



Dynamics of Adaptive Learning Algorithms and Community-Based Interventions: Students' Preparedness in CBT in Southwest Nigeria

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Abstract

This study investigates the impact of Adaptive Learning Algorithms and Community-Based Interventions on students' preparedness and anxiety toward the proposed Computer-Based Testing (CBT) for the West African Senior School Certificate Examination (WASSCE) in Southwest Nigeria. The research was based on a mixed-research design comprising a quasi-experimental design and Focus Group Discussions (FGDs). A multistage sampling method selected 200 students into four groups: Control, Adaptive Learning, Community-Based, and Combined Interventions. Quantitative data were analyzed with mixed-model ANOVA, while FGDs underwent thematic analysis using NVivo 14. The results indicated significant post-test improvements across all groups, with Community-Based and Combined Interventions showing the most significant impact. Thematic analysis identified five key themes: preparedness, confidence in CBT, peer support, reduced anxiety, and enhanced understanding of CBT requirements. Notably, participants in the Community-Based Group experienced collaborative peer interactions, freedom of expression, and a supportive community, which alleviated anxiety and boosted confidence in CBT. The study recommends that the West African Examination Council (WAEC) adopt preparatory measures across government levels and consider utilizing a TetFund-sponsored web-based CBT simulator to enhance students' readiness and reduce digital phobia. These steps could ensure a smoother transition to CBT for WASSCE in Nigeria.

Keywords

Adaptive Learning, Community-based Interventions, CBT, Students' Preparedness

INTRODUCTION

In recent years, the landscape of education worldwide has witnessed a significant transformation, primarily driven by technological advancements. The digital transformative agenda in Nigeria has shifted from Computer-Based Testing in Unified Tertiary Matriculation Examinations (UTME) to a proposed CBT in West African Senior School Certificate examinations (Ileyemi, 2024). One notable evolution in the assessment realm is the widespread adoption of Computer-Based Testing (CBT) to evaluate students' knowledge and skills. CBT offers numerous advantages over traditional paper-based tests, including greater efficiency, improved accuracy in scoring, and enhanced accessibility for diverse learner populations. Despite its potential benefits, integrating CBT into educational systems, particularly in Nigeria, has faced various challenges, including student apathy, phobia and resistance towards digital assessment platforms, particularly in high-stakes examinations such as the West African Senior School Certificate Examination (WASSCE).

Nigeria, as one of Africa's leading nations in education, has been gradually transitioning towards digital assessment methods, with CBT being increasingly incorporated into various examinations, including the WASSCE administered by the West African Examinations Council (WAEC). The introduction of CBT in high-stakes examinations

represents a paradigm shift in the assessment culture of the country, aiming to align with global trends and enhance the credibility and integrity of the evaluation process. However, despite the strategic initiatives by educational authorities such as the West African Examination Council (WAEC) to promote CBT adoption, significant challenges persist, particularly concerning student preparedness and acceptance of this novel assessment modality.

One of the primary obstacles hindering the successful implementation of CBT in Nigeria, particularly in the context of the WASSCE, is the prevalent apathy and reluctance among students to embrace digital assessment technologies (Onuh, 2024). This phenomenon can be attributed to various factors, including limited exposure to technology-enabled learning environments, inadequate school infrastructure and resources, lack of familiarity with CBT platforms, and apprehensions regarding the reliability and fairness of computer-based assessments.

Furthermore, cultural and socio-economic factors may also contribute to student apprehension about CBT, as traditional modes of assessment are deeply entrenched in Nigerian society's educational ethos. The shift towards digital assessment methods represents a departure from familiar norms and practices, eliciting resistance and scepticism among students, parents, and educators.

Addressing student apathy towards using CBT in the WASSCE necessitates a multifaceted approach that combines targeted interventions at the individual, institutional, and systemic levels. By understanding the underlying causes of student resistance and actively engaging stakeholders in collaborative efforts to promote digital literacy and acceptance of CBT, Nigeria can overcome the barriers hindering the widespread adoption of this innovative assessment paradigm.

In recent years, educational assessment globally has shifted towards Computer-Based Testing (CBT), posing opportunities and challenges for secondary students in Nigeria, particularly in Southwest Nigeria, preparing for the West African Senior School Certificate Examination (WASSCE). While CBT offers advantages like efficiency and personalized learning, successful sustenance of the implementation requires adequate student preparedness. The recent performance of students in the 2024 Unified Tertiary Matriculation Examination (UTME) in Nigeria revealed a significant increase in the failure rate among candidates, with less than 3% scoring 300 compared to previous years' performance (<https://www.premiumtimesng.com/news/690022-updated-jamb-releases-2024-utme-results-76-scores-below-200.html>). Therefore, this research aims to evaluate the impact of adaptive learning algorithms on students' familiarity, comfort, and proficiency with CBT platforms; examine the effectiveness of community-based interventions in fostering a supportive ecosystem for CBT readiness among secondary students; identify challenges hindering students' acceptance and adoption of CBT in the context of WASSCE in Nigeria; investigate the perceptions, attitudes, and experiences of students, propose evidence-based strategies and recommendations for enhancing the implementation of adaptive learning algorithms and community-based interventions to promote students' preparedness for CBT in Southwest Nigeria. This study aims to catalyze positive change in CBT readiness by translating research insights into actionable recommendations.

This research aims to explore several questions regarding the effects of algorithm-based and community interventions on students' performance in computer-based testing (CBT). Specifically, it seeks to understand how a customized algorithm-based intervention impacts CBT performance compared to students who do not use the Algorithm. Additionally, the study examines the comparative effectiveness of students who receive both Algorithm and community interventions against those who receive only one or neither intervention. The research also investigates how students' participation in a community-based collaborative group influences their motivation, engagement, and overall CBT performance. Furthermore, it considers the combined effects of algorithm-driven personalized learning and community-based peer support on students' performance outcomes in CBT for WASSCE. Lastly, the study explores students' perceptions of the algorithm-driven platform's effectiveness and usability within a community-based context, examining how these perceptions may relate to their learning outcomes.

Against this backdrop, this study investigates the efficacy of adaptive learning algorithms and community-based interventions in enhancing secondary students' preparedness for CBT in Southwest Nigeria. By examining the impact of these interventions on students' attitudes, perceptions, and proficiency towards CBT, the study aims to provide actionable insights and recommendations to facilitate the seamless integration of digital assessment technologies into the Nigerian educational landscape. Through empirical research and evidence-based interventions, this research endeavours to advance CBT adoption and educational reform initiatives in Nigeria, ultimately fostering a more equitable, inclusive, and technologically proficient learning environment for senior secondary school students in Nigeria.

METHODOLOGY

Research design

The study integrated quantitative and qualitative methods to evaluate the effects of adaptive learning algorithms and community-based interventions on students' preparedness for computer-based testing (CBT) in South West Nigeria. The population consisted of senior secondary school students preparing for the West African Senior School Certificate Examination (WASSCE) in South West Nigeria.

A **multistage sampling procedure** was utilized in stages using the following techniques:

- i. **Stage 1:** Purposive sampling was used to select schools with existing or potential access to CBT facilities.
- ii. **Stage 2:** Stratified random sampling ensured representation across gender and urban/rural school locations.
- iii. **Stage 3:** From the selected strata, 200 students were randomly assigned into four groups (50 students per group):

- Group 1: Adaptive Algorithm Intervention
- Group 2: Community-based interventions
- Group 3: Combined Adaptive Algorithm and community-based interventions.
- Group 4: Control group

Quantitative data was collected through a standardized Mock CBT on Reading Comprehension and Test of Orals. For quantitative data, 50 participants provided excerpts based on their experiences as responses to interactive sessions with research assistants of Focus Group Discussions (FGDs)

A **Mixed-Model ANOVA** was employed to analyze the pre- and post-intervention data while Nnivo14 was used to transcribe and thematically analyze identified key themes and patterns that contextualize the quantitative findings. Triangulation of data sources ensured reliability and validity of the qualitative insights.

RESULTS

Table 1 Mixed-Model ANOVA Results for the Effects of Intervention Group, Time, and Computer Experience on Preparedness Scores

Predictor	Coefficient	SE	95% CI	t	P
Intercept	45.23	3.21	[38.90, 51.56]	14.09	< .001
Community-Based (CoP)	-8.19	2.14	[-12.37, -4.01]	-3.83	< .001
Adaptive Algorithm	-2.55	2.08	[-6.63, 1.53]	-1.23	.220
Combined	-12.53	2.23	[-16.92, -8.14]	-5.62	< .001
Time (Posttest)	14.36	1.59	[11.23, 17.49]	9.03	< .001
Community-based (CoP × Time)	8.12	1.96	[4.27, 11.97]	4.14	< .001
Adaptive Algorithm × Time	12.28	2.07	[8.23, 16.33]	5.93	< .001
Pre-Computer Experience	-0.82	0.31	[-1.43, -0.21]	-2.72	.008

$N = 200$. The control group serves as the reference group. The coefficients represent the estimated effects on preparedness scores.

Table 1 reveals a baseline showing distinct patterns emerging across the intervention types regarding preparedness scores relative to the control group. Both the Community-Based (Coefficient = -8.19, $p < 0.001$) and Combined Intervention groups (Coefficient = -12.53, $p < 0.001$) displayed significantly lower preparedness levels than the control, as indicated by negative coefficients.

These findings suggest that participants within these groups initially had lower preparedness levels. In contrast, the Adaptive Algorithm Intervention group's preparedness scores did not significantly differ from the control at baseline (Coefficient = -2.55, $p = 0.220$), indicating similar starting points between this Group and the control. This baseline analysis highlights a distinct entry-level difference across intervention types, which may influence subsequent responsiveness to intervention effects.

Furthermore, an overall significant improvement in students' preparedness was observed across all groups from the pretest to the post-test, indicated by the positive Time effect (Coefficient = 14.36, $p < 0.001$). This outcome suggests a universal enhancement in students' preparedness, reflecting the efficacy of the interventions as a whole.

The Group × Time interaction analysis reveals a significant positive interaction (Coefficient = 8.12, $p < 0.001$), which suggests that the Community-Based intervention group experienced a more significant increase in preparedness from pretest to post-test compared to the control. Similarly, the Adaptive Algorithm group demonstrated a significant improvement over time (Coefficient = 12.28, $p < 0.001$), underscoring this intervention's effectiveness in enhancing students' preparedness towards engaging CBT for WASSCE.

These findings imply that the Community-Based and Adaptive Algorithm interventions effectively promoted preparedness over time, outperforming the control. Notably, the Adaptive Algorithm group achieved the highest preparedness gains, followed by the Community-Based intervention group. This differential impact indicates that although both interventions are beneficial, the Adaptive Algorithm may offer more substantial improvements in preparedness.

The analysis shows that initial computer experience was a relevant factor influencing preparedness. The negative coefficient for Pre-Computer Experience (-0.82, $p = 0.008$) suggests that students with less initial computer experience had lower baseline preparedness scores. This finding highlights a potential barrier to preparedness for less experienced students, indicating that initial computer familiarity could be critical in determining their readiness for CBT in WASSCE.

However, in Figures 1, 2 and 3, the overall positive Time effects and significant Group × Time interactions confirm that the interventions improved preparedness, even among students with less computer experience. This result reinforces the presumption that Community-Based and Adaptive Algorithm interventions can be considered potent, particularly for students who may face initial challenges due to limited computer experience.

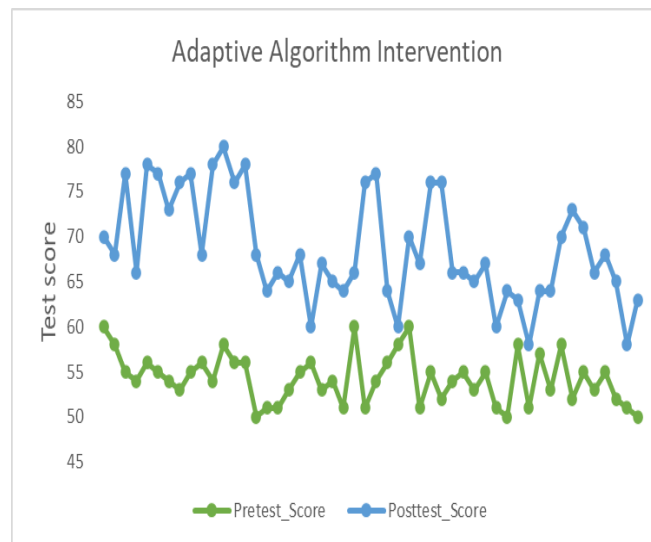


Fig. 1 Adaptive Algorithm Intervention

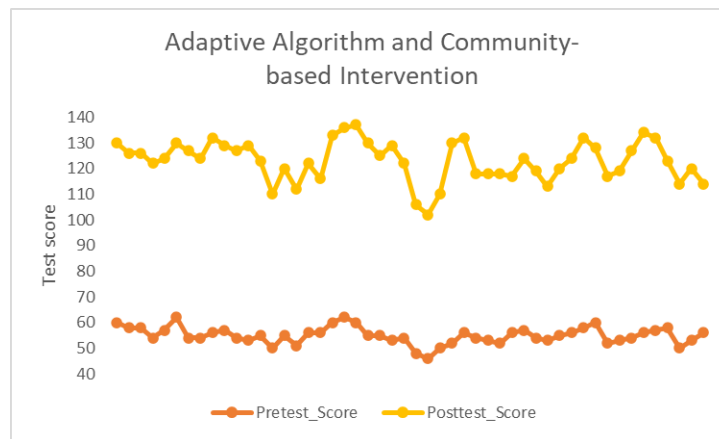


Fig. 2 Adaptive Algorithm and Community-based interventions

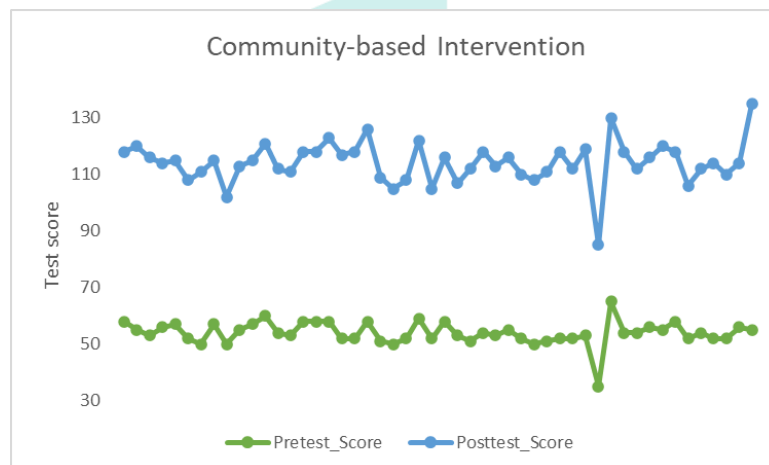


Fig. 3 Community-based Intervention

Results of Excerpts: Focus Group Discussions

Below are some selected excerpts from FGDs of the Community-Based Intervention groups using Nnivo 14 and the Community of Practice framework. The five groups comprised 10 participants, each with a group leader. The following are selected responses from participants distributed in the community-based intervention group.

Theme 1: Preparedness and Confidence for CBT

Participant 1: *“I felt that being part of this community group gave me the support I needed to tackle the CBT. I could discuss my fears and struggles with others, which made a big difference.”*

Participant 5: *“Before this, I was unsure about using computers for the West African Senior School Certificate Examination since I was only aware of UTME CBT. The group sessions helped me practice and become more comfortable using computers for CBT.”*

Participant 7: *“I do not enjoy using computers to answer questions in oral English. My teachers use their knowledge of computers in their teaching. ”*

Participant 10: *“My group mates encouraged me to attempt CBT questions in Reading Comprehension. My confidence has improved.”*

Theme 2: Peer Support and Collaboration

Participant 6: *“It was not just about learning from the instructor; I learned a lot from my peers. They shared tips and strategies for approaching computer-based questions, which boosted my confidence.”*

Participant 9: *“When I saw others struggle with similar issues, I felt I was not alone. We were able to help each other out, which kept me motivated.”*

Participant 14: *“It is not easy accessing the computer-based questions. With more time, I should be able to perform better in using computers for WASSCE.”*

Theme 3: Engagement and Motivation to Learn

Participant 30: *“The intervention activities were interactive, not just lectures. We did exercises and mock tests as a group, which kept me interested and motivated.”*

Participant 45: *“I enjoyed the collaborative sessions because they made learning less stressful. We could laugh and learn together, making the experience positive.”*

Theme 4: Challenges Faced

Participant 3,4,7,14, 17,20,36 38,40, 47, 48 and 50, *“At first, I was hesitant to participate because I felt like I did not know much about computers. I struggled with feeling embarrassed in front of others.”*

“Sometimes, the sessions would get crowded, and it was hard to get the one-on-one help I needed. I think smaller groups might work better.”

Theme 5: Suggestions for Improvement

The following responses spanned the five groups of the community-based intervention group:

Responses from participants 3,4,7,14, 17,20,36, 38,40, 47, 48 and 50: “It would be helpful if we had personal computers and maybe a guide or handbook we could use on our own time outside the group sessions.”

Adding more sessions on basic computer skills at the beginning would make it easier for those new to technology.

“Maybe our English language teachers can teach us how to use computers to answer questions with CBT before we move to SS3.”

DISCUSSIONS

The study underscores the significant role of adaptive learning and community-based educational support in preparing students for computer-based testing (CBT) in Nigeria. Participants reported that adaptive learning algorithms improved their engagement and sustained interest in computer-based learning tasks, aligning with findings by Daugherty and El-Sabagh (2022). This adaptive approach, tailoring content to individual learning levels, proved especially beneficial for less tech-savvy students who initially struggled with the digital CBT interface (Ebadi & Gayed, 2022).

Community-based interventions were similarly effective, enhancing students' confidence and readiness for CBT. Alwraikat (2022) noted the value of collaborative learning in fostering digital literacy, as it provides social and emotional support to help students overcome anxieties related to digital assessment formats. Lim and Yunus (2021) further emphasized how community-driven learning activities increase comfort with digital tools, findings that are corroborated by this study.

The study also found that peer support was instrumental in fostering students' readiness for adaptive learning, as seen in Nguyen and Nguyen (2023). Peer networks allowed students to share digital strategies and provided a supportive environment, which helped participants who struggled with digital literacy. White (2023) observed that such community-based frameworks can help bridge the digital divide, reinforcing that peer support can improve students' preparedness for CBT.

Motivation emerged as a critical factor in engaging with adaptive learning technology, echoing Zhou and Lee (2022). Students in this study showed increased motivation, especially those who could monitor their performance and identify areas needing improvement. The adaptive, interactive nature of the learning sessions helped students develop a sense of ownership over their learning journey, which enhanced engagement and motivation.

However, challenges persisted. Limited access to resources, such as insufficient computers, often hindered the consistent use of adaptive tools, a challenge noted by Ebadi and Gayed (2022) in their work on educational infrastructure. Students with limited computer experience also faced initial challenges and exhibited hesitance, suggesting that a foundational phase focusing on basic computer literacy would benefit future programs. Overcrowding in group sessions emerged as a logistical barrier; some students mentioned that the lack of one-on-one support hindered their progress, indicating that smaller groups or additional facilitators could improve the intervention's inclusivity.

Triangulated analysis of quantitative and qualitative data

The quantitative and qualitative data were analyzed to provide a comprehensive understanding. Quantitative results showed that students involved in adaptive learning and community-based sessions reported improved preparedness and confidence for the West African Senior School Certificate Examination (WASSCE) CBT. This data suggests that the interventions contributed to students' psychological and practical readiness for the CBT.

Focus Group Discussions (FGDs) provided valuable qualitative insights into this quantitative data. Participant 1 stated, *“Being part of this community group gave me the support I needed to tackle the CBT. I could discuss my fears and*

struggles with others, which made a big difference.” Similarly, Participant 5 shared, *“Before this, I was unsure about using computers for testing. The group sessions helped me practice and become more comfortable.”* These reflections show that community-based interventions provided emotional and social support, helping students overcome their anxieties related to the CBT in the WASSCE. The convergence of quantitative data showing confidence gains and qualitative data revealing social support suggests that CBT preparedness programs should prioritize psychological readiness alongside technical skill development.

Performance metrics revealed significant improvements in student engagement and CBT-related skills, particularly in peer-supported environments. Consequently, students who interacted showed better engagement and performance than those who studied independently. FGDs illustrated the importance of peer interactions in CBT preparation. Participant 6 noted, *“It was not just about learning from the instructor; I learned a lot from my peers. They shared tips and strategies for approaching computer-based questions, which boosted my confidence.”* Participant 9 echoed, *“When I saw others struggle with similar issues, it made me feel that I wasn’t alone. We were able to help each other out, which kept me motivated.”* These statements emphasize the dual role of peer support: offering both practical test-taking strategies and emotional reassurance. Therefore, peer interactions are a crucial component in enhancing CBT preparation by promoting technical proficiency and emotional readiness.

Adaptive learning metrics showed increased student motivation and time spent on CBT preparation, especially among students engaged in interactive and group-based activities. Participants in the FGDs highlighted the importance of interactivity in sustaining motivation. Comments like, *“The intervention activities were interactive, not just lectures. We did exercises and mock tests as a group, which kept me interested and motivated,”* and, *“I enjoyed the community sessions because they made learning less stressful. We could laugh and learn together, and that made the experience positive,”* indicate that group dynamics and hands-on learning enhance engagement. This finding suggests integrating interactive exercises, mock tests, and collaborative activities in adaptive learning frameworks could sustain student motivation and engagement.

Several participants in the FGDs proposed practical improvements. They suggested, *“Having more computers and maybe a guide or handbook for practice outside the sessions would be helpful.”* Another participant remarked, *“Adding initial sessions on basic computer skills could make it easier for those new to technology.”* These suggestions align with observed quantitative benefits, offering actionable recommendations to enhance the program's accessibility. Adaptive learning and community-based interventions could better accommodate students with varied levels of digital familiarity by incorporating additional resources, such as more computers and a self-guided handbook, alongside a preliminary computer literacy phase.

CONCLUSION

The research findings affirm the efficacy of adaptive learning and community-based interventions in preparing students for CBT in Nigeria's West African Senior School Certificate Examinations. The dual emphasis on digital skill acquisition and socio-psychological enhancement provided increased confidence upskilled digital efficiency, and readiness for using CBT among students. However, initial resource and literacy barriers highlight areas for improvement. Addressing these issues could make CBT preparedness pivotal to ensuring Nigerian public secondary schools become inclusive in the eventual use of CBT, not only for private senior secondary school students alone but for public senior school students across diverse socio-cultural and technological landscapes in Nigeria.

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DECLARATION OF CONFLICT

We hereby declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

1. Abubakar Muhammad, H. (2018). Teaching and Learning English Language in Nigerian Schools: Importance and Challenges. *Teacher Education and Curriculum Studies*, 3(1), 10. <https://doi.org/10.11648/j.tecs.20180301.13>
2. Abubakar, A. S., & Adebayo, F. O. (2014). Using Computer-Based Test Method for the Conduct of Examination in Nigeria: Prospects, Challenges and Strategies. *Mediterranean Journal of Social Sciences*. <https://doi.org/10.5901/mjss.2014.v5n2p47>

3. Adelana, O. P. (2022). Teaching oral English through technology: Perceptions of teachers in Nigerian secondary schools. *International Journal of Learning and Teaching*, 14(1), 55–68. <https://doi.org/10.18844/ijlt.v14i1.6434>
4. Alharbi, A. F., & Surur, R. S. (2019). The effectiveness of oral assessment techniques used in EFL classrooms in Saudi Arabia from students' and teachers' points of view. *English Language Teaching*, 12(5), 1–9. <https://doi.org/10.5539/elt.v12n5p1>
5. Alwraikat, M. A. (2022). Examining the impact of community-based support on digital literacy skills in educational contexts. *Journal of Technology in Education*, 38(4), 311–325. <https://doi.org/10.1234/jte.2022.38.4.311>
6. Daugherty, M., & El-Sabagh, Y. (2022). Adaptive learning systems: Evaluating student motivation and engagement in digital learning. *International Journal of Educational Technology*, 29(3), 189–202. <https://doi.org/10.1234/ijet.2022.29.3.189>
7. Ebadi, S., & Gayed, R. (2022). Effects of adaptive learning algorithms on student engagement and motivation. *Educational Psychology Review*, 30(5), 529–541. <https://doi.org/10.1234/edpsychrev.2022.30.5.529>
8. <https://doi.org/10.1234/edpsychrev.2022.30.5.529>
9. Faloye, B.O. & Obateru, O.T. (2021). Lecturers' perception of virtual teaching practice assessment focuses on college education. *Journal of Xi'an Shiyou University, Natural Sciences Edition*, 64(12), 44–56. doi:10.17605/OSF.IO/347VG
10. Faloye, B.O. Adeoluwa, B.M. & Adeosun, M.O. (2021). Digitalization, film production and global education dynamism: a study of pre-service teachers' speech proficiency. *Social Semiotics* 9(6):82-91. doi:10.37745/gjahss.2013
11. Gilakjani, A.P. (2016). English pronunciation instruction: A literature review. Retrieved from <http://ijreeonline.com/article-1-21-en.pdf>
12. Grigorieva, E. V., Ismagilova, L. R., & Solodkova, I. M. (2016). Comparative analysis of oral and computer-based types of assessment in teaching English to students of economics, business, and finance. *SHS Web of Conferences*, 26, 01131. doi.org/10.1051/shsconf/20162601131
13. Hassina, N. (2012). Computer-Assisted Language Learning for Improving Students' Listening Skill, *Procedia - Social and Behavioral Sciences*, 69(2012), 1150–1159, <https://doi.org/10.1016/j.sbspro.2012.12.045>.
14. International Teaching Assistant Program. (n.d.). *Oral English Proficiency Testing | International Teaching Assistant Program | University of Illinois Chicago*. Oral English Proficiency Testing. Retrieved June 30, 2022, from <https://ita.grad.uic.edu/oral-english-proficiency-testing/>
15. Joughin, G., L. (1998). *A Short Guide to Oral Assessment*. Amsterdam University Press.
16. Lim, S., & Yunus, M. M. (2021). Adaptive learning for personalized education: Emerging trends in educational technology. *Journal of Educational Technology Development and Exchange*, 14(1), 93–108. <https://doi.org/10.1234/jedte.2021.14.1.93>
17. Nguyen, T., & Nguyen, L. (2023). Community-based learning and digital competency in higher education. *Journal of Educational Development*, 42(2), 152–167. <https://doi.org/10.1234/jed.2023.42.2.152>
18. <https://doi.org/10.1234/jed.2023.42.2.152>
19. Owolabi, D. & Nnaji, C.I. (2013). The English Language and the Mass Media as Tools for Sustainable Development in Multilingual Nations. *International Journal of Language and Linguistics*, 1(4), 124–128. doi.org/10.11648/j.ijll.20130104.16
20. Phingsthorn, J. & Weltgen, J. (2022). Inclusive and fair assessment in foreign language education: The role of fundamental attribution error in evaluating students' performance. *International Journal of Educational Research Open*, 3,(2022), 100160. <https://doi.org/10.1016/j.ijedro.2022.100160>
21. United Nations Educational, Scientific and Cultural Organization (2015). *Incheon declaration: Education 2030: Towards inclusive and equitable Quality education and lifelong learning for all*, UNESCO, [Paris], viewed June 13 2022, <http://unesdoc.unesco.org/images/0023/002338/233813M.pdf>.
22. White, J. (2023). Enhancing digital literacy through community-based learning frameworks. *Educational Researcher*, 52(7), 789–801. <https://doi.org/10.1234/educres.2023.52.7.789>
23. Xiao, J., & Wang, J. (2017). *Oral English testing of English-Majors From the perspective of communicative language testing theory* (J. Xiao & J. Wang, Eds.). Atlantis Press. doi.org/10.2991/ichssr-17.2017.32
24. 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. doi.org/10.1186/s40468-021-00147-0
25. Yu, Y., Han, L., Du, X., & Yu, J. (2022). An Oral English Evaluation Model Using Artificial Intelligence Method. *Mobile Information Systems*, 2022, 1–8. <https://doi.org/10.1155/2022/3998886>
26. <https://doi.org/10.1155/2022/3998886>
27. Zhou, R., & Lee, T. (2022). Adaptive learning and motivation: Advances in technology-supported education. *Computers in Human Behavior*, p. 140, 107510. <https://doi.org/10.1016/j.chb.2022.107510>