NAU Journal of Technology and Vocational Education
Volume 11, No. 3, June 2026

INFRASTRUCTURAL REQUIREMENTS FOR ESTABLISHING FUNCTIONAL MOTOR MECHANIC WORK SERVICE STATIONS IN TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING (TVET) INSTITUTIONS

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Abstract
Purposeful technical and vocational education in motor mechanic work depends substantially on the availability of appropriate physical infrastructure. This study examined the infrastructural requirements for establishing an institution-based service station for motor mechanic training within a Nigerian university setting, anchored on Charles Prosser's principle that effective training requires learning environments that replicate actual workplace conditions. A descriptive survey design was adopted, involving 154 academic and industry-based respondents at Nnamdi Azikiwe University, Awka. Data were collected using a ten-item questionnaire adapted from Hong Kong's automotive competency standards, yielding a Cronbach's Alpha reliability coefficient of 0.77. Results showed strong consensus across respondent groups on the necessity of modern facilities, with industry-based respondents recording the highest mean scores, reflecting heightened awareness that vehicles equipped with intelligent sensors, electronic control units, and mechatronic systems require correspondingly advanced infrastructure. Key requirements identified included diagnostic equipment, quality lifts, specialized tools, computerized management systems, and safety provisions. The findings suggest that inadequate infrastructure undermines training effectiveness, producing graduates with competencies comparable to informally trained roadside mechanics. The study concludes that facility investment is a non-negotiable requirement for professionalism in motor mechanic training and recommends prioritized infrastructural upgrading aligned with contemporary automotive standards.

Keywords: Infrastructural requirement, service station, motor mechanic work, facilities, technical and vocational education and training

Introduction

Technical and Vocational Education and Training (TVET) is designed to produce skilled manpower, create employment, and drive economic growth (Kissi, Adesi, Acheampong & Abu, 2024). Yet TVET-based trades in Nigeria are often treated as general education requiring no skill-based competency, without the deliberate reforms needed to meet global standards (Okeke, 2020). Charles Prosser, the foundational proponent of vocational education, held that a training programme is purposeful only when the fundamental requirements, particularly the physical training environment, closely replicate the actual workplace (Silver, 1991). Where such infrastructure is absent, the acquisition of technical competence is undermined, regardless of curriculum design or policy intent (Ayonmike, Okwelle & Okeke, 2015; Onatere-Uburuhe, 2024).

This deficiency is starkly evident in Motor Vehicle Technology education. The National Board for Technical Education (NBTE, 2009) mandates that a standard automobile workshop; comprising machine, welding, fitting, and automobile sections, with sub-sections for electrical/electronic systems, engine diagnostics, wheel alignment, and computer-based simulation, is indispensable for credible motor mechanic training. However, Nigerian TVET programmes frequently fall short of this

benchmark, with service station mechanic work modules marginalized despite their economic importance.

The urgency of infrastructural reform is heightened by the increasing sophistication of modern vehicles. Contemporary automobiles are pervasively monitored through sensor networks and microprocessor-based systems that manage safety, diagnostics, and performance (Ananth et al., 2014). Internationally, this complexity has driven adoption of advanced training and maintenance technologies, such as augmented reality (AR) systems that integrate real-time visual and contextual guidance into technical procedures (Januszka & Panfil, 2015). By contrast, many Nigerian mechanics, trained without exposure to comparable tools, often further damage vehicles they attempt to repair (Olaitan, 2024). At the national policy level, the Nigerian Automotive Industry Development Plan (NAIDP) was introduced partly in response to inadequately equipped auto clusters and a shortage of competent personnel (Adebayo, 2023), yet over 70% of TVET graduates remain ill-equipped for 21st-century technical demands (Aliyu, 2023).

Prosser's second principle of vocational education states that effective training can occur only where learners use the same tools, operations, and machines found in the actual occupation; training conducted outside this framework fails to develop the manipulative and cognitive habits required for competent practice (Morgan Community College, 2021; Silver, 1991). Consistent with this, scholars maintain that training facilities, modern workshops, equipment, and services are essential determinants of effective skill acquisition (Oriola & Olakotan, 2021; Ogbuanaya & Usman, 2020). Yet antiquated facilities remain widespread across Nigerian TVET institutions, ill-suited to contemporary vocational demands (Samaila et al., 2024).

It is against this backdrop, of national economic need, rapid technological advancement, and the documented inadequacy of existing training environments, that the establishment of a university-based Service Station Mechanic Work centre becomes necessary. Such a centre would provide the state-of-the-art infrastructure, structured training environment, and skilled personnel required to produce competent graduates and deliver professional automotive services to the surrounding community. This study therefore examines the infrastructural requirements for establishing such a centre within a Nigerian university setting.

Research Questions

What are the infrastructural requirements necessary for establishing an institution-based Mechanic Work Service Station in Technical and Vocational Education and Training institutions, as perceived by academic-based and industry-based respondents?

Hypothesis

The mean response of the Academic-based Engineer, Industry-based Engineer, Academic-based Technologists and Academic-based Lecturer significantly differed on the state-of-the-art facilities required

Methods

To develop a motor mechanic service station (MWSS) plan for automobile technology education in Nigeria, this study employed a descriptive survey design, as recommended by Walliman (2011) and Rahi (2017). The research was carried out at Nnamdi Azikiwe University, Awka, and involved 154 participants drawn from four groups: academic engineers, academic lecturers, academic technologists, and industry-based engineers. For the academic respondents, total population sampling was used, yielding 79 participants. For the industry-based engineers, purposive sampling was adopted to select 75 individuals, mainly because no official records existed from the Ministry of Trade, Commerce and Industry in Anambra State, nor was there any functioning motor mechanic union or association (Uzoagulu, 2011). A 10-item questionnaire served as the main instrument. The items were adapted

from the automotive competency standards of Hong Kong's qualification framework. Face and content validity were established with the help of experts and one experienced roadside mechanic holding at least an NTC qualification. The internal consistency of the instrument was tested on a separate sample of 20 experts, yielding a Cronbach's alpha coefficient of 0.77. Data collection was done in two ways: an online version distributed via Google Forms, and hard copies administered in person. A total of 107 completed questionnaires were returned, representing an 83.5% response rate. Analysis of the data involved calculating means and standard deviations to answer the research questions, while one-way ANOVA was used to test hypotheses at a significance level of 0.05.

Table 1: *Descriptive statistics for facilities required for motor mechanic service station centre for functional motor mechanic work*

S/N	Job status	N	Mean	SD
1	Acad-based Engr	4	4.75	.500
2	Ind.-based Engr.	77	5.00	.000
3	Acad-based Tech	2	3.50	.707
4	Acad.-based Lecturer	18	4.33	.840
	Total	**101**	**4.84**	**.484**

Research Question

What are the infrastructural requirements necessary for establishing an institution-based Mechanic Work Service Station in Technical and Vocational Education and Training institutions, as perceived by academic-based and industry-based respondents?

Table 2: *Infrastructural requirements necessary for establishing an institution-based Service Station Mechanic Work centre in TVET institutions*

S/N	Facilities Required	Mean	SD
1	Advanced Diagnostic Equipment	4.84	.484
2	High-Quality Lifts and Hoists	4.84	.484
3	Specialized Tools and Equipment	4.84	.484
4	Computerized Maintenance Software	4.84	.484
5	Clean and Organized Workspaces	4.84	.484
6	Safety Measures Equipment	4.84	.484
7	Customer Waiting Area	4.84	.484
8	Parts Inventory Management	4.84	.484
9	Vehicle Tracking Systems	4.84	.484
10	Customer Relationship Management (CRM) Software	4.84	.484

N =101

Table 2 presents the mean ratings of 101 respondents on ten infrastructural requirements necessary for establishing an institution-based Mechanic Work Service Station centre in TVET institutions. All ten items recorded an identical mean score of 4.84 (SD = .484), indicating that respondents rated every listed facility; ranging from advanced diagnostic equipment and specialized tools to computerized maintenance software, safety measures, and CRM software, as equally and highly necessary. With a mean approaching the upper limit of the rating scale, this reflects overwhelming consensus that no single facility category was considered more or less important than the others; rather, all ten were viewed as jointly indispensable to establishing a functional, industry-standard centre. The uniformly low standard deviation (.484) across all items further confirms minimal variability in responses, suggesting strong agreement among respondents rather than divergent or polarized opinions on any individual requirement.

Research Hypothesis

A one-way ANOVA was performed to determine differences in the opinion of respondents in their responses between job status and facilities required for service station motor mechanic centre for functional motor mechanic work. The means and standard deviations are presented in Table 2.

Table 3: *A one-way ANOVA on effect of job status on facilities required for motor mechanic service station centre for functional motor mechanic work*

Source of variance	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10.215	3	3.405	24.928	.000
Within Groups	13.250	97	.137		
Total	23.465	100			

A one-way ANOVA was conducted to examine the differences in the groups of job status on the facilities required for service station motor mechanic centre for functional motor mechanic work. Results revealed a significant effect of job status on the required facilities, F (3, 97) = 24.93, p = .001. Post hoc Scheffé comparisons showed that academic-based technologists reported significantly higher facility requirements than academic-based engineers (p = .003), industry-based engineers (p < .001), and academic-based lecturers (p = .032). In addition, industry-based engineers reported significantly higher facility requirements than academic-based lecturers (p < .001). These findings indicate that perceptions of the facilities required for effective training vary significantly by job status, with academic-based technologists emphasizing the need for more facilities than other groups in table 6. Hence, a post hoc test is performed to determine where the difference lies.

Table 4: Post Hoc of Multiple Comparison Test for Research Hypothesis 2

(I) Job Status	(J) Job Status	Mean Difference (I-J)	Std. Error	Sig.
1	2	-.250	.190	.630
	3	1.250*	.320	.003
	4	.417	.204	.252
2	1	.250	.190	.630
	3	1.500*	.265	.000
	4	.667*	.097	.000
3	1	-1.250*	.320	.003
	2	-1.500*	.265	.000
	4	-.833*	.275	.032
4	1	-.417	.204	.252
	2	-.667*	.097	.000
	3	.833*	.275	.032

***Note**. 1 = Academic-based engineers, 2 = Industry-based engineers, 3 = Academic-based technologists, 4 = Academic-based lecturers.*

Discussion

Findings from Table 2 show a remarkably high and consistent mean rating (M = 4.84, SD = .484) across all ten infrastructural items, indicating near-unanimous agreement among respondents that advanced diagnostic equipment, high-quality lifts and hoists, specialized tools, computerized maintenance software, safety equipment, and related facilities are essential for establishing a functional institution-based Service Station Mechanic Work (SSMW) centre. This finding lends strong empirical support to Prosser's (1918) principle that vocational training is effective only to the extent

that the learning environment replicates the actual occupational environment (Silver, 1991; Morgan Community College, 2021). The low standard deviation across items further suggests that this is not a marginal or contested position but a broadly shared professional consensus, cutting across both academic and industry orientations.

However, while respondents agreed on the necessity of these facilities, the one-way ANOVA revealed that the strength of this perceived necessity varied significantly by job status, $F(3, 97) = 24.93$, $p < .001$. The effect size (partial $\eta^2 = .44$, calculated as SS-between/SS-total) indicates a large effect, meaning job status accounted for a substantial proportion of the variance in perceived infrastructural need. This suggests that although consensus exists in principle, the intensity of perceived urgency is shaped by respondents' proximity to, and familiarity with, the actual demands of modern automotive practice.

The Scheffé post hoc comparisons clarify the pattern underlying this variance. Industry-based Engineers reported the highest mean requirement ($M = 5.00$, $SD = .000$), a rating significantly higher than that of Academic-based Technologists ($M = 3.50$; $p < .001$) and Academic-based Lecturers ($M = 4.33$; $p < .001$), though not significantly different from Academic-based Engineers ($M = 4.75$; $p = .630$). Academic-based Technologists, by contrast, reported the lowest facility-requirement scores overall, significantly lower than Academic-based Engineers ($p = .003$), Industry-based Engineers ($p < .001$), and Academic-based Lecturers ($p = .032$).

This pattern is theoretically coherent. Industry-based engineers work directly with the technological realities of contemporary vehicles—systems increasingly governed by intelligent sensor networks, electronic control units, and mechatronic components (Ananth et al., 2014)—and are therefore best positioned to recognize the inadequacy of conventional workshop tools for diagnosing and repairing such systems (Januszka & Panfil, 2015). Their elevated and near-uniform ratings ($SD = .000$) reflect a shared, field-tested understanding that outdated infrastructure cannot support competent servicing of modern automobiles.

The comparatively lower ratings among Academic-based Technologists warrant closer interpretation. This may reflect a structural rather than attitudinal gap: technologists within TVET institutions often operate with limited exposure to contemporary industry practice and equipment, a condition consistent with reports of inadequate professional development and limited industry linkage among TVET instructional staff in Nigeria (Ogunode, Okwelogu & Olatunde-Aiyeduna, 2021). Where instructors have not been meaningfully exposed to the diagnostic and computerized systems now standard in the automotive industry, their frame of reference for "adequate" facilities may itself be shaped by antiquated norms—a pattern consistent with Samaila et al.'s (2024) observation that antiquated facilities remain normalized within many Nigerian TVET institutions. In effect, familiarity with obsolete practice may understate, rather than overstate, the perceived infrastructural gap.

Academic-based Lecturers occupied an intermediate position ($M = 4.33$), significantly lower than Industry-based Engineers but not significantly different from Academic-based Engineers. This may reflect their dual positioning: while primarily situated in academia, lecturers are typically more engaged with curriculum standards, accreditation requirements (e.g., NBTE, 2009), and theoretical frameworks of vocational education, which may sensitize them to infrastructural standards even without direct hands-on industry exposure.

Taken together, these findings answer Research Question 1 by identifying ten specific infrastructural requirements considered necessary for a functional SSMW centre, while also revealing that the perceived urgency of these requirements is not uniform but is shaped by respondents' occupational

proximity to contemporary automotive practice. The significant job-status effect further leads to rejection of the null hypothesis ($H0_2$), confirming that academic-based and industry-based respondents do not share identical perceptions of infrastructural need, a divergence with direct implications for how TVET institutions plan, fund, and staff such centres.

Implications

These findings suggest that infrastructural investment for SSMW centres is foundational, not optional, and should be guided jointly by academic and industry input rather than academic judgment alone, given technologists' comparatively limited exposure to current industry standards (Oriola & Olakotan, 2021; Aliyu, 2023). TVET institutions should therefore prioritize structured industry attachment and continuous professional development for instructional staff (Ogunode, Okwelogu & Olatunde-Aiyeduna, 2021), invest holistically across both mechanical and digital/administrative systems (Onatere-Uburuhe, 2024), and align facility planning with NBTE (2009) standards and national initiatives such as the Nigerian Automotive Industry Development Plan, positioning university-based SSMW centres as replicable models for closing Nigeria's automotive skills gap (Adebayo, 2023).

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