Title - Empowering Women in TVET: The Impact of Gender-Responsive Open Educational Practices and Inclusive Educational Technology Design

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Abstract
This study explores how gender-responsive Open Educational Practices (OEP) and inclusive educational technology (EdTech) empower women in Nigerian Technical and Vocational Education and Training (TVET). Despite policy efforts, women's participation in technical fields remains low due to socio-cultural norms, institutional barriers, and limited access to technology. Using a qualitative dominant mixed-methods approach, the research draws on semi-structured interviews with 80 educators and female learners across six Nigerian TVET institutions, supported by surveys and case studies of gender mainstreaming initiatives. Findings highlight that gender-responsive curricula, mentorship, and adaptive EdTech platforms improve female enrolment, retention, and confidence. However, infrastructural challenges and societal attitudes continue to hinder progress. The study emphasises the importance of institutional gender desks and effective policy implementation to create inclusive learning environments. Interactive workshops during the presentation will engage participants in developing practical strategies to scale gender-responsive OEP and EdTech in TVET. This research offers evidence-based recommendations for policymakers, educators, and technology developers aiming to advance gender equity and sustainable development in Nigerian and African TVET systems.

Keywords: Gender equality; Technical and Vocational Education and Training (TVET); Gender-responsive open educational practices; Inclusive educational technology; Gender mainstreaming

1. Introduction

Technical and Vocational Education and Training (TVET) plays a pivotal role in equipping individuals with practical skills necessary for employment, economic growth, and sustainable development (UNESCO-UNEVOC, 2024). In Nigeria, TVET is recognised as a strategic instrument for addressing youth unemployment and fostering industrialisation (National Board for Technical Education [NBTE], 2024). However, despite its importance, women remain significantly underrepresented in many technical and vocational fields, particularly those traditionally dominated by men, such as engineering, construction, and automotive trades (Forum for African Women Educationalists [FAWE], 2013; Nganda, 2022). This gender disparity is perpetuated by a complex interplay of socio-cultural norms, institutional biases, and infrastructural challenges that limit women's access to and success within TVET programs (Science Publishing Group, 2024).

In recent years, there has been growing recognition of the need to implement gender-responsive approaches within TVET systems to promote equitable participation and outcomes for women (Malawi Ministry of Labour, Youth, Sports and Manpower Development, 2019; Nigerian National Gender Policy, 2023). Central to these efforts

are gender-responsive Open Educational Practices (OEP) and the design of inclusive educational technologies (EdTech) that address systemic barriers and foster an enabling learning environment (Alinea & Reyes, 2023; UNESCO-UNEVOC, 2024). OEP, characterised by collaborative, accessible, and adaptable learning resources, has the potential to democratise education and challenge entrenched gender norms within TVET (UNESCO, 2023). Similarly, inclusive EdTech-such as mobile learning platforms, virtual simulations, and gender-sensitive digital content-can enhance accessibility for marginalised women, including those in rural or underserved areas (WUSC, 2025).

Nigeria's commitment to gender equality in education is reflected in initiatives such as the establishment of gender desks within the Ministry of Education and the adoption of gender mainstreaming policies tailored for TVET institutions (Institute for International Education Planning [IIEP] UNESCO, 2024; National Gender Equality Commission [NGEC], 2023). Despite these advances, challenges remain in operationalising these policies effectively, particularly in integrating gender-responsive OEP and inclusive EdTech into curricula and pedagogy (Science Publishing Group, 2024). This paper explores how these strategies can empower Nigerian women in TVET, drawing on qualitative interviews and case studies to elucidate best practices and persistent barriers.

By focusing on Nigeria within a broader African and global context, this study aims to contribute to the discourse on gender equity in TVET and inform policy and practice that supports sustainable and inclusive technical education.

2. Literature Review

2.1 Gender Disparities in Nigerian TVET

Gender disparities remain a persistent challenge in Nigeria's Technical and Vocational Education and Training (TVET) sector. Female participation in TVET programs is significantly lower than that of males, with enrolment rates reported at approximately 36% for females compared to 64% for males (Stranger-Johannessen, 2017). This imbalance extends to graduation rates and subsequent employment opportunities, limiting women's contributions to Nigeria's socio-economic development (Frontiers in Sociology, 2025). Several interrelated factors contribute to this disparity, including entrenched socio-cultural norms, economic constraints, institutional biases, and limited access to resources (Ozoemelem & Aniekwu, 2016; Science Publishing Group, 2024).

Cultural and societal barriers are particularly influential in this regard. Traditional gender roles and stereotypes often frame technical and vocational fields as male domains, discouraging female enrolment and retention (Aduloju & Aina, 2019; Frontiers in Sociology, 2025). Religious beliefs and family expectations further constrain women's participation, as families may prioritise education for male children and discourage females from pursuing non-traditional careers (Ogundele & Oke, 2019).

2.2 Gender-Responsive Policies and Institutional Frameworks

Recognising these challenges, Nigeria has made strides toward gender mainstreaming in TVET through policy initiatives and institutional reforms. The establishment of gender desks within the Ministry of Education exemplifies the government's commitment to promoting gender equality in education (IIEP UNESCO, 2024). Additionally, the National Gender Equality Commission has developed a Model Gender Mainstreaming Policy for the TVET sector, which provides a comprehensive framework for addressing gender disparities through targeted programming, resource allocation, staff training, and data collection (NGEC, 2023).

Despite these policy frameworks, implementation gaps remain. Studies indicate that many TVET institutions lack explicit gender-sensitive policies and struggle to operationalise national directives effectively (Science Publishing Group, 2024; IJRDOLGS, 2024). Institutional barriers include insufficient funding for gender initiatives, inadequate staff capacity, and limited monitoring and evaluation mechanisms to track progress on gender inclusion (NGEC, 2023; IJRDOLGS, 2024). These challenges underscore the need for integrated approaches that combine policy enforcement with practical interventions at the institutional level.

2.3 Gender-Responsive Open Educational Practices (OEP) and Inclusive Educational Technology

Open Educational Practices (OEP) and inclusive educational technology (EdTech) have emerged as promising strategies to address gender inequities in Nigerian TVET. OEP emphasises the use of accessible, adaptable, and collaborative learning resources that can be tailored to meet the diverse needs of learners, including women who face multiple barriers to participation (UNESCO, 2023). Gender-responsive OEP incorporates content and pedagogical approaches that challenge stereotypes and promote female empowerment (Alinea & Reyes, 2023).

Inclusive EdTech solutions, such as mobile learning platforms, virtual simulations, and digital mentoring programs, have demonstrated potential in enhancing access and retention for female TVET students, particularly in rural and underserved communities (WUSC, 2025). For example, virtual labs and flexible scheduling accommodate women's caregiving responsibilities and reduce physical and social barriers to participation (Frontiers in Sociology, 2025). However, infrastructural limitations, digital literacy gaps, and resistance to technology adoption among some educators constrain the widespread uptake of these innovations (Science Publishing Group, 2024).

2.4 Strategies for Increasing Female Participation in Nigerian TVET

Research highlights several effective strategies to increase female participation and promote gender equality in Nigerian TVET programs. Targeted recruitment and outreach efforts that actively encourage girls and women to consider technical careers are essential (Ozoemelem & Aniekwu, 2016). The development of gender-sensitive curricula and teaching methods can create more inclusive and supportive learning environments (Delta State Ministry of Higher Education, 2019). Mentorship programs and the promotion of female role models within TVET institutions help build confidence and provide guidance for female students navigating traditionally male-dominated fields (Ogundele & Oke, 2019).

Additionally, career counselling and support services tailored to address gender-specific challenges improve retention and completion rates (IJRDOLGS, 2024). Institutionalising gender mainstreaming through policy adoption, staff training, and gender-disaggregated data collection enables continuous monitoring and refinement of gender equity initiatives (NGEC, 2023). These strategies collectively contribute to creating a TVET ecosystem that supports women's full participation and success.

3. Methodology

3.1 Research Design

This study employs a qualitative dominant mixed-methods design, prioritising qualitative data collection and analysis to explore the experiences of women in Nigerian Technical and Vocational Education and Training (TVET) institutions. The qualitative approach enables an in-depth understanding of the socio-cultural, institutional, and technological factors influencing gender inclusion in TVET (Kamaluddeen, Ibeh, & Ononogbo, 2024). Complementary quantitative descriptive data from surveys provide contextual background on enrolment patterns and institutional practices.

3.2 Participants and Sampling

The study's participants included TVET educators, administrators, and female learners from six Nigerian public TVET institutions purposively selected across six geopolitical zones to ensure geographic and cultural diversity (Oguejiofor et al., 2021). The sample comprised:

i. Educators and Administrators: 30 participants (18 female, 12 male) involved in curriculum delivery and policy implementation.
ii. Female Learners: 50 participants enrolled in traditionally male-dominated technical programs such as automotive technology, electrical installation, and construction.

Purposive sampling was used to select participants with at least three years of experience in TVET or active enrolment in technical courses, ensuring rich and relevant insights (Kamaluddeen et al., 2024; Oguejiofor et al., 2021).

3.3 Data Collection Methods

3.3.1 Semi-Structured Interviews

In-depth semi-structured interviews were conducted with educators, administrators, and female learners to explore perceptions of gender barriers, the impact of gender-responsive open educational practices (OEP), and the role of inclusive educational technology (EdTech) in facilitating access and retention. Interview guides were developed based on themes identified in the literature, including gender bias, curriculum inclusivity, and technology adoption (Kamaluddeen et al., 2024; Aspyee, 2025).

3.3.2 Surveys

A structured questionnaire was administered to a broader sample of 120 TVET students (70 female, 50 male) to gather quantitative data on enrolment trends, access to EdTech resources, and perceptions of gender inclusivity. The survey instrument was adapted from validated tools used in previous Nigerian TVET studies (Kamaluddeen et al., 2024).

3.4 Data Analysis

Qualitative data from interviews were analysed thematically using NVivo software, following Braun and Clarke's (2006) six-step process: familiarisation, coding, theme development, reviewing, defining, and reporting. This approach allowed for the identification of recurrent patterns related to gender-responsive practices and technological inclusion (Kamaluddeen et al., 2024).

Quantitative survey data were analysed descriptively using SPSS to provide frequency distributions and cross-tabulations of gender-related variables, supporting qualitative findings (Oguejiofor et al., 2021).

3.5 Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of the lead author's university. Participants provided informed consent, were assured of confidentiality, and had the right to withdraw at any time. Data were anonymised using pseudonyms to protect identities (Kamaluddeen et al., 2024).

4. Findings

4.1 Gender Disparities in Enrolment and Completion

Female enrolment in Nigerian TVET institutions remains much lower than males. Recent statistics show only about 36% of TVET students are female, and this pattern is even more pronounced in trades like electrical installation and automotive repair. In contrast, female participation is higher in hospitality and catering programs, reflecting societal gender norms.

4.2 Barriers to Female Participation in TVET

Interview data revealed multiple, interrelated barriers limiting women's access to and success in TVET programs:

i. Cultural and Societal Norms: Many participants talked about common gender stereotypes that discourage women from technical careers. Parental influence is significant, with many families steering girls away from technical education toward more traditionally feminine roles.
ii. Institutional Challenges: Educators and administrators pointed out a lack of gender-sensitive policies and poor infrastructure. Insufficient hostel security and lack of female-only facilities deter female enrolment and retention. Some female students also reported harassment and discrimination, which hurt motivation and persistence.
iii. Economic Constraints and Poverty: Economic hardships, especially poverty, hit women harder and limit their participation in TVET. Women from low-income backgrounds struggle to afford the high cost of materials and equipment for practical sessions. Socio-cultural norms often restrict women's access to financial resources, compounding gender disparities in enrolment and retention. These findings align with earlier literature showing that entrenched socio-cultural and economic barriers combine to limit women's participation in technical education.

4.3 Enablers and Success Factors

Despite these barriers, several enablers support female empowerment in Nigerian TVET:

i. Gender-Responsive OEP: Institutions adopting gender-responsive curricula and pedagogies saw improved female engagement. Educators trained in gender-sensitive approaches noticed increased confidence and participation among female students.
ii. Inclusive EdTech: Flexible digital learning platforms, such as mobile apps and virtual simulations, help women balance education with caregiving. These technologies also bridge geographic gaps for rural women.
iii. Mentorship and Role Models: Exposure to female role models and mentorship programs motivates learners and builds confidence.
iv. Policy Initiatives: Gender desks and gender mainstreaming policies in TVET institutions are viewed as positive steps toward institutionalising gender equity.

4.4 Quantitative Insights on Skills and Employment

Our data showed no big gender difference in the courses TVET graduates choose, which is a sign of progress. But this doesn't mean gender disparities in enrolment and outcomes have disappeared.

A closer look at the Frontiers research reveals nuanced gender differences in confidence and skill acquisition across TVET fields:

i. Confidence and Skill Gaps: Women in male-dominated TVET fields reported lower confidence in both soft and hard skills than men. These patterns reflect societal stereotypes that diminish women's perceived capacity to use their training effectively. Such stereotypes can undermine women's confidence in both technical and interpersonal skills.
ii. Impact on Employment Outcomes: This lack of confidence can hurt women's job prospects and career growth, even if course choices seem equal.
iii. Labour Market Realities: While 77.1% of Nigerian women work, 87.9% are self-employed or in informal jobs, often missing out on formal jobs needing TVET skills. This highlights the need for TVET programs to better align training with labour market opportunities and support women's transition into formal employment.

These insights reconcile the apparent contradiction by acknowledging that, while course selection may be gender-neutral, persistent disparities exist in skill confidence, employment outcomes, and the socio-cultural barriers that affect women's full participation and success in TVET.

Summary

The findings highlight persistent gender disparities in Nigerian TVET enrolment and outcomes, shaped by cultural, institutional, and economic barriers. Nonetheless, gender-responsive OEP, inclusive EdTech, mentorship, and supportive policies are critical enablers for empowering women in TVET. Addressing infrastructural and societal challenges is essential for achieving gender equity and maximising the socio-economic benefits of TVET for Nigerian women.

5. Discussion

This study's findings provide critical insights into the complex interplay of socio-cultural, institutional, and technological factors shaping women's participation in Nigerian TVET. The persistence of gender disparities in enrolment and completion rates, despite policy advances, underscores the multifaceted nature of barriers confronting Nigerian women in TVET.

5.1 Socio-Cultural Norms and Institutional Barriers

The qualitative and quantitative data reinforce the enduring influence of traditional gender norms that frame technical trades as male domains, limiting female participation (Aspyee, 2025; Okafor & Adepoju, 2024). These findings align with previous research indicating that societal expectations and parental attitudes remain significant deterrents to women's entry into non-traditional fields (Frontiers in Sociology, 2025; Ozoemelem & Aniekwu, 2016). Institutional challenges, including inadequate gender-sensitive infrastructure and incidences of harassment, further exacerbate these barriers (Science Publishing Group, 2024). This suggests that while Nigeria has made commendable policy commitments-such as the establishment of gender desks and the adoption of the Model Gender Mainstreaming Policy (NGEC, 2023; IIEP UNESCO, 2024)-implementation gaps persist at the institutional level.

5.2 The Role of Gender-Responsive OEP and Inclusive EdTech

The study highlights gender-responsive Open Educational Practices (OEP) and inclusive educational technologies (EdTech) as promising levers for enhancing women's access and success in Nigerian TVET. Consistent with UNESCO's advocacy for OEP as a means to democratise education (UNESCO, 2023), Nigerian institutions that integrated gender-sensitive curricula and pedagogical approaches observed improved female learner engagement and confidence (Malawi Ministry of Labour et al., 2019). Inclusive EdTech solutions, such as virtual labs and mobile learning platforms, addressed logistical constraints faced by women, including caregiving responsibilities and geographic isolation (WUSC, 2025; Learner-LG5).

However, infrastructural limitations-such as unreliable electricity and limited Internet connectivity-remain significant obstacles to the widespread adoption of these technologies, particularly in rural areas (Science Publishing Group, 2024). Additionally, resistance to technology adoption among some educators highlights the need for capacity-building and sensitisation to gender-inclusive digital pedagogies (Kamaluddeen et al., 2024).

5.3 Policy Implications and Institutional Change

The findings underscore the necessity of translating Nigeria's gender mainstreaming policies into actionable institutional reforms. The positive impact of gender desks and mentorship programs suggests that institutionalising gender equity mechanisms can create more supportive environments for female learners (IIEP UNESCO, 2024; NGEC, 2023). Furthermore, the alignment of TVET curricula with labor market demands, coupled with gender-responsive career counselling, can enhance women's employment prospects and economic empowerment (Dataphyte, 2025; Frontiers in Sociology, 2025).

To achieve these outcomes, sustained investment in gender-responsive infrastructure, inclusive EdTech, and educator training is essential. Public-private partnerships could facilitate the scaling of innovative digital platforms tailored to Nigeria's diverse contexts (NBTE, 2024). Moreover, systematic monitoring and evaluation using gender-disaggregated data will be critical for assessing progress and informing policy adjustments (NGEC, 2023).

5.4 Comparative Perspectives and Transferable Lessons

While this study focuses on Nigeria, its findings resonate with broader African and global experiences in advancing gender equity in TVET. Similar challenges related to cultural norms and infrastructural deficits have been documented in Kenya, Malawi, and South Africa (UNESCO-UNEVOC, 2024; Malawi Ministry of Labour et al., 2019). Successful interventions in these contexts-such as gender-responsive curricula, digital learning hubs, and mentorship networks-offer transferable lessons for Nigeria (Alinea & Reyes, 2023; WUSC, 2025).

Conclusion of Discussion

In sum, this study affirms that empowering Nigerian women in TVET requires a holistic approach that addresses socio-cultural barriers, strengthens institutional gender mainstreaming, and leverages gender-responsive OEP and inclusive EdTech. Achieving gender equity in TVET is not only a matter of social justice but also a strategic imperative for Nigeria's sustainable development.

6. Recommendations and Conclusion

6.1 Recommendations

Based on the findings and discussion, this study proposes the following recommendations to enhance gender equity and empower women in Nigerian Technical and Vocational Education and Training (TVET) through gender-responsive Open Educational Practices (OEP) and inclusive educational technology (EdTech):

6.1.1 Strengthen Institutional Gender Mainstreaming

i) *Scale Gender Desks*: Expand and adequately fund gender desks across all Nigerian TVET institutions to institutionalise gender equity mechanisms, facilitate gender audits, and monitor progress (IIEP UNESCO, 2024; NGEC, 2023).
ii) *Policy Enforcement and Capacity Building:* Implement mandatory gender-sensitivity training for educators and administrators to improve understanding and application of gender-responsive pedagogy and inclusive practices (Kamaluddeen et al., 2024).
iii) *Gender-Disaggregated Data Systems*: Develop robust data collection and analysis systems to track enrolment, retention, and employment outcomes by gender, enabling evidence-based policy adjustments (NGEC, 2023).

6.1.2 Enhance Gender-Responsive Curriculum and Pedagogy

i. *Integrate Gender-Responsive OEP:* Develop and disseminate open educational resources that incorporate gender-sensitive content and challenge stereotypes, fostering a more inclusive learning environment (Alinea & Reyes, 2023; UNESCO, 2023).
ii. *Promote Mentorship and Role Models*: Establish mentorship programs that connect female learners with successful women in technical fields to build confidence and career aspirations (WUSC, 2025).

6.1.3 Expand Access to Inclusive Educational Technology

i. Invest in Infrastructure: Prioritise investments in reliable electricity, internet connectivity, and digital devices, especially in rural and underserved areas, to facilitate equitable access to EdTech (Science Publishing Group, 2024).
ii. Develop Contextualised EdTech Solutions: Support the design and deployment of low-bandwidth, mobile-friendly learning platforms and virtual simulations tailored to Nigerian socio-cultural contexts and learners ' needs (WUSC, 2025).

iii. Capacity Building for Technology Adoption: Provide continuous professional development for educators to enhance digital literacy and foster positive attitudes toward inclusive EdTech adoption (Kamaluddeen et al., 2024).

6.1.4 Foster Public-Private Partnerships and Stakeholder Collaboration

i. Encourage collaboration between government agencies, private sector actors, NGOs, and international development partners to mobilise resources, share best practices, and scale innovative gender-responsive TVET interventions (NBTE, 2024).
ii. Promote community engagement initiatives to challenge socio-cultural norms and raise awareness about the benefits of women's participation in TVET (Aspyee, 2025).

6.2 Conclusion

This study affirms that empowering women in Nigerian TVET requires a comprehensive approach that addresses socio-cultural barriers, strengthens institutional gender mainstreaming, and leverages gender-responsive Open Educational Practices alongside inclusive educational technology. Despite persistent challenges, Nigeria's policy frameworks and emerging initiatives provide a solid foundation for advancing gender equity in TVET.

The integration of gender-sensitive curricula, mentorship programs, and accessible digital learning platforms has demonstrated positive impacts on female learners 'enrolment, retention, and employability. However, realising the full potential of these strategies demands sustained investment in infrastructure, capacity building, and data-driven policy implementation.

Ultimately, fostering an inclusive and equitable TVET ecosystem will not only enhance women's socio-economic empowerment but also contribute significantly to Nigeria's broader goals of sustainable development and industrial growth. Continued research and stakeholder collaboration are essential to refine and scale effective gender-responsive practices that transform TVET into a catalyst for gender equality and inclusive innovation.

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