43				

a. R Squared = .780 (Adjusted R Squared = .764)

The result in Table 2 shows that there is a significant difference in mean retention scores of students assessed using Computer Adaptive Test in educational research and those assessed using Computer Based Test in favour of those assessed using CAT, $F (1,40) = 135.005$, $p = .000$. Thus, the null hypothesis is rejected ($p > .000$).

Discussion of the Findings

The study found that there was a significant difference in the mean retention scores of students assessed using CAT mode of assessment in educational research when compared to those assessed using CBT. The actual difference between groups may be attributed the nature of feedback experienced during the artificial intelligence mode of assessment. The CBT treatment as administered lacks feedback and thus was unable to reinforce learning and engineer an assessment practice for improved learner capacity. Prior studies by Lesinski et al. (2016) finds that the use of Artificial intelligence for learning and assessment such as CAT

helps improve graduation rates and increase student retention. In a similar study by Hattie (2019) feedback as used in assessment for learning is generally recognized as a valuable tool to promote student learning and engagement; Providing timely, specific, and actionable feedback during assessment helps students understand their strengths, identify areas for improvement, and make necessary adjustments to their learning strategies. This, in turn, can enhance learning retention by reinforcing and consolidating knowledge and skills (Hattie, 2019). Nicol and Macfarlane-Dick (2016) argue that feedback should focus on self-regulated learning providing information and guidance to students, which promotes deep learning, metacognitive awareness towards greater retention of knowledge and skills. AI driven assessments and CAT has been found to reduced Test Anxiety, so Adaptive testing can mitigate test anxiety by presenting students with questions that are appropriately challenging, reducing stress and promoting a positive learning experience and their ability to recall lessons (Zhang & Miller, 2011). Further studies showed, it enables continuous learning progress, adaptive testing systems track students' progress over time, allowing educators to monitor their development and provide timely support. This ongoing assessment can contribute to improved retention by addressing learning gaps as they arise (Bangert-Drowns, 2021). Adaptive testing was found to optimize the use of instructional resources by focusing on areas where students require additional support.

This targeted approach can result in more effective learning experiences and improved retention (Wainer, Bradlow & Wang, 2019). Adaptive testing also provides immediate feedback to students, allowing them to identify areas where they need improvement. This feedback loop can help students address weaknesses promptly and stay on track with their learning (Biggs & Tang, 2021). Finally, to improve students' retention capacity it helps promote personalized learning experience, Adaptive testing tailors the assessment to individual student abilities, ensuring that students receive questions that match their skill levels. This personalized approach can enhance student engagement and motivation, leading to improved retention (An & Carr, 2017).

The study discloses the significant impact of Artificial Intelligence (AI) mode of assessment on student retention, attributed to tailored feedback. This aligns with prior research emphasizing AI's positive influence on graduation rates and retention. The absence of adaptive feedback in Computer-Based Tests (CBT) may compromise learning reinforcement. Strategic assessment practices, particularly those involving AI, contribute to deep learning, reduced test anxiety, optimized resource allocation, and personalized learning experiences, collectively enhancing student retention in educational research.

Conclusion

The study underscores the profound impact of Artificial Intelligence (AI) mode of assessment on student retention, revealing a significant difference in mean retention scores compared to the traditional Computer-Based Test (CBT). The key differentiator lies in the nature of feedback provided during AI assessments, which is tailored, timely, and promotes a personalized learning experience. The absence of adaptive feedback in CBT may hinder learning reinforcement, making a compelling case for the strategic integration of AI-driven assessments in educational research.

Implications of Findings

Since, the findings also found a significant mean difference between Artificial intelligence mode of assessment and computer-based test on students' retention. This implied that the CAT mode of assessment could influence higher retention among students in the

learning of educational research; it also raises the concern on the need to invest all available resources on artificial intelligence testing practices in tertiary institutions.

The study highlights the need for educational institutions to embrace technology-enhanced learning practices, particularly those leveraging AI. Such practices can lead to more effective learning experiences and improved student retention. The findings also suggest that the CAT assessment has implications for promoting personalized learning experiences. Institutions should explore ways to tailor educational content and assessments to individual student abilities, fostering engagement and motivation.

Recommendations

i. Educational institutions are encouraged to consider integrating AI-driven assessments to enhance learning experiences. The tailored and timely feedback provided by AI can contribute significantly to student retention.

ii. As AI becomes more prevalent in education, it is crucial to provide teachers with the necessary training and support to effectively integrate AI-driven assessments into their teaching practices. This ensures optimal utilization of the technology for improved student outcomes.

iii. Further research is recommended to continually evaluate the effectiveness of AI-driven assessments in different educational settings and contexts. This ongoing examination can provide insights into the evolving role of technology in education and its impact on student retention.

In conclusion, the study's findings advocate for a transformative shift in assessment practices by embracing AI, emphasizing the potential for enhanced learning outcomes and improved student retention.

Conflict of interest

No conflict of interest was declared by the authors

Data availability statement

Data for this research are in the custody of the corresponding author and can be made available on request.

References

Al-Tameemi, R.A., Johnson, C., Gitay, R., Abdel-Salam, A.G, Al-Hazaa, K., BenSaid, A & Romanowski,M. H. (2023) Determinants of poor academic performance among undergraduate students—A systematic literature review. *International Journal of Educational Research Open,4* (1) from https://doi.org/10.1016/j.ijedro.2023.100232.

American Education Research Association (2019). What is Education Research. AERA. Retrieved on March 16, 2023 from https://www.aera.net/About-AERA/What-is-Education-Research

Andrew, J. B & Rebello, N. S.(2013), Retention and Learning, in Norbert, M.S.(ed), *Encyclopedia of the sciences of learning*. Retrieved from https://link.springer.com/referenceworkentry/ 10.1007%2F978-1-4419-1428-6_664

Bridge, T. (2015) *Pros & Cons of CBT*. http://www.thecbtclinic.com/pros-cons-of-cbt-therapy.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-Regulated learning: A Theoretical Synthesis. *Review of Educational Research, 65*(3), 245–281. https://doi.org/10.3102/00346543065003245

City and Guilds (2015) *The impact of different modes of assessment on achievement and progress in the learning and skills sector.* https://files.eric.ed.gov/fulltext/ED508506.pdf

Custers, E. J. &Cate. O. T. (2017). Very long-term retention of basic science knowledge in doctors after graduation. *Medical Education, 45* (4), 422–430.

Custers, E. J. (2020). Long-term retention of basic science knowledge: a review study.*Advances in Health Science Education15* (1), 109–128.

DAAD (2021).*The German doctorate: DAAD.* Retrieved on 21st November 2022 from https://www.daad.de/imperia/md/content/islamabad/the_german_doctorate_barrierefr ei.pdf

Ferreira, J. J., Maguta, L, Chissaca, A. B., Jussa, I. F. &Abudo S. S. (2016). Cohort study to evaluate the assimilation and retention of knowledge after theoretical test in undergraduate health science. *Porto Biomed Journal 1* (5),181-5.

Fetzer, I., Dainis, I. J., Lambert, I. E. and Meade I. R. (2019*) Computer Adaptive Testing (CAT) in an Employment Context*: retrieved on March 16, 2023 from http://www.previsor.com/pdf/WPCAT.pdf, p

Hattie, J. (2019). *Visible Learning: A synthesis of over 800 meta-analyses relating to achievement.* Routledge.

Jones, H., Black, G. J., Langton, P., Rutherford, S., Scott, J. & Brown, S. (2014): Indications of Knowledge Retention in the Transition to Higher Education, *Journal of Biological Education*, DOI: 10.1080/00219266.2014.926960

Kanjanawasee, S. (2012) *Modern Test Theory* (Ed.4). Bangkok: Chulalongkorn University Press.

Lesinski, G. Corns S. & Dagli, C. (2016).Application of an Artificial Neural Network to Predict Graduation Success at the United States Military Academy.*Procedia Computer Science.*Volume 95 (1), 375-382

Lunds University (2022). *The PhD student as a teacher and administrator. Department of political Science.* Retrieved on March 16, 2023 https://www.svet.lu.se/en/research/doctoral-studies/phd-student-teacher-and-administrator

Makondo L (2012) Mindset change prerequisite for academic excellence: A case of four Zimbabwean and South African Universities. *South African Journal of Higher Education*, 26 (1), 105-119

McCarthy, J. (1998). *What is artificial intelligence.* Retrieved on May 6, 2023 from https://www.semanticscholar.org/paper/what-is-artificial-intelligence-McCarthy/be67fbc3db47fdaa118fd6816b21968fb1cf547e

Mcwilliam, E. L. (2016). The Problem of The Problem with Educational. *Australian Educational Researcher*. https://www.researchgate.net/publication/27471871.

Nicol, D. J., & Macfarlane-Dick, D. (2016). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education, 31(2),* 199-218. doi:10.1080/03075070600572090.

Nikolova, M. (2012) *Characteristics and Forms of the Electronic Assessment of the Knowledge*. https://conf.uni-ruse.bg/bg/docs/cp12/6.2/6.2-15.pdf

Omwirhiren, E. M. (2015). Enhancing academic achievement and retention in senior secondary school chemistry through discussion and lecture methods: a case study of some selected secondary schools in Gboko, Benue State, Nigeria. *Journal of Education and Practice. 6* (21) retrieved on March 16, 2023 fromhttps://files.eric.ed.gov/fulltext/EJ1079117.pdf

Onyenma, C. & Olele, C. N. (2020).Effect of blended learning on students' retention of physics in federal colleges of education in south east, Nigeria. *International Journal of Education, Learning and Development8* (1) 66-76.

Ramadam, M. & Aleksandrovna, E. (2018) *Computerized Adaptive Testing.* Retrieved on March 16, 2023 fromhttps://www.researchgate.net/publication/329935670

Seibert, G.S., Bauer, K.N., May, R.W., Fincham F.D. (2017), Emotion regulation and academic underperformance: The role of school burnout. *Learning and Individual Differences,* 60 pp. 1-9

Wani, R. S. (2021). *Research methodology: educational research*. Retrieved on November 15 2022 from http://ddeku.edu.in/Files/2cfa4584-5afe-43ce-aa4b-ad936cc9d3be/Custom/Educational%20Research.pdf

Zoubi, S. A and Younes N. A. (2015) Low Academic Achievement: Causes and Results. *Theory and Practice in Language Studies* 5(11):2262 DOI:10.17507/tpls.0511.09