Sustainable Practices in Informal Apprenticeship Skill Training: Navigating Global Economic Challenges in Nigeria's Motor Vehicle Mechanic Industry

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Abstract
This research investigates the sustainability of informal apprenticeship skill training programs in Nigeria's motor vehicle mechanic industry, examining the impact of economic challenges like fuel price volatility and currency depreciation. Using a mixed-methods approach comprising both quantitative and qualitative analysis, the study aims to understand how economic fluctuations affect sustainable practices in mechanic workshops. The research was conducted in urban and semi-urban areas of Nsukka and Enugu, targeting the motor vehicle mechanic workshops, including master-craftsmen, workshop owners, apprentices, and relevant motor vehicle industry representatives. Qualitative data was collected through interviews and focus groups, while a quantitative survey sampled 293 respondents. The findings reveal a varied landscape of sustainability integration, with economic factors playing a pivotal role. While some workshops incorporate sustainability aspects, the lack of standardized curricula and reliance on observational learning are prominent. Economic fluctuations present a dual challenge, impacting both short-term cost-saving measures and long-term sustainability goals. However, the study also uncovers promising sustainable practices, such as waste oil recycling and energy-efficient equipment usage. The research highlights skill gaps among apprentices, emphasizing the need for targeted training modules. The conclusions advocate for standardized sustainability curricula, integration of sustainable practices, and policy interventions to support environmental protection and resilience within the industry. Key insights include the importance of enhancing sustainability education, responding to economic dynamics with sustainable solutions, and fostering collaboration between stakeholders. The study underscores the complex interplay between economic pressures and the adoption of sustainable practices in the informal automotive repair sector, providing recommendations to improve the long-term viability and environmental impact of this critical industry in Nigeria.
Keywords: Sustainable Practices, Informal Apprenticeship, Skill Training, Motor Vehicle Mechanic, Economic Challenges.

Introduction

Apprenticeship has been a significant aspect of skill transfer and job creation for generations, contributing to economic growth. It has roots in ancient civilizations like Babylon, Egypt, Greece, Rome, and modern Europe, and has been present in the United States (Achugo and Chigbo, 2014). In Nigeria, apprenticeship practices began during the pre-colonial era, where clans and families trained young people in family trades and crafts. Apprenticeship involves the exchange of labor and sometimes money for job-specific training (Obi & Agha, 2016). Various industries, such as welding, fabrication, auto mechanics, tailoring, generator repair, mobile phone repair, carpentry, furniture making, catering, manicure/pedicure, and plumbing, engage in apprenticeship practices (Olaitan et al, 2024). These trades are recognized for absorbing and training unemployed youths, promoting manpower development and economic empowerment.

An informal apprenticeship is a unique and time-honored method of learning that takes place outside the traditional classroom

setting. It involves an individual, known as the apprentice, working closely with a skilled craftsman or artisan to acquire practical knowledge and hands-on experience. Unlike formal apprenticeships that typically have structured programs and predetermined durations, informal apprenticeships in Nigeria are often unstructured, more flexible and adaptable (Olaitan et al, 2024; Uwamaiye and Iyanmu, 2023). They can vary in length depending on the complexity of the craft being learned, ranging from several months to several years. What sets informal apprenticeships apart is their emphasis on experiential learning (Alla-Mensah, & McGrath, 2021).

Alla-Mensah and McGrath (2021) highlight the importance of informal apprenticeships, where apprentices are trained under seasoned professionals to develop technical proficiency, critical thinking, and problem-solving skills. These apprenticeships cover various trades and crafts, such as carpentry, tailoring, blacksmithing, and pottery. Although there may be no official certification at the end, employers value the knowledge gained through this immersive process. Informal apprentices often emerge as competent craftsmen with both theoretical understanding and practical expertise, leading to sustainable livelihoods or entrepreneurship ventures (Emamorose, 2023).

Informal apprenticeship skill training in Nigeria is characterized by on-the-job learning, where aspiring motor vehicle mechanics acquire practical skills through hands-on experience. While this form of training offers flexibility and accessibility, it often lacks structured curricula and standardized sustainability education necessary for human development (Alla-Mensah, & McGrath, 2021). The automotive repair industry, facing economic constraints and environmental pressures, presents a unique setting for exploring sustainable practices.

Informal apprenticeship skill training is a prevalent pathway for individuals seeking to become motor vehicle mechanics in Nigeria. This form of training is often characterized by on-the-job learning, where aspiring motor vehicle mechanics acquire skills through hands-on experience under the guidance of experienced mechanics or workshop owners (Akanbi & Adeyeye, 2020). While informal apprenticeships offer flexibility and accessibility, they often lack structured curricula and standardized training, including sustainability education.

In Nigeria, motor vehicle mechanic repair workshops are run by master-craftsmen in the informal service sector (Uwameiye, Iyanmu & Ede, 2002). These workshops provide training to apprentices, enabling them to become master-craftsmen and become enterprising. The main duty of the master-craftsman and his apprentices is to diagnose malfunctions and perform necessary repairs to meet manufacturers' specifications for safety, drivability, and reliability (Ede and Olaitan, (2010). The apprentices are trained in adjusting, repairing, rebuilding, and replacing faulty parts of an automobile engine. They also perform major or minor repairs on steering, suspension, braking, cooling, computer and electronics, fuel and exhaust systems, lubrication systems, transmission systems, air conditioning systems, and general service station mechanic work (Ede and Olaitan, (2010).

The modern automobile and its maintenance industry are becoming more technologically oriented, with many computerized systems, making it more sophisticated. Besides this, there is a constant influx of modern cars into the country. The Nigerian automobile industry is made up of a few automobile assembly plants, automobile merchandising, transportation, maintenance, and spare parts dealerships/sales. Because there are no indigenous automobile manufacturing companies in Nigeria, the

maintenance sector has grown to be a major automobile industry in Nigeria (Ahmed, Shehu, Yalams, & Yaduma, 2022). Also, because most of the modern vehicles are imported into the country, their maintenance poses a major challenge to the automobile technicians, thus the need for retraining of the automobile technicians in the maintenance and servicing of modern vehicles.

Olaitan and Olaitan (2024) posited that, due to the increasing complexity of technology that gives birth to modern automobiles that run on integrated electronic systems and complex computers, which measure their performance while on the road, it becomes very necessary for automobile technicians and users to acquire broad-based knowledge and the ability to work with electronic diagnostic equipment and computer-based technical reference material through regular training and retraining. The advent of scanning tools for diagnosing engine faults and code readers has also brought about the elimination of guesswork and trial-by-error services on modern automobiles. This development has also led to a serious need for retraining of automobile mechanics in the informal sector. With the rapid changes in automobile technology, there is concern as to how the informal sector has coped, especially with the quality of work considering the unique characteristics of the informal sector for sustainability.

Sustainable practices refer to environmentally friendly practices followed or employed by mankind to maintain the valued qualities in the physical environment (Singh, Singh, & Sharma, 2023). According to Habek and Villahoz (2018), sustainable practices in the motor vehicle industry have been defined mostly from an environmental perspective, aiming at minimizing the impacts of manufacturing, services, and repair operations of vehicles on the environment while optimizing the production efficiency of the industry (Nordin et al., 2024).

The most common environmental sustainability practices used among large companies are eco-design, renewable energy usage, energy and material optimization, recycling, product life cycle and end-of-life cycle management, and waste minimization (Hurreeram et al., 2021). There is often a misinterpretation of the concept of sustainable production/manufacturing, limiting it to "green manufacturing or technology" which usually refers to production characterized by reducing energy consumption per unit of production, using materials from recycling, or limiting the amount of waste generated. However, sustainability should be defined through its three dimensions: economic, environmental, and social. In this study, sustainable production practices are understood as the actions, initiatives, and techniques that positively affect the environmental, social, or economic performance of a firm (Alay et al., 2020).

Sustainable practices could also be referred to as the application of green technology into our everyday lives. These sustainable practices in the motor vehicle industry, according to Neilson (2024), include minimizing harmful emissions, using eco-friendly alternatives made from recycled or sustainable materials, establishing good customer service relationships, customer education, employee/apprentice education, proper waste management techniques, eco-friendly facilities/practices, recycling of waste, proper disposal of hazardous waste, finding resources, the use of energy-efficient equipment, good supply chain management, and community involvement.

Sustainable practices in the automotive repair industry refer to environmentally and socially responsible approaches that promote long-term viability and resource efficiency. These practices include waste management, energy efficiency, the use of alternative fuel sources, and responsible disposal of hazardous materials (Aleke, 2018). However, the

integration of sustainable practices into informal apprenticeship skill training faces several challenges. The extent to which all these sustainable practices are incorporated into the informal apprenticeship skill training will go a long way in combating the global economic challenges confronting the nation currently.

The World Bank (2024) reports that Nigeria's economy experienced sustained growth of over 7% annually between 2000 and 2014, largely due to favorable global conditions and macroeconomic reforms. However, from 2015-2022, growth rates decreased and GDP per capita flattened due to monetary and exchange rate policy distortions, increasing fiscal deficits, trade protectionism, and external shocks like the COVID-19 pandemic. Nigeria's inflation reached a 24-year high of 31.7% in February 2024, pushing millions into poverty. Economic challenges include weak monetary policy tightening, failure to address petrol pricing imbalances, and rising insecurity. Spatial inequality remains large, with the best-performing regions comparing favorably to upper middle-income countries, while the worst-performing states fare below the average for low-income individuals. Infrastructure gaps constrain access to electricity and hinder domestic economic integration, aggravated by trade protectionism. Emerging problems like increased severity and frequency of extreme weather events, especially in the northern parts of the country, further exacerbate these long-standing development challenges.

Nigeria's economy faces several challenges that impact the automotive repair industry and informal apprenticeship skill training. Frequent fuel price fluctuations directly affect the operational costs of workshops and the affordability of sustainable practices. Currency depreciation further exacerbates the financial constraints, making it more expensive to import environmentally friendly technologies and resources (Adebayo, 2021). Additionally, limited access to affordable financing options hinders investments in sustainable practices and infrastructure upgrades.

The economic challenges in Nigeria have direct implications for informal apprenticeship skill training. The lack of financial resources and access to affordable technologies can hinder the adoption of sustainable practices within training programs. Apprentices may not receive adequate training on waste management, energy efficiency, or the use of alternative fuel sources, compromising their ability to contribute to environmental sustainability in their future careers (Aleke, 2018).

The Nigerian motor vehicle mechanic industry faces challenges due to global economic fluctuations and a lack of standardized training programs. The informal apprenticeship system, which relies on informal methods, lacks structure, curricula, and quality control, causing varying skill levels among apprentices. To improve the sustainability and effectiveness of informal apprenticeship systems, according to Adebayo (2021) Nigeria must address issues like inconsistent training methods, lack of standardized assessments, limited resources, and inadequate preparation for evolving industry requirements. Innovative solutions like standardized training frameworks and continuous professional development can help.

The apprenticeship system, a crucial aspect of informal education, is a subject of interest in the Global North and South. Gough et al (2023) study in Accra, Ghana, reveals that the learning process is constantly evolving, with some aspects remaining informal, some being formalized, and others being informalized. The study highlights the complex relationship between informal and formal education, with processes of informalization and formalization occurring concurrently. The study calls for a rethinking

of the informal-formal divide within education, incorporating livelihood-related issues and apprenticeships in the geographies of informal education in both regions.

Studies have shown that motor vehicle mechanic work skills contribute to sustainable development in Nigeria. Isue, Igrubai, and Yekorgba (2023) investigated the impact of engine and auto electricity maintenance on sustainable development. Agbonenu et al (2023) focused on safer automotive practices and sustainable development in the Nigerian automotive service sector. Emphasis was placed on comprehensive vehicle safety training, rigorous risk assessment, compliance with safety standards, continuous improvement, and fostering workplace safety and environmental awareness.

Onyema and Iwu (2023) found that apprenticeship practices in Nigeria have led to poverty reduction and sustainable development. Okadi, Onah, Ekenta, and Ezhim (2020) explored apprenticeship training systems as a way to bridge the gap between education and the labor market. Obi and Agha (2016) explored the impact of apprenticeship practices on SMEs and poverty reduction. However, none of these studies have shown sustainable practices in motor vehicle mechanic work and the global challenges posed in economic development.

1. The following purposes of the study were stated to guide the study:
2. To assess the current state of sustainability education within informal apprenticeship skill training programs in motor vehicle mechanic workshops in Nigeria.
3. To understand how fuel price fluctuations and currency depreciation impact the adoption of sustainable practices in motor vehicle mechanic workshops in Nigeria.
4. To explore sustainable practices that can be implemented within informal apprenticeship skill training programs in motor vehicle mechanic workshops.
5. To identify skill gaps among apprentices in areas such as waste management and energy efficiency in motor vehicle mechanic workshops in Nigeria.
6. To explore collaborative initiatives and knowledge-sharing practices among industry stakeholders in motor vehicle mechanic workshops in Nigeria.

Methodology

This study used a mixed-methods approach, combining qualitative and quantitative methodologies, to explore sustainable practices in informal apprenticeship skill training in Nigeria's motor vehicle mechanic industry. This approach involves collecting, analyzing, and integrating data from multiple sources to gain a comprehensive understanding of the research problem, as described by Creswell, Plano, & Clark (2018).The study was conducted in motor vehicle mechanic workshops and apprenticeship training workshops in urban and semi-urban areas of Nsukka and Enugu, Nigeria. The area of the study includes Mkpunano, Nru, and Ihe'n Owerre, and Nsukka which is home to the first indigenous university in Nigeria, the University of Nigeria, Nsukka (UNN). Nsukka is also the capital city of Enugu State. The study involved 4,303 individuals, including mastercrafts men, workshop owners, apprentices, journeymen, industry association representatives, and trade union representatives from the National Automotive Technician Association (NATA) in Nsukka and Enugu urban areas (National Bureau of Statistics, 2024).The study employed purposive and snowball sampling techniques to select key informants with extensive industry knowledge and experience for the qualitative phase. Snowball sampling involved referring participants to other relevant individuals, ensuring diverse perspectives and expertise. The quantitative phase used

convenience sampling due to the dispersed nature of the population, with 293 respondents selected for the study. Both methods ensured diverse perspectives and expertise.The survey was distributed through industry networks, mechanic workshops, and online platforms to mechanics and apprentices. In-depth interviews were conducted using a semi-structured interview guide, based on the literature review and research objectives. A structured questionnaire was developed for the quantitative phase, covering topics like demographic information, training methods, perceived benefits and challenges of informal apprenticeship systems, adoption of sustainable practices, and economic impacts. The questionnaire was structured on a five-point rating scale, based on a comprehensive literature review, to explore existing research on sustainable practices in informal apprenticeship skill training, global economic challenges, and their impact on the automotive repair industry.The review identified best practices, challenges, and strategies for sustainability promotion using a questionnaire divided into two parts: demographic variables for respondents and research questions for the study. The questionnaire was used for quantitative analysis.The study conducted semi-structured interviews with industry experts to understand the current state of sustainability education, perceived economic challenges, and potential improvement strategies. Focus group discussions were held with motor vehicle mechanic apprentices and their masters to understand their perspectives on sustainable practices, economic challenges, and training experiences. These discussions were recorded, transcribed, and analyzed using content analysis. The interviews and focus groups were conducted in different regions of the country to capture diverse perspectives and identify gaps in sustainability education.The study used thematic analysis and NVivo software to analyze qualitative data from interviews and survey responses. Descriptive statistics were calculated to summarize demographic characteristics and responses. A mean above 3.50 was accepted, while a mean below 3.49 was rejected. The findings were interpreted and validated through triangulation and focus group discussions. Industry workshops further refined the interpretation, ensuring the relevance and practicality of the research outcomes. The study aimed to enrich the understanding of sustainable practices in informal apprenticeship skill training.

Results

Demographic data of the master craftsmen motor vehicle mechanics, journey men and apprentices

Table 1: Frequency and Percentage responses of master craftsmen motor vehicle mechanics, journey men and apprentices N=293

S/n	Demographic data of participants/categories	Frequency	Percentage distribution%
1.	**Age Range:**		
	20-30 years	19	6.48
	31-40 years	69	23.51
	41-50 years	121	41.21
	51-60 years	47	16.0
	61- and over	37	12.61
2.	**Years of Experience:**		
	1-5 years	18	6.14
	6-10 years	25	8.53
	11-20 years	67	22.86
	21- and over	188	64.16
3.	**Gender:**		
	Male	283	95.5
	Female	10	3.41
4.	**Marital status:**		
	Married	145	49.4
	Single	107	36.5
	Divorced	30	10.2
	Widow/widower	10	3.41
5	**Location:**		
	Urban	120	41.0
	Semi-urban	85	29.0
	Rural	90	30.7
6	**Role in motor vehicle mechanic:**		
	Master craftsman	81	27.6
	Journey man	87	29.6
	Apprentice	103	35.1
	Auto parts merchandiser	12	4.0
	Industry Stakeholders/Representatives	10	3.4
7	**Level of Education**		
	No formal Education	121	41.2
	Apprenticeship training	70	23.8
	FSLC	77	26.2
	WAEC/SSCE	15	5.11
	NCE/OND	10	3.41
	HND	7	2.40
	Others	-	

The profile of the respondents to the questionnaire items for the quantitative analysis is described in Table 1 above. It was revealed that 42% of the respondents had age range between 41-50 years old while 24% had age range between 31-40 years old. Only about 6% had age range of 20-30 years old while 16% and 12% of the respondents were between 51-60 and 61years old and over respectively. It was also revealed that most of the respondents have been on the job for quite some time for they represent about 60% of the

respondents while the apprentices were represent about 23%. Based on the demographic information, it was further revealed that it a male dominated profession for majority of the respondent was male and represents 95.5% while the female were only 5%. 49% of the respondents were married, 36% were single, and 10% of them were divorced while 3% of them were widowers. It was revealed that 41% of the respondents reside in the urban areas which represent the majority, while 30 and 29% reside in semi-urban and rural areas respectively. It was revealed that 41% of the respondent had no formal education, while about 26% of them had FSLC. 26% of them had undergone some form apprenticeship training. Only 2% of the respondent had higher education.

Table 2:Mean and Standard Deviation of motor vehicle mechanics, journey men and apprentices Responses on the current state of sustainability education within the informal apprenticeship skill training programme in motor vehicle mechanic workshop (N=293)

s/n	Current states of sustainability education in the workshop	X	SD
1	The workshop provides sustainability education or training as part of the apprenticeship training program	2.71	1.11
2.	The workshop provides training/offered training on specific topics related to sustainability (e.g., eco-friendly practices, waste management, energy efficiency, electric vehicles	2.44	1.01
3.	Sustainability topics are treated on regular basis	2.43	0.89
4.	There are structured curricula or standardized training materials used for sustainability education	2.31	1.05
5	The master craftsmen/mentors or experienced mechanics play a role in delivering sustainability training	2.40	0.94
6	External organizations or experts are involved in providing sustainability education in the workshop.	2.51	1.08
7	Continuing education or professional development opportunities related to sustainability are provided in the workshop.	2.53	0.87
8	There are incentives or recognition programs in place to encourage the adoption of sustainable practices	2.11	0.99
9	Resources or support are provided to help apprentices implement sustainable practices effectively	2.35	1.09
10	The workshop collaborates with industry associations or networks to promote sustainability practices	2.57	1.02
11	There are partnerships or initiatives with local communities or educational institutions to enhance sustainability education	2.44	0.99

Table 2 above revealed that all the 11 items had their means ranged from 2.11-2.71 and less than the cutoff point of 3.50 on a five-point likert rating scale. This revealed that the respondents (Master crafts-man, journey men and apprentices) disagreed that all the 11 items indicates the current states of sustainability education within the informal apprenticeships skill training in motor vehicle mechanics workshops which indicates that they are not in support of the items indicated above.

Table 3:Mean and Standard Deviation of motor vehicle mechanics, journey men and apprentices Responses on the way fuel price fluctuations and currency depreciation has impacted the adoption of sustainable practices in motor vehicle mechanic workshops in Nigeria (N=293)

S/n	Fuel price fluctuations and currency depreciation impacted the adoption of sustainable practices.	X	SD
1.	Changes in customer behaviour or vehicle maintenance patterns during periods of high fuel prices.	3.57	1.09
2.	Fuel price fluctuations influence the demand for fuel-efficient vehicle technologies or alternative fuel options	3.89	1.99
3.	Workshop offer any services or products specifically targeted at improving fuel efficiency during periods of high fuel prices	3.71	0.96
4.	Fuel price fluctuations impacted the investment in energy-efficient equipment or practices for your workshop	3.89	1.09
5	Currency depreciation has greatly influenced the cost of vehicle parts, tools, and equipment in the workshop	4.11	1.21
6	Currency fluctuations affect the availability and affordability of imported automotive technologies or sustainable products	4.87	1.02
7	Challenges in accessing foreign exchange to purchase sustainable or advanced automotive technologies	3.87	1.22
8	Currency fluctuations impact the pricing of services, and how do customers respond to price changes	3.99	0.98
9	Currency fluctuations influenced your decision to adopt more cost-effective or locally sourced sustainable alternatives	4.11	0.99
10	Fuel price fluctuations and currency depreciation encourage or discourage the adoption of sustainable practices in your workshop	4.54	1.08
11	Customers become more or less receptive to sustainable practices during periods of fuel price fluctuations and currency depreciation	4.11	1.21
12	Customers prioritize cost-saving measures over sustainable practices when fuel prices are high or the currency is weak	3.98	0.98
13	Changes in customer preferences or demands regarding fuel-efficient vehicles or eco-friendly technologies during economic fluctuations	3.97	1.03

Table 3 revealed that all the 13 items had their means ranged from 3.57-4.87 and were above the cutoff point of 3.50 on a five-point likert rating scale. This revealed that the respondents (Master crafts-man, journey men and apprentices) agreed that all the 13 items indicate how fuel price fluctuations and currency depreciation has impacted the adoption of sustainable practices in motor vehicle mechanic workshops.

Table 4:Mean and Standard Deviations of motor vehicle mechanics, journey men and apprentices' responses on the skill gaps among apprentices in the areas of waste management and energy efficiency within motor vehicle mechanic workshops in Nigeria (N=293)

S/n	skill gaps among apprentices in the areas of waste management and energy efficiency	X	SD
1.	apprentices receive training on proper waste management practices, including disposal, recycling, and hazardous waste handling	2.47	1.02
2.	apprentices should receive training on the different types of automotive waste (e.g., used oil, batteries, scrap metal) and their appropriate disposal methods	3.57	0.99
3.	apprentices trained to identify and separate recyclable materials from automotive waste	2.44	1.09
4.	apprentices understand the environmental impact of improper waste management practices	2.37	0.87
5.	apprentices understand the specific waste management regulations or standards that apprentices are taught to follow	2.43	0.99
6.	apprentices received hands-on experience in implementing waste reduction or recycling initiatives in the workshop	2.49	0.96
7.	apprentices receive training on energy efficiency practices and their importance in the automotive industry	2.59	1.11
8	apprentices familiar with energy-efficient technologies and equipment used in motor vehicle maintenance and repair	2.59	1.09
9.	apprentices identify opportunities for energy conservation in the workshop, such as lighting, equipment usage, or vehicle idling	2.47	1.12
10.	apprentices learn about fuel-efficient technologies and practices, and how to advise customers on fuel economy improvements	2.78	1.07
11	apprentices trained to perform energy audits or assessments to identify areas for energy efficiency improvements in vehicles or workshop operations	2.39	0.95
12	apprentices feel confident in their ability to implement waste management and energy efficiency practices in the workshop	2.54	1.19
13	apprentices expressed interest in receiving more comprehensive training on sustainable practices, including waste management and energy efficiency	2.54	1.03
14	mentors or experienced mechanics provide guidance and support to apprentices on sustainable practices related to waste management and energy efficiency	2.79	1.12
15	there are industry partnerships or collaborations that provide training opportunities in these areas of sustainable practices	2.67	0.97
16	apprentices receive updates or continuing education on new developments in waste management and energy efficiency technologies	2.67	1.23
17	there are challenges or barriers in accessing training programs focused on waste management and energy efficiency in the workshop	3.57	1.21

Table 4 above revealed that all the 17 items had their means ranged from 2.39-2.78 and less than the cutoff point of 3.50 on a five-point likert rating scale. This revealed that the respondents (Master crafts-man, journey men and apprentices) disagreed that all the 17 items indicatethe skill gaps among apprentices in the areas of waste management and energy efficiency within motor vehicle mechanic workshops in Nigeria and which further indicates that they are not in support of the items indicated above. However, item 2 had a mean of 3.57 which indicates the respondent agreed to that particular item which means the apprentices are not trained on waste management procedure in the workshop.

Research question 4: What are the sustainable practices that can be implemented within informal apprenticeship skill training programs in motor vehicle mechanic workshops?

Table 5:Mean and Standard Deviations of motor vehicle mechanics, journey men and apprentices' responses on the sustainable practices that can be implemented within informal apprenticeship skill training programs in motor vehicle mechanic workshops (N=293)

S/n	sustainable practices	X	SD
1.	apprenticeship program include education on sustainable practices, such as eco-friendly technologies and waste management	3.79	1.02
2.	apprentices trained to identify and implement energy-efficient practices in vehicle maintenance and repair	3.99	0.99
3.	provide training on the use of alternative fuels or electric vehicle technologies	4.21	1.12
4	apprentices taught about the environmental impact of the automotive industry and the importance of sustainability	4.56	0.98
5	mentors or experienced mechanics share their knowledge and practices related to sustainability with apprentices	4.57	1.15
6	Apprentices familiar with eco-friendly products and technologies used in vehicle maintenance and repair? (e.g., biodegradable lubricants, recycled parts	3.98	1.09
7.	hands-on training on the use and disposal of environmentally friendly materials	4.21	1.17
8	apprentices encouraged to suggest or implement eco-friendly alternatives in their daily work	4.43	0.93
9	Apprentices are taught specific waste management regulations or standards that apprentices are taught to follow	4.44	1.15
10	encourage apprentices to adopt a circular economy mindset in their work	4.21	0.96
11	apprentices receive training on fuel-efficient technologies and practices	4.32	1.09
12	Are energy audits or assessments conducted as part of the apprenticeship program to identify energy-saving opportunities	3.98	1.09
13	offer guidance on energy-efficient equipment or tools that apprentices can use in their daily work	3.99	0.90
14	apprentices encouraged to suggest energy-saving initiatives within the workshop	3.69	1.21
15	apprentices trained to educate customers about the benefits of sustainable practices, such as fuel economy improvements or eco-friendly alternatives	4.11	1.11
16	apprentices learn how to advise customers on maintaining and optimizing vehicle performance for sustainability	3.89	0.99
17	customer service practices aligned with sustainability values, such as minimizing waste or offering eco-friendly options	4.11	1.11
18	apprentices understand the link between customer satisfaction and sustainable practices	3.98	1.09
19	incentives or recognition programs for apprentices who demonstrate exceptional commitment to sustainability	3.78	0.97

Table 5 above revealed that all the 19 items had their means ranged from 3.69-4.11 and above cutoff point of 3.50 on a five-point likert rating scale. This revealed that the respondents (Master crafts-man, journey men and apprentices) agreed that all the 19 items indicatethe sustainable practices that can be implemented within informal apprenticeship skill training programs in motor vehicle mechanic workshops.

Table 6:Mean and Standard Deviations of motor vehicle mechanics, journey men and apprentices' responses on are the collaborative initiatives and knowledge-sharing practices among industry stakeholders in motor vehicle mechanic workshops in Nigeria (N=293)

S/n	collaborative initiatives and knowledge-sharing practices	X	SD
1.	formal or informal networks or associations that bring together motor vehicle mechanic workshops in your region	3.78	0.99
2.	workshop actively participate in industry events, conferences, or workshops where knowledge sharing and collaboration take place	4.11	0.97
3	established partnerships or collaborations with other workshops or industry stakeholders to share knowledge, resources, or best practices	4.34	1.09
4	engage in knowledge-sharing activities with other industry stakeholders (e.g., workshops, webinars, online forums	4.43	1.23
5.	What types of knowledge or information such as technical solutions, business practices, industry trends should be share with your peers or industry colleagues? (e.g., technical solutions, business practices, industry trends	4.66	0.99
6	utilize digital platforms or online communities to connect and share knowledge with other motor vehicle mechanics	3.78	1.09
7	collaborative initiatives led to the development or implementation of innovative practices or solutions within your workshop	4.76	1.21
8	collaborative initiatives contributed to the adoption of sustainable practices or technologies in your workshop	3.98	1.12
9	specific topics or issues that you believe are underrepresented in industry discussions or knowledge-sharing activities should be addressed	4.27	1.09
10	specific areas or topics (e.g., technical advancements, sustainability practices) where industry collaboration is particularly valuable should be part of the collaborative initiatives	4.33	1.17
11	barriers or challenges you face in accessing or contributing to knowledge-sharing platforms or communities should be identify and resolved	4.11	1.19
12	knowledge sharing among industry stakeholders enhances the overall competitiveness and reputation of motor vehicle mechanic workshops in Nigeria	4.12	1.10
13	collaborative initiatives contributed to the adoption of sustainable practices or technologies in your workshop	3.98	1.19

Table 6 above revealed that all the 13 items had their means ranged from 3.78-4.43 and above cutoff point of 3.50 on a five-point likert's rating scale. This revealed that the respondents (Master crafts-man, journey men and apprentices) agreed that all the 19 items indicates the collaborative initiatives and knowledge-sharing practices among industry stakeholders in motor vehicle mechanic workshops in Nigeria

Themes that emerged for the qualitative study:

Discussion of findings

The study reveals a varied landscape of sustainability education within informal apprenticeship skill training programs in motor vehicle mechanic workshops across Nigeria. While some workshops incorporated aspects of sustainability into their training, others lacked a structured approach, relying mostly on apprentices' observational learning. This finding underscores the need for standardized sustainability curricula and training resources tailored to the motor vehicle mechanic profession as posited by (Habek and Villaoz,2018). Economic factors, such as fluctuating fuel prices and currency depreciation, significantly influence the adoption of sustainable practices in motor vehicle mechanic workshops. During periods of high fuel prices, workshop owners and apprentices showed greater interest in energy-efficient practices and alternative energy sources, while currency depreciation often shifted the focus towards short-term cost-saving measures, sometimes at the expense of long-term sustainability goals (Eneh et al, 2023). The research identified several sustainable practices with potential for implementation within informal apprenticeship programs, such as waste oil recycling, the use of energy-efficient equipment and lighting, and the adoption of basic waste management practices such as separation and responsible disposal of hazardous materials. In agreement with Chen and Li (2021) by integrating these practices into their daily operations and training, workshops can not only reduce their environmental impact but also create a safer and more efficient working environment. Skill gaps among apprentices were evident, particularly in waste management and energy efficiency. Many apprentices lacked knowledge of proper waste handling procedures, often due to a lack of formal training in this area. These findings are in agreement with Hureeram, Bhoomitra and Devkumar (2021). Addressing these gaps through targeted training modules and awareness campaigns can empower apprentices to make more sustainable choices in their future careers (Cheng and Konig, 2023). Collaborative initiatives among industry stakeholders, such as workshops, parts suppliers, and government agencies, were limited, but some promising examples were identified, including knowledge-sharing workshops and the formation of industry associations. These initiatives corroborate the suggestion by Eneh et al (2023) facilitated the exchange of best practices, provided a platform for collective action, and helped raise awareness of sustainability issues, scaling up and replicating these collaborative models could have a significant impact on the sector's sustainability. Overall, the findings highlight the potential for enhancing sustainability within informal apprenticeship skill training programs in motor vehicle mechanic workshops in Nigeria by addressing gaps in sustainability education, responding to economic fluctuations with sustainable solutions, and promoting collaborative initiatives. Government intervention in regulating and standardizing sustainability curricula in informal apprenticeship programs is essential, as industry associations and training institutes can play a pivotal role in developing and disseminating sustainable practices. By embracing sustainability, motor vehicle mechanic workshops can contribute to environmental protection and enhance their resilience amidst global economic challenges.

Conclusions

The study highlights the importance of enhancing sustainability education in informal apprenticeship programs due to recent economic challenges in Nigeria's motor vehicle workshops. Addressing gaps and challenges can help the industry contribute to environmental protection and resilience amid global economic fluctuations. The varied

nature of sustainability education underscores the need for standardized curricula and structured training resources. Integrating sustainability topics into the core curriculum will ensure apprentices develop the necessary knowledge and skills.Economic factors and sustainability are crucial in implementing sustainable practices. Fluctuating fuel prices and currency depreciation directly impact the adoption of sustainable solutions. Workshops should focus on implementing practices that offer long-term cost savings and environmental benefits. Policy interventions and industry initiatives can support workshops during economic shifts to prioritize sustainability.Promising sustainable practices, such as waste oil recycling, energy-efficient equipment, and waste management, provide a roadmap for workshops to improve environmental performance. Addressing skill gaps among apprentices requires targeted training modules and awareness campaigns. Fostering collaboration through industry associations or platforms can facilitate the exchange of best practices and promote collective action.

Recommendations

The study suggests the following recommendations:

1. Standardize sustainability curricula and training resources, integrating topics like waste management, energy efficiency, and environmental regulations.
2. Promote sustainable practices that offer long-term cost savings and environmental benefits, especially during economic fluctuations.
3. Provide workshops with resources and guidance on energy-efficient technologies, waste reduction, and alternative energy sources.
4. Encourage the adoption of identified sustainable practices through incentives, grants, or subsidies.
5. Foster collaboration and knowledge sharing through industry associations and workshops.
6. Engage policymakers and industry associations to advocate for policy interventions supporting sustainability.
7. Develop metrics and assessment frameworks to measure the impact of sustainability initiatives and communicate their benefits.

By implementing these recommendations, the motor vehicle mechanic industry in Nigeria can enhance the sustainability of informal apprenticeship programs, contribute to environmental protection, and build resilience in the face of global economic challenges.

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