Impact of Sustainable TVET Practices on Employment Outcomes among Graduates in Automobile Technology Sectors in Delta State

[1]Ujevbe Oke Benjamin, Ph.D, [2]Nwahunanya Innocent Ph.D, [3]Samson Oluwatimilehin Ariyo Ph. D & [4]Mustapha Aliyu

[1]DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
UNIVERSITY OF DELTA, AGBOR, DELTA STATE, NIGERIA

[2]DEPARTMENT OF INDUSTRIAL TECHNOLOGY EDUCATION
MICHAEL OKPARA UNIVERSITY OF AGRICULTURE UMUDIKE, UMUAHIA, ABIA STATE, NIGERIA

[3]DEPARTMENT OF INDUSTRIAL TECHNICAL EDUCATION
UNIVERSITY OF NIGERIA, NSUKKA, ENUGU STATE, NIGERIA

[4]DEPARTMENT OF INDUSTRIAL AND TECHNICAL EDUCATION
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA
Correspondence: benjamin.ujevbe@unidel.edu.ng

Abstract
*The study assessed the impact of sustainable TVET practices on employment outcomes among ATGs in the automobile technology sector in Delta State. Three research questions were answered and hypotheses formulated were tested at 0.05 level of significance. The study adopted a descriptive survey design, involving a population of 152 respondents. The entire population was studied due to its manageable size. A questionnaire with 64-items titled Sustainable TEVT Practices Questionnaire (STVETPQ),"was used to collect data. The instrument was face validated by three experts in automobile technology education and an overall reliability coefficient of .87 was obtained, using Cronbach alpha reliability method. Data were analyzed using Mean to a*nswer research questions while t-test was used to test the null hypotheses at .05 level of significance.
Keywords: Sustainable TVET Practices, Automobile Technology Sector, Automobile Technology Graduates, Global Economic Challenges, Employment Outcomes

Introduction

The automobile technology sector is a critical component of the global economy, representing a major source of employment and innovation. Ujevbe et al., (2020) highlighted a related concern, stating that automobile technology sectors are key in national development, providing skilled relevant workforce required for sustainable industrial development. Observations over the years show that the automotive industry significantly boosts employment in countries and equally contributes tangibly to their GDP (Pisková et al., 2024;Umair, 2024; Muro et al., 2019; Yin et al., 2018). As the automotive industry navigates a landscape of evolving challenges in software development, data analytics, and artificial intelligence, including the global economic challenges and fluxes, technological advancements and environmental concerns, there is a snowballing need for a skilled and adaptable workforce capable of addressing these challenges (Jimmy, 2024; Ahmadian et al., 2023). Sustainable technical and vocational education and training (TVET) practices has become more visible, tangible and recognized than ever before, as vital tools to equip individuals with the knowledge, skills and attitudes needed to cope and thrive in such a dynamic and challenging tech-environment (Adams &Baddianaah, 2023; Haßler et al.,

2020). The validity of this statement is strong,as we witness the rise of skilled young men and women who through TVET system today, own and successfully run their own businesses. As such, more graduates of TVET programmes need to equally position themselvesproperly to enhance their employability amidst theglobal challenges and fluxes. This study examines the role of sustainable TVET practices in improving employment prospects for graduates in the automobile technology sector, particularly in the face of global economic challenges.

The concept of sustainability is critical and serves as a crux to the future of humanity. In recent years, the issue of sustainability became a key focus in education and industry owing to its potential to engender social equity, economic resilience and environmental stewardship among others (Bohvalovs et al., 2023; United National Educational, Scientific and Cultural Organization (UNESCO), 2022; Kiplagat & Mutebi, 2022). Particularly, the sustainable development goals 4 (SDG4), emphasized specific targeted outcomes and measurable indicators and ways geared towards fostering practices to achieve sustainability in various educational sector (Ayuba et al., 2024; UNESCO, 2024). One of such sectors where sustainability is a huge concern for scalability and constant upgrade is in TVET (UNESCO, 2023). In the context of TVET, sustainability involves integrating environmental, social, and economic considerations into educational programs and practices (UNESCO, 2017), such that similar systems can provide skilled workforce that are required and relevant for sustainable industrial development in Nigeria (Ujevbe et al., 2020). This can translate to mean that TVET may need to go beyond the common curricula to reflect contents and components recommended in the SDG4. With such in place, students can be prepared for careers in different trade-areas that contribute positively to society, while minimizing the anthem of unemployment both locally and globally. The adoption of sustainable TVET practices is particularly relevant in the automobile technology sector, which is undergoing a significant transformation driven by the shift towards cleaner, more efficient vehicles and manufacturing processes (International Labour Organization (ILO), 2022). Some areas where such increasing considerations in automobile technology sector/education have been captured include diagnostics and maintenance efficiency, electric and hybrid vehicles, waste management and recycling (International Renewable Energy Agency, (IRENA), 2023), public-private partnership (PPT) (Ujevbe et al., 2020), energy-efficient practices, alternative fuels and emerging technologies, customer education and awareness, continuous learning and adaptation among others (Chen et al., 2024; Ionita, 2023). These and many more are likely to amplify the grave need for the inclusion of sustainable TVET practices in the curricula in a bid to curb global economic challenges as it pertains to TVET and related sectors.

The Nigerian auto industry gained prominence in the 1970s and 1980, with a production of vehicles cars, trucks and tractors, reaching a capacity of 149,000 units a year from few states-owned manufacturing plants (Agarwal et al., 2023). According to the authors, the passage of time revealed that several constraints the industry had, like limited technology and knowledge transfer, high cost of domestic production and weak demand amid economic problems, currency volatility and the end of the commodity boom. The authors further noted that, despite having a vehicle market size of 1,150,000 for new and used cars and a growing middle class, as the author further stated, the country is a net importer of (mostly used) vehicles, and domestic production has been in declining. In 2021, imports of vehicles reached around $2.3 billion, with 60% being passenger cars. Additionally, Nigeria is also a significant net

importer of automotive components, sourced mainly from China and South Africa, in the words of the author. To reverse this trend, in the statement of the authors, the Nigerian government has taken action to revive the industry and enhance its competitiveness through the National Automotive Industry Development Plan.

Currently, the industry spans three clusters, Lagos-Ogun-Oyo, Kaduna-Kano, and Enugu-Anambra (JICA, 2015). A recent study identified 35 companies operating in the sector, of which six were former government-owned, later privatised assembly plants; 12 were private manufacturers; and 17 were licensed manufacturers at various stages of development (Ugwueze et al., 2020). However, in 2019, the national automotive design and development council (NADDC), revealed that only nine assemblers were active. The combined annual production of these companies amounts to 143,395 vehicles (with an installed capacity of a little over 200,000 vehicles), not enough to satisfy the local demand. Apart from Innoson Vehicles Manufacturing (IVM), known for the assemblageof completely knocked down (CKD) kits, there are other foreign-owned manufacturers who import semi knocked down (SKD) kits and fully built units (FBUs) from their parent companies, as stated by Ugwueze et al. Meanwhile, the authors and JICA (2015) had expatiated on the several challenges faced by the automobile industry, both locally and globally. Some of these challenges somehow rub off on automobile technology graduates as well.

Automobile technology graduates (ATGs) are the bedrock of automobile technology and related industries and educational institutions. Ugwueze et al., further described ATGs as those who have successfully completed any TVET programme, particularly, automobile technology from tertiary institutions and have equally acquired relevant attitude, scientific understanding and knowledge and practical skills in the repair, diagnosis and general maintenance of vehicles (Gbolahan, 2023;Ujevbe et al., 2020), including hybrid vehicles (Thomas et al., 2023). Beyond these, ATGs should possess communication skills, interpersonal skills, critical thinking, problem solving and entrepreneurial skills. Azameti (2024) similarly averred that such graduates do embrace and utilize their knowledge and practical and digital technology skills to substantially influence their prospects in the job market in a world marked by rapids technical breakthroughs. Following these, chances are that, in a wellbeing economy, ATGs may possess the antidote for unemployment and global economic challenges.

In industrialised climes, such graduates are normally trained in an appropriate environment, where sustainable TVET practices reflecting technological trends are adopted to meet the demands of employers (Galal, 2024; Siti, 2023; Kenayathulla, 2021; Yeap et al., 2021). However, most in Nigeria, particularly in the Southern part of the country face humongous challenges of meeting the needs of employers in the automobile technology and related sector (Saue et al., 2024; Allen, 2020). Moreso, statistics show that over 400,000 graduates are produced by TVET institutions annually, but more than 70% cannot be employed because they do not possess the prerequisite technical skills to drive the 21st century workplace results (Nigerian Automotive Industry Development Plan, (NAIDP) 2024). These and more are part of the global economic challenges in the auto-space.

Volatility and unpredictability are hallmarks of the global economy, with trade disputes, technology advancements and environmental laws having an impact on industries worldwide (World Bank, 2023). Globally, the automobile sector in particular, faces tremendous challenges from unstable oil

prices (Johnston et al., 2022), stringent emissions standards and the ever-growing demand for electric and hybrid vehicles and strict emission targets that automotive manufacturers must meet (Alanazi, 2023), which in turn affects the skills required by the workforce (European Commission, 2023). In Nigeria, the automobile sector yet faces challenges like lack of robust auto-industries, inadequate infrastructure and high tariffs and import dependence, skills shortage and inadequate training (Agarwal et al., 2023; Ujevbe et al., 2020). The evolving economic landscape in the automotive industry necessitates a workforce that is not only technically proficient but also adept at adapting to new technologies and sustainable practices. In this context, TVET programs that integrate sustainability-focused curricula and training can play a pivotal role in meeting these industry demands (Okoth, 2023; UNESCO, 2022). By producing graduates with the relevant skills, knowledge, and competencies required to navigate the shifting technological and environmental landscape, these TVET programs and trade-areas can help equip the workforce to address the challenges faced by the automotive sector (ILO, 2024; Tanaka et al., 2023; UNESCO, 2022). With this in place, there might be chances for automobile technology education students (ATESs) to cope with the global economic challenges in automobile technology industries and related educational institutes. Likewise, more insights to the role of TVET in the automobile technology sector might be gained.

TVET has been recognized for its ability to provide practical, hands-on training that aligns with industry needs (Ruslan et al., 2024). In the automobile technology sector, TVET programs offer a range of courses covering areas such as vehicle maintenance, repair, diagnostics, and manufacturing (Ariyo et al., 2021). Abo-Khalil (2024) similarly stressed that integrating sustainable practices into these programs, educational institutions can enhance the employability of their graduates and ensure they are equipped to address the challenges of a rapidly evolving industry. Sustainable TVET practices in the automotive field may include the use of eco-friendly materials, training on electric and hybrid vehicles, and the incorporation of energy-efficient technologies into the curriculum (Habiburrahman et al., 2024; Shibia, 2022). For instance, the inclusion of modules on electric drivetrain systems, regenerative braking, and eco-design principles might ensure students are prepared for dynamic trends in the automotive sector, which most likely could help them develop necessary technical skillsand equally fosteran understanding of sustainability and environmental responsibility. In addition, TVET programs that incorporate sustainable practices can bridge skills gap among ATESs (Ujevbe et al., 2020) and also facilitate the development of critical thinking, problem-solving, and collaborative skills, which are essential for addressing the multifaceted challenges faced by the automotive industries (Tanaka et al., 2023). These components eventually make technical students more balanced in their career as lecturers, technologists and technical instructors, among others.In a study carried out by Ali (2020) revealed that part of the challenges TVET face is the non-integration of sustainable TVET practices in their curriculum. A similar finding was also made by Jebba et al., (2024). By aligning their curricula with the evolving industry needs and incorporating sustainability-focused content, TVET institutions can produce graduates who are well acclimatized and equipped to contribute to the transition towards a more sustainable and environmentally-conscious automotive sector (Witenstein& Iyengar, 2023).

Employment outcomes are a critical measure of the effectiveness of TVET programs. Graduates who possess skills in

sustainable practices are likely to be more competitive in the job market, as employers increasingly seek individuals who can contribute to sustainable business practices (Okoth, 2023). Moreover, these authors emphasized that the growing emphasis on sustainability across industries reflects a global shift towards environmentally and socially responsible business models, which ATGs must be prepared to support and embrace. Additionally, sustainable TVET practices like career teamwork, latest teaching practices and guidance and support (Varma & Malik, 2023), critical thinking (Ye et al., 2024; López et al., 2023), public-private partnership (PPT) (Ujevbe et al., 2020) among others, increases the job-readiness, meaningful employment prospects and employability among ATGs. This might be suggestive of higher chances among ATGs for higher wages, and greater job satisfaction.

In a study conducted by ILO (2023) it was discovered that graduates with sustainability training have a 20% higher employment rate in the automotive sector compared to those without. Similarly, the IRENE (2023) noted that a reformation of TVET practices in university curricula to reflect components, strategies and practices embedded in SDG will ensure a substantial increase in employment outcomes of TVET products in Nigeria. Moreso, Wang (2024) observed that by fostering a culture of sustainability, TVET programs can encourage innovation and entrepreneurship, further enhancing employment opportunities in the automobile technology sector. According to Wang, graduates may be more likely to engage in developing new sustainable technologies or start their own environmentally-focused businesses, contributing to job creation and economic growth. As such, TVET programs that prioritize sustainability are well-positioned to supply the labour market with qualified candidates who can drive this transition. Moreso, it may be postulated that, higher employability, especially in TVET systems may be attributed to increasing demand for sustainable strategies and practices.

Statement of the Problem

Ideally, the automobile technology sectors are expected to have a substantial workforce gotten from TVET systems, particularly, graduates from automobile technology education trade areas. Such individuals are expected to be well acclimatized, vast and skilled in green skills and in the knowledge of sustainable practices to solve problems, perform simple and complex repairs and maintenance on electric and hybrid vehicles, engage software development, data analyses and artificial intelligence (AI) embedded vehicle systems among others. This is expected to enhance the employability of graduates and also ensure their readiness to meet the demands of the evolving automobile technology sector.

Today, sadly, the automobile technology sector and institutions where such program is run, experience grave lack of workforce that are trained in sustainable TVET practices, as earlier highlighted. As it is, most of ATGs are devoid of the ability to engage simple tasks involving computerized diagnosis, auto-software development and AI embedded vehicle systems that reflect sustainable TVET practices. Some lack the grace and attitude to display green skills and adapt properly to work environment upon graduation and securing a job placement. Though sustainable TVET practices exist and are taught to an extent, automobile technology graduates yet struggle a lot to sufficiently demonstrate a satisfactory degree of knowledge upon interviews with employers in auto-industries and related institutions and while on the job.

This study therefore, seeks to address this gap by assessing the impact of sustainable TVET practices on enhancing employment outcomes for graduates in the automobile

technology sector in Delta State. Due to the paucity of empirical studies addressing this study area, this study became a necessity.

Purpose of the Study

This study assessed the impact of sustainable TVET practices on employment outcomes in the automobile technology sectors in Delta State. Specifically, the study sought to identify:

1. specific sustainable TVET practices currently implemented in automobile technology programmes in universities, and how they align with the demands of the economy in Delta State
2. how sustainable TVET practices influence the employability and skill development of graduates in the automobile technology sectors in universities in Delta State?
3. key challenges and opportunities associated with integrating sustainable TVET practices in the automobile technology sector in universities in Delta State

Research Questions

The following research questions guided the study:

1. What specific sustainable TVET practices are currently implemented in automobile technology programs in universities, and how do they align with the demands of the economy in Delta State?
2. How do sustainable TVET practices influence the employability and skill development of graduates in the automobile technology sector in universities in Delta State?
3. What are the key challenges and opportunities associated with integrating sustainable TVET practices in the automobile technology sector in universities in Delta State?

Hypotheses

Three null hypotheses were tested at 0.5 level of significance:

1. There is no significant difference between the mean responses of automobile technology lecturers (ATL) and automobile mechanics (AM) on the specific sustainable TVET practices currently implemented in automobile technology programs in universities, and how do they align with the demands of the economy in Delta State.
2. There is no significant difference between the mean responses of automobile technology lecturers (ATL) and automobile mechanics (AM) on whether or not sustainable TVET practices influence the employability and skill development of graduates in the automobile technology sector in universities in Delta State.
3. There is no significant difference between the mean responses of automobile technology lecturers (ATL) and automobile mechanics (AM) on the key challenges and opportunities associated with integrating sustainable TVET practices in the automobile technology sector in universities in Delta State.

Methodology

The study adopted the descriptive survey research design. The research design was found suitable for the study because it allowed for the generalization of study outcome on the entire population (Fowler, 2013; Anyakoha, 2009). The population of the study consisted 152 respondents (5 automobile technology lecturers (ATLs) and 147 automobile mechanics (AMs), across Abraka and Agbor urban areas of Delta State). These areas were used as they have the only universities in the State that offer automobile technology education, including the availability of a reasonable number of standard registered mechanic shops in the areas. The entire population was used because it was a manageable size. A structured questionnaire named “Sustainable TEVT practices Questionnaire (STVETPQ)” was used to collect data from respondents. The

questionnaire was designed on a 4-point Likert scale and assigned ordinal values, strongly disagree (SD) = 1, disagree (D) = 2, agree (A) = 3 and strongly agree (SA) = 4.

The instrument contained 64-items, 21-items, 35-items and 25-items to sieve responses from respondents based on research questions one, two and three. The instrument was face validated by three experts in the field of industrial technical education. Cronbach Alpha was used to determine the internal consistency of the instruments and reliability coefficients of .88, .84 and .81 were obtained, with an overall reliability of .87. Data were analyzed using Mean, while t-test was used to test the null hypotheses at .05 level of confidence. It was decided that mean scores equal to or less than 2.49 implied "strongly disagree," while mean scores equal to or greater than 2.50 connoted "strongly agree". SPSS version 23 was used to aid the entire data analysis.

Results

The data answering research questions and testing hypotheses are contained in tables 1- 6

Table 1: Mean and standard deviation of ATLs and AMs on specific sustainable TVET practices that are currently implemented in automobile technology programs in universities, and how do they align with the demands of the economy in Delta State

		ATLs N = 5			AMs N = 147		
S/N	Items	$\bar{X}i$	SDi	Rmk.	$\bar{X}i$	SDi	Rmk.
A.	**SUSTAINABLE TVET PRACTICES**						
1.	**Which of the following sustainable TVET practice are integrated into your automobile technology education program**						
	Training on electric and hybrid vehicle technologies	1.40	.54	Disagree	1.47	.50	Disagree
	Recycling and waste management in workshops	1.80	.44	Disagree	1.41	.49	Disagree
	Teaching on alternative fuels and energy sources	2.00	.00	Disagree	1.95	.19	Disagree
	Partnerships with sustainable companies	1.20	.44	Disagree	1.30	.46	Disagree
	Emphasis on energy-efficient automotive system	1.40	.54	Disagree	1.42	.49	Disagree
	Use of eco-friendly materials and technologies	1.60	.54	Disagree	1.57	.49	Disagree
	Conducting carbon footprint analysis	1.60	.54	Disagree	1.47	.50	Disagree
	Training on telematics and smart technology	1.80	.44	Disagree	1.57	.49	Disagree
	Engage regular community engagement and awareness	1.40	.54	Disagree	1.42	.49	Disagree
B.	**ALIGNMENT WITH GLOBAL ECONOMIC DEMANDS**						
1.	**How well do the sustainable TVET practices in your program align with current economic demands in theautomobile industry?**						
	Not aligned at all	1.60	.54	Disagree	1.47	.50	Disagree
	Slightly aligned	2.00	.00	Agree	1.60	.49	Agree
	Moderately aligned	1.40	.54	Agree	1.42	.49	Agree
	Strongly aligned	1.40	.54	Disagree	1.44	.49	Disagree
	Very strongly aligned	1.60	.54	Disagree	1.47	.50	Disagree
	GRAND MEAN	**1.58**	**.11**	**Disagree**	**1.50**	**.11**	**Disagree**

Data presented in table 1 above, reveals that the generality of the respondents disagreed that the stated sustainable TVET practices were integrated into automobile technology programs as can be deduced from the grand mean scores and standard deviations for ATLs (1.58 and .11) and for AMs (1.50 and .11).

Table 2: t-test analysis of respondents on the specific sustainable TVET practices currently implemented in automobile technology programs in universities, and how do they align with the demands of the economy in Delta State

	F	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confi. Interval of the Difference	
							Lower	Upper
Specific Sustainable TVET Practices	.005	1.531	150	.128	1.145	.0748	-.333	2.624

Table 2 displays an independent sample t-test that compared the opinions of ATLs and AMson currently implemented in automobile technology programs in universities, and how do they align with the demands of the economy in Delta State. The table showed that there were no significant differences (t (150) = 1.531, p = .128>.05). The magnitude of the difference in the mean (mean difference = 1.145, 95% *Cl*: -.333 to 2.624) was not significant. Hence, hypothesis 1was accepted.

Table 3: Mean and standard deviation of ATLs and AMs on whether or not sustainable TVET practices influence the employability and skill development of graduates in the automobile technology sector in universities in Delta State

		ATLs N = 5			Ams N = 147		
S/N	**Items**	$\bar{X}i$	**SDi**	**Rmk.**	$\bar{X}i$	**SDi**	**Rmk.**
A.	**INFLUENCE ON EMPLOYABILITY**						
1.	**How do sustainable TVET practices impact the employability of graduates in the automobile technology sector?**						
	No impact	1.60	.54	Disagree	1.39	.49	Disagree
	Slightly positive impact	4.00	.00	Agree	3.61	.48	Agree
	Moderately positive impact	3.20	.44	Agree	3.55	.49	Agree
	Strongly positive impact	3.60	.54	Agree	3.59	.49	Agree
	Very strongly positive impact	3.60	.54	Agree	3.98	.11	Agree
2.	**Which skills developed through sustainable TVET practices are most valued by employers in the automobile industry?**						
	Technical proficiency in sustainable automotive technologies	3.60	.54	Agree	3.72	.44	Agree
	Problem-solving and innovation	3.80	.44	Agree	3.44	.49	Agree
	Understanding of environmental regulations and practices	3.60	.54	Agree	3.18	.38	Agree
	Adaptability to new technologies	4.00	.00	Agree	3.61	.48	
	Collaboration and teamwork	4.00	.00	Agree	3.63	.48	Agree

3.	**Have you observed any changes in employment opportunities for graduates with training in sustainable TVET practices?**						
	No change	4.00	.00	Disagree	3.61	.48	Disagree
	Decreased opportunities	3.20	.44	Disagree	3.17	.37	Disagree
	Slightly increased opportunities	3.60	.54	Agree	3.18	.38	Agree
	Moderately increased opportunities	3.60	.54	Agree	3.95	.19	Agree
	Substantially increased opportunities	4.00	.00	Agree	4.00	.00	Agree
B.	**INFLUENCE ON SKILL DEVELOPMENT**						
1.	**To what extent do sustainable TVET practices enhance the following skills in graduates?**						
	Understanding the design, operation, and maintenance of hybrid and electric vehicles						
	Not enhanced	1.80	.44	Disagree	1.78	.41	Disagree
	Slightly enhanced	1.60	.54	Agree	1.55	.49	Agree
	Moderately enhanced	3.80	.44	Agree	3.82	.37	Agree
	Strongly enhanced	4.00	.00	Agree	3.60	.49	Agree
	Very strongly enhanced	3.60	.54	Agree	3.95	.19	Agree
	Optimizing vehicle performance for fuel efficiency, including aerodynamics, weight reduction, and eco-driving practices						
	Not enhanced	2.00	.00	Disagree	1.39	.49	Disagree
	Slightly enhanced	3.80	.44	Agree	3.80	.39	Agree
	Moderately enhanced	3.60	.54	Agree	3.56	.49	Agree
	Strongly enhanced	3.80	.44	Agree	3.81	.38	Agree
	Very strongly enhanced	4.00	.00	Agree	4.00	.00	Agree
	Ability to conduct lifecycle assessments to evaluate the environmental impact of vehicles from production to disposal, fostering holistic thinking about sustainability						
	Not enhanced	2.80	1.30	Disagree	3.78	.49	Disagree
	Slightly enhanced	3.80	.44	Agree	3.89	.30	Agree
	Moderately enhanced	3.60	.54	Agree	3.56	.49	Agree
	Strongly enhanced	4.00	.00	Agree	4.00	.00	Agree
	Very strongly enhanced	3.60	.54	Agree	3.95	.19	Agree
	Skills in assessing and improving the sustainability of automotive supply chains, focusing on ethical sourcing and reducing carbon footprints						
	Not enhanced	1.60	.54	Disagree	1.56	.49	Disagree
	Slightly enhanced	3.60	.54	Agree	3.95	.19	Agree
	Moderately enhanced	4.00	.00	Agree	3.60	.49	Agree
	Strongly enhanced	4.00	.00	Agree	3.60	.49	Agree
	Very strongly enhanced	3.80	.44	Agree	3.43	.49	Agree
	GRAND MEAN	**3.43**	**.70**	**Agree**	**3.38**	**.07**	**Agree**

From table 3, the grand mean scores and standard deviations for ATLs (3.43 and .70) and for AMs (3.38 and .07) imply that the majority of the respondents agreed that sustainable TVET practices influence the employability and skill development of graduates in the automobile technology sector in universities in Delta State.

Table 4: t-test analysis of respondents on whether or not sustainable TVET practices influence the employability and skill development of graduates in the automobile technology sector in universities in Delta State

	F	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confi. Interval of the Difference	
							Lower	Upper
TVET INFLUENCE	.087	1.088	150	.278	1.307	1.201	-1.067	3.682

Table 4 evinces the independent sample t-test comparing the views of ATLs and AMson whether or not sustainable TVET practices influence the employability and skill development of graduates in the automobile technology sector in universities in Delta State.The table showed that there were no significant differences (t (150) = 1.088, p = .278>.05). The magnitude of the difference in the mean (mean difference = 1.307, 95% *Cl*: -1.067 to 3.682) was not significant. Hence, hypothesis 2was accepted.

Table 5: Mean and standard deviation of ATLs and AMs on the key challenges and opportunities associated with integrating sustainable TVET practices in the automobile technology sector in universities in Delta State

		ATLs N = 5			Ams N = 147		
S/N	**Items**	$\bar{X}i$	**SDi**	**Rmk.**	$\bar{X}i$	**SDi**	**Rmk.**
A.	**Challenges faced by your program in implementing sustainable TVET practices that align with economic demands.**						
	Lack of funding and resources	4.00	.00	Agree	3.60	.49	Agree
	Insufficient industry partnership	4.00	.00	Agree	4.00	.00	Agree
	Lack of awareness and advocacy	4.00	.00	Agree	4.00	.00	Agree
	Resistance to curriculum changes	3.80	.44	Agree	3.82	.37	Agree
	Potential brain-drain	3.60	.54	Agree	3.95	.19	Agree
	Technology barrier	3.60	.54	Agree	3.57	.49	Agree
	Regulatory and policy gap	4.00	.00	Agree	4.00	.00	Agree
	Outdated training equipment	4.00	.00	Agree	3.61	.48	Agree
B.	**What are the key opportunities presented by integrating sustainable TVET practices in the automobile technology sector?**						
	Enhanced employability	4.00	.00	Agree	3.22	.41	Agree
	Bridged technology gap	4.00	.00	Agree	4.00	.00	Agree
	Stronger industry-partnerships	3.60	.54	Agree	3.57	.49	Agree
	Enhanced curriculum	3.60	.54	Agree	3.57	.49	Agree
	Availability of strong expertise	4.00	.00	Agree	4.00	.00	Agree
	More engaging internships and work-based learning outcomes	4.00	.00	Agree	3.60	.49	Agree
	Policy advocacy and support	4.00	.00	Agree	3.60	.49	Agree
	GRAND MEAN	**3.88**	**.13**	**Agree**	**3.74**	**.90**	**Agree**

Table 5 evinces the grand mean scores and standard deviations for ATLs (3.43 and .70) and for AMs (3.38 and .07). This implies that the generality of the ATLs and AMs agreed that the stated items captured really well the key challenges and opportunities associated with integrating sustainable TVET practices in the automobile technology sector in universities in Delta State.

Table 6: t-test analysis of respondents on the key challenges and opportunities associated with integrating sustainable TVET practices in the automobile technology sector in universities in Delta State

	F	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confi. Interval of the Difference	
							Lower	Upper
INTEGRATE SUS. TVET PRACTICES	2.462	3.013	150	.003	4.032	1.338	1.388	6.677

Table 6 evinces the independent sample t-test comparing the views of ATLs and AMson the key challenges and opportunities associated with integrating sustainable TVET practices in the automobile technology sector in universities in Delta State. The table showed that there were significant differences (t (150) = 3.013, p = .003<.05). The magnitude of the difference in the mean (mean difference = 4.032, 95% *Cl*: 1.388 to 6.677) was significant. As such, hypothesis 3was accepted.

Discussion of Findings

The findings that were observed are discoursed in-line with the research questions and hypotheses tested.

Findings obtained from this study revealed that the generality of the ATLs and AMs disagreed that the stated sustainable TVET practices were integrated into automobile technology programs. Moreso, the findings are further supported by the outcome based on the hypothesis which showed that the mean difference or gap between the groups was not significant. This study outcome is in tandem with the observations of Jebba et al., (2024) and Ali (2020) who noted that part of the challenges TVET face is the non-integration of sustainable TVET practices in their curriculum. The authors further observed similar non-significant difference among respondents. As such, the likelihood of TVET graduates, particularly ATGs, facing difficulties getting employed in the automobile sector remains slim.

Findings obtained from this study revealed that the respondents agreed that sustainable TVET practices influence the employability and skill development of graduates in the automobile technology sector in universities in Delta State. The results are yet reinforced by the hypothesis, showing or significant difference between the two groups. A similar discovery was made by Che and Kola (2024) who stated that innovative practices in TVET influence the employability and skill development of graduates in the TVET systems. This has positive implications on the employability of ATGs in TEVT systems.

The findings from the study revealed that the generality of the ATLs and AMs agreed that the stated items captured really well the key challenges and opportunities associated with integrating sustainable TVET practices in the automobile technology sector in universities in Delta State. To further strengthen the study outcomes, the hypothesis evinced that there was a significant difference between the ATLs and the AMs on the stated items captured really well the key challenges and opportunities. This study outcome corroborates the observations of Sibiya (2024) and Jebba et al., (2024) who attested to the stated key challenges and opportunities associated with sustainable TVET practices in automobile technology education and related institutions and sectors. Contrarily to the result of the hypothesis in this study, Jebba observations were not significant among respondents. Such knowledge would help universities and related stakeholder to develop ways to address the challenges and also latch on the opportunities.

Conclusion

Although sustainable TVET practices have tremendous impact on the employability of ATGs, if they lacking in ATE curriculums among TVET systems, there is no gainsaying to the fact that the employability will be yet be a strong problem among ATGs. The discoveries in this empirical study provides insights for universities and related stakeholders to latch on the SGD4 goals that clearly supports the strong integration of sustainable TVET practices into study contents, as it promises to pave huge ways to contribute in the reduction of national and global economic challenges among TVET students, particularly those in the automobile fields and related sectors.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Include in-depth instruction on eco-friendly car technology, alternative fuels, and sustainable technologies in the revised automobile technology education(ATE) curriculum.
2. Intensify deliberate collaborations between educational institutions and automotive industries.
3. Institutions where ATE is taught can implement exchange programme for automobile technology education students.
4. Faculties where ATE is taught can organize continuing workshop training for technologies and instructors to keep them abreast of emerging trends and innovations in sustainable automotive practices.

REFERENCES

Abo-Khalil, A. G. (2024). Integrating sustainability into higher education challenges and opportunities for universities worldwide. *Heliyon, 10*(9). https://doi.org/10.1016/j.heliyon.2024.e29946

Adams, A., &Baddianaah, I. (2023). Factors affecting female enrolment in technical and vocational education and training institutions in sub-Saharan Africa: insights from north-western Ghana. *International Journal of Training Research, 21*(3), 187-210. https://doi.org/10.1080/14480220.2023.2179096

Agarwal, P., Abudu, D., Calabrese, L. & Chukwurah, O. (2023) *The automotive sector in Nigeria: Opportunities under the AfCFTA. London: ODI*. https://odi.org/en/publications/theautomotive-sector-in-nigeria-opportunities-under-the-afcfta

Ahmadian, S., Tawfeeq, T., Alabdullah, Y., &Motaghian, I. (2023). Maintenance and repairs system of automotive industry for sustainable internationalization. *International Journal on Advanced Technology, Engineering, and Information System, 2*(2), 106-123. https://ojs.transpublika.com/index.php/IJATEIS/article/view/804/679

Alanazi, F. Electric Vehicles: Benefits, challenges, and potential solutions for widespread adaptation. *Applied Science, 13*, 6016. https://doi.org/10.3390/app13106016

Ali, C. C. (2020). Challenges facing TVET institution-industry collaboration in skills acquisition for sustainable growth in Nigeria. *Vocational and Technical Education Journal, 2*(2), 231-238.https://www.researchgate.net/publication/375085623_Challenges_Facing_TVET_Institution-Industry_Collaboration_in_Skills_Acquisition_for_Sustainable_Growth_in_Nigeria

Allen, J. E. (2020). Challenges and prospect of vocational technical education and training in tertiary institution in South-south, Nigeria. *Vocational And*

Technical Education Journal, 2(1), 273-278. ISSN: 2734-2697.

Anyakoha, E. U. (2009). Developing research skills: Concept and conceptual framework. Nsukka: Great AP Express Publishers Ltd.

Ariyo, S. O., Udogu, K. C., &Mamman D. (2021). Integration of automobile mechatronics technology into the curriculum of automobile trades programmes at the technical colleges in Nigeria. Randwick International of Education and LinguisticsScience, 2(1), 20-28. http://www.randwickresearch.com/index.php/rielsj

Ayuba, Z. G., Datol, I. G., &Aluwong, E. B. (2024). Greening technical vocational education and training (TVET) for combating climate change and promoting sustainable development in Nigeria. *Innovative Journal of Scientific and Advanced Studies, 9*(3), 43-49 https://bwjournal.org/index.php/bsjournal/article/view/2175/1862

Azameti, C. Y. (2024). Technology Acceptance and Employability in TVET Graduates. ISBN: ISBN-13: 9780134763423. https://www.researchgate.net/publication/378679519_Technology_Acceptance_and_Employability_in_TVET_Graduates

Bohvalovs, G., Kalnbaļķīte, A., Pakere, I., Vanga, R., Kirsanovs, V., Lauka, D., Prodaņuks, T., Laktuta, K., Doļģe, K., Zundāns, Z., Brēmane, I., Blumberga, D., &Blumberga, A. (2023). Driving Sustainable Practices in Vocational Education Infrastructure: A Case Study from Latvia. *Sustainability, 15*(14), 10998; https://doi.org/10.3390/su151410998

Che, S., & Kola, O. O. (2024). An analysis of how TVET is playing a significant role in fostering students' skills and competencies in South Africa. *Journal of Educational and Social Research, 14*(3), 293-305. (https://creativecommons.org/licenses/by-nc/4.0/)

Chen, W., Alharthi, M., Zhang, J., & Khan, I. (2024). The need for energy efficiency and economic prosperity in a sustainable environment. *Gondwana Research, 127*(4), 22-35. https://doi.org/10.1016/j.gr.2023.03.025

European Commission. (2023). *European Green Deal*. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

Fowler, F. J. (2013). *Survey research methods* (5th ed.). Sage Publications.

Galal, S. (2024 June 30). *Number of graduates of TVET in Egypt 2021/2022, by specialty and gender*. https://www.statista.com/statistics/1252852/number-of-technical-vocational-training-graduates-by-specialty-and-gender-in-egypt/

Gbolahan, A. M. (2023). "*Skills required by technology graduates in establishing automobile enterprises in Minna metropolis of Niger State."* [Doctoral dissertations]. Department of Industrial and Technology Education Federal University of Technology, Minna. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://repository.futminna.edu.ng:8080/jspui/bitstream/123456789/24158/1/skills%20required%20by%20technology%20graduates%20in%20establishing%20automobile%20enterprises%20in%20minna%20metropolis%20of%20niger%20state.pdf

Habiburrahman, M., Nurcahyo, R., Azanizawati, M., &Natuda, K. (2024). Driving the transport electrification:

Exploring stakeholders' perceptions and actions in the indonesian automotive industry transition to electric mobility. *Sustainability, 16*(14), 5855-5875. 10.3390/su16145855

Haßler, B., Stock, I., Schaffer, J., Winkler, E., Kagambèga, A., Haseloff, G., Watson, J., Marsden, M., Gordon, R., & Damani, K. (2020). *Technical and Vocational Education and Training in Sub-Saharan Africa: A Systematic Review of the Research Landscape. German office for international cooperation in vocational education and training.* https://lit.bibb.de/vufind/Record/DS-185338

ILO. (2022). *Skills for a Greener Future. International Labour Organization*. https://www.ilo.org/global/topics/green-jobs/publications/WCMS_662504/lang--en/index.htm

ILO. (2023). *The impact of green skills on employment outcomes. International Labour Organization*. https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_740388.pdf

Ionita, A. (2023, April 25). *The Power of Efficiency: How Energy-Saving Measures Are Transforming Buildings, Transportation, and Industry*. https://carilec.org/the-power-of-efficiency-how-energy-saving-measures-are-transforming-buildings-transportation-and-industry/

IRENA. (2023). *Renewable Energy and Jobs: Annual Review. International Renewable Energy Agency*. https://www.irena.org/publications/2023/Jun/Renewable-Energy-and-Jobs-Annual-Review-2023

Jebba, M. M., bin Nordin, M. S., & Isa, M. U. (2024). Integration of green energy technologies into automobile technology education curriculum in tertiary institutions in Nigeria: challenges and prospects. *Migration Letters, 21*(5), 412-419.chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.researchgate.net/profile/Mahmud-Mustaha-Jebba/publication/378297902_Integration_Of_Green_Energy_Technologies_Into_Automobile_Technology_Education_Curriculum_In_Tertiary_Institutions_In_Nigeria_Challenges_And_Prospects/links/65d425ef01325d46521570a8/Integration-Of-Green-Energy-Technologies-Into-Automobile-Technology-Education-Curriculum-In-Tertiary-Institutions-In-Nigeria-Challenges-And-Prospects.pdf

JICA. (2015). *Data collection survey on automotive sector in the Federal Republic of Nigeria*. JICA (https://openjicareport.jica.go.jp/pdf/12235321.pdf).

Jimmy, H. (2024). *Workforce Development for the Automotive Future*. https://www.linkedin.com/pulse/workforce-development-automotive-future-jimmy-ho-zrcsc/

Johnston, M., Rhinehart, C., & Schmitt, K. R. (2022, September 11). *Do Oil Prices Affect the Auto Industry? Investopedia*. https://www.investopedia.com/articles/personal-finance/062515/do-oil-prices-affect-auto-industry.asp

Kenayathulla, H. B. (2021). Are Malaysian TVET graduates ready for the future? *Higher Education Quarterly, 75*(3), 453–467. doi:10.1111/hequ.12310

Kiplagat, H., & Mutebi, R. (2022). TVET response to global challenges of sustainable development. *African Journal of Education, Science and Technology, 7*(1), 447-456. chrome-

extension://efaidnbmnnnibpcajpcglclefindmkaj/https://d1wqtxts1xzle7.cloudfront.net/104992326/TVET_Response_to_Global_Challenges_of_Sustainable_Development-libre.pdf?1692015184=&response-content-disposition=inline%3B+filename%3DTVET_Response_to_Global_Challenges_of_Su.pdf&Expires=1722987153&Signature=O3GktsTr~nWTovwfD537lzqaNRArzzQgS2oWGHjng010n6~6bdu~zY9qwr-upjM27S~bP3tQxJdoPyOCwqJ-ofUvD8P~OXE-O~izEl6duyqrJXB6ctkrbvRxzCT6lPOtfZ2Yt4gON2tPHRbUpiPWS5DRgy0O-8b9EUHw7OjGpSmSuq83eOjsqd9xYG-k~NcKf9c8gWBTKSF0gpHVnxO6gBrQnitszht1yTvXiPUZIXoZXSGlGqEute8el1IKfIe1DBWG-msb6ZkX-kRKv4mRLsD9vVHEePkb90PWx-0ktDBGcv9QKt3BUJImpHFpyP~fIVI6BZd1EUba-eQcgsMn3Q__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

López, F., Contreras, M., Nussbaum, M., Paredes, R., Gelerstein, D., Alvares, D., &Chiuminatto, P. (2023). Developing critical thinking in technical and vocational education and training. *Education Science, 13*(6), 590. https://doi.org/10.3390/educsci13060590

Muro, M., Maxim, R., & Whiton, J. (2019). *Automation and artificial intelligence: How machines are affecting people and places. Metropolitan Policy Program at Brookings*. https://www.brookings.edu/research/automation-and-artificial-intelligence-how-machines-affect-people-and-places/

Nigerian Automotive Industry Development Plan. (NAIDP). (2024). chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://naddc.gov.ng/wp-content/uploads/2023/06/Nigerian-Automotive-Industry-Development-Plan-2023.pdf

Okoth, O. E. (2023). TVET, economy and sustainable development. *International Journal of Vocational and Technical Education, 15*(2). 12-17. DOI: 10.5897/IJVTE2022.0315

Pisková, L., Dobranschi, M., Semerád, P., Otavová, M. (2024). Impact of robot installations on employment and labour productivity in automotive industry. *Central European Business Review, 13*(2), 53-68. https://doi.org/10.18267/j.cebr.342

Ruslan, Simanjuntak, R. R., &Hidayat, M. A. (2024). *Energy efficiency through solar panelled mobile workshop for vocational education teaching factory*. [IOP Conference Series: Earth Environmental Science] 1324 012099 DOI 10.1088/1755-1315/1324/1/012099

Saue, B. P., Chukuigwe, O. N., & Bassey, I. S. (2024). Development and Validation of Autotronic Training Module for Automobile Technology Students in Polytechnics in Southern Nigeria. *Journal of Informatics and Web Engineering, 3*(2), 188–198. https://doi.org/10.33093/jiwe.2024.3.2.14

Shibia, A. G. (2022). *Analysis of motor vehicle industry value Chain in Kenya. Public Policy Repository*. https://repository.kippra.or.ke/handle/123456789/4248

Sibiya, A. T. (2024). Challenges regarding TVET training programs in the SA automotive industry. *International Journal of Training Research,*

https://doi.org/10.1080/14480220.2024.2369501

Siti, H. (2023, July 26). *What's The Demand for TVET Graduates in the UK*? Here's An Outlook. https://www.digiformag.com/en/regulation/what-is-the-demand-for-tvet-graduates-in-the-uk/

Tanaka, N., Angel-Urdinola, D., & Rodon, G. (2023, December, 04). *Teachers in technical and vocational education and training are critical for successful workforce development.*https://blogs.worldbank.org/en/education/teachers-technical-and-vocational-education-and-training-are-critical-successful

Thomas, C. G., Amaechi, O. J., & Bassey I. S. (2023). Technological Skill Improvement Needs of Automobile Engineering Graduates to Effectively Maintain Hybrid Vehicles in Nigeria. *Iconic Research and Engineering Journals, 7*(6), 139-146. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.irejournals.com/formatedpaper/1705297.pdf

Ugwueze, M.I., Ezeibe, C.C. and Onuoha, J.I. (2020) 'The political economy of automobile development in Nigeria', Review of African Political Economy, 47(163), pp. 115–125. Available at: https://doi.org/10.1080/03056244.2020.1721277.

Ujevbe, B. O., Mustapha, A., Attah, P. E., Oguguo, U. O., &Nwahunnaya, I. (2019). Bridging the skills gap among automobile technology graduates in Nigeria through innovative TVET policies and practices. *Vocational and Technical Education Journal, 2*(1), 2734-2697. https://www.acjol.org/index.php/votej/article/view/373/401

Umair, M. (2024). *Pakistan Economy and Exploring the Potential of the Automotive Industry for Economic Growth.* [Politecnico di Torino]. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://webthesis.biblio.polito.it/secure/32013/1/tesi.pdf

UNESCO (2023). *Technical and Vocational Education and Training (TVET).* https://www.unesco.org/en/fieldoffice/beirut/tvet

UNESCO. (2022). *Education for Sustainable Development. United Nations Educational, Scientific and Cultural Organization*. https://en.unesco.org/themes/education-sustainable-development

UNESCO. (2024). *Sustainable Development Goal 4 (SDG4). Leading SDG4: Education2030 for Inclusive and Quality Education.* https://www.unesco.org/sdg4education2030/en/sdg4#:~:text=SDG4%20is%20a%20commitment%20to,a%20sustainable%20and%20equitable%20world.

UNESCO-UNEVOC. (2017). *Greening Technical and Vocational Education and Training: A practical guide. United Nations Educational, Scientific and Cultural Organization.*

Varma, C., & Malik, S. (2023). Perspective chapter: TVET in the 21st Century – A Focus on innovative teaching and competency indicators. DOI: 10.5772/intechopen.112516

Wang, L. (2024). *TVET infuses a much-needed dose of relevance into education Addressing existing gaps in TVET and skills development is crucial for better alignment with evolving industries and future job creation.* https://www.unesco.org/en/articles/tvet-infuses-much-needed-dose-relevance-education

Witenstein, M., & Iyengar, R. (2023). Policies, practices and the future of technical and vocational education and training

for communities in the margins – a special issue commentary and introduction. *Policies, Practices and the Future of Technical and Vocational Education and Training for Communities in the Margins, 17*(3), 163-167. https://doi.org/10.1080/15595692.2023.2222503

World Bank. (2023). *Global Economic Prospects*. https://www.worldbank.org/en/publication/global-economic-prospects

Ye, J.‐H., He, Z., Bai, B., & Wu, Y.‐F. (2024). Sustainability of technical and vocational education and training (TVET) along with vocational psychology. *Behavioural Science, 14*(10), 859. https://doi.org/10.3390/bs14100859

Yeap, C., Suhaimi, N. & Nasir, M. (2021). Issues, challenges, and suggestions for empowering technical vocational education and training education during the COVID-19 pandemic in Malaysia. Creative Education, 12, 1818-1839. doi: 10.4236/ce.2021.128138.

Yin, Y., Stecke, K. E., & Li, D. (2018). The evolution of production systems from Industry 2.0 through Industry 4.0. *International Journal of Production Research, 56*(1-2), 848-861. https://doi.org/10.1080/00207543.2017.1403664