

Exploring Technological Gaps in the Implementation of Auto-Electricity or Electronics: Aligning Motor Vehicle Mechanic Programs in Nigeria with Modern Automobile Industry Needs

Nzube Cyril Muoghalu^{1,2*}, Adnan Bin Ahmad¹

¹ Department of Technical and Engineering Education,
School of Education, Faculty of Social Sciences and Humanities,
Universiti Teknologi Malaysia, Skudai 81310 Johor Bahru, Johor, MALAYSIA

² Automobile Technology Education Department, School of Secondary Education (Technical),
Federal College of Education (Technical), P.M.B 1044, Asaba, Delta State, NIGERIA

*Corresponding Author: cyril@graduate.utm.my
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Abstract

This study explores the technological gaps in the implementation of the Motor Vehicle Mechanic (MVM) program, with a particular focus on auto-electricity and electronics in Nigerian technical colleges. Using a qualitative research design, data were collected through semi-structured interviews with 20 stakeholders, including MVM administrators, teachers across nine technical colleges in Delta State, master craftsmen, and managers from the automotive industries in Nigeria. Reflexive thematic analysis, supported by NVivo 14 software, was utilized to identify key themes that illustrate critical gaps impeding the program's ability to meet industry standards. Findings revealed gaps in curriculum alignment with evolving industry practices, outdated teaching and learning resources, insufficient cutting-edge equipment and tools, and the limited technological expertise of teachers. Furthermore, the study highlighted a lack of industrial partnerships necessary for experiential learning and exposure to modern automotive technologies, such as electric and hybrid vehicles. These deficiencies hinder the development of practical skills required for maintaining contemporary vehicles. The study emphasizes the urgent need for curriculum reform, enhanced teacher training, and strengthened collaboration with industry stakeholders to bridge these gaps. Addressing these challenges is essential for equipping MVM graduates with relevant competencies, ultimately aligning technical training programs with the demands of the modern automotive sector and improving graduates' employability in Nigeria's evolving labour market.

1. Introduction

The rapid evolution of automobile technology has significantly reshaped the landscape of skills required for effective vehicle maintenance and repair. Modern vehicles increasingly incorporate sophisticated electrical/electronic systems. Consequently, auto maintenance is becoming increasingly difficult. Due to the

critical nature of OBD-2 diagnostics, it is essential that MVMs understand and read diagnostics error codes and perform repairs accurately (Oluwatimilehin et al., 2021; Usman, 2020). To keep pace with the continuous advancements in automobile technology, MVMs are required to possess expertise in utilizing computerized diagnostic tools, digital instructions, and documentation, as well as the capability to identify and rectify various systems within a vehicle. MVMs should also be technologically savvy (Ogbuanya & David, 2020). Because of this, auto-electricity/electronics have become critical components of the Motor Vehicle Mechanic (MVM) programs in technical colleges in Nigeria

However, studies have indicated that graduates of MVM programs in technical colleges in Nigeria are not equipped with the essential technical abilities to repair modern automobiles (Ibeneme & Ebubechi, 2021; Idris, & Abutu, 2019). Along these same lines, Opeyemi and Chibueze (2022) discovered that many artisans who participate in MVM programs lack the requisite skills to accomplish the labour needed by contemporary vehicles. In a similar vein, research conducted by Alabi et al. (2019), Awolola and Olayiwola (2021), Idris, and Abutu (2019), Opeyemi and Benjamin (2020) discovered that individuals who have completed their studies in the field of automotive mechanics have a deficiency in the essential practical skills required for the effective repair and maintenance of contemporary automobiles. This has resulted in a shortage of skilled mechanics who are capable of successfully utilizing computers in the diagnosis and repair of automobiles (Monye et al., 2023).

To remain competitive, the MVM program must equip its students with contemporary industry-relevant knowledge and skills. Therefore, this study is poised to identify and address these technological gaps, specifically in the context of auto-electricity/electronics training within the MVM program in Nigerian technical colleges. This research seeks to uncover critical areas of deficiency and propose solutions for bridging these gaps to enhance the quality of training, improve student preparedness, and foster stronger student employment potential. Such efforts are essential for producing a workforce capable of meeting the challenges of today's automotive industry and driving economic development in Nigeria.

Auto-electricity/electronics is a course or a module domiciled in the MVM program that trains students to acquire the fundamental knowledge and skills for vehicle construction, operation, material selection, repairs, and maintenance (Abdulkadir et al., 2020). The program aims to equip students with essential technical knowledge, a strong entrepreneurial attitude, and self-reliance (Oluwatimilehin et al., 2021). At the technical college level, the MVM program consists of five (5) unit/module courses: Service Station Mechanics' Work, Auto-Electrics/Electronics, Engine Reconditioning (Petrol & Diesel), Gasoline engine maintenance, and Diesel engine maintenance (NBTE, 2001; 2022). Students can specialise in any of the courses at successfully completing the module.

2. Methods

This study utilized a qualitative research method by employing semi-structured interviews as data collection techniques. The study's participants included nine (9) MVM administrators, primarily serving as heads of MVM departments and as MVM teachers, and five (5) teachers of the MVM program. They were selected from the nine (9) technical colleges in Delta State, South-South geopolitical zone of Nigeria. Moreover, all nine (9) technical colleges in the state offer MVM programs. Other participants include three (3) master craftsmen from the automotive industry who represent themselves in automobile service companies, and 3 managers/representatives of automobile companies who are considered employers of labour. Therefore, a total of twenty (20) participants were selected for the study using a non-probability purposive sampling method.

2.1 Procedure

The final interview protocol was developed after expert validation, and a pilot study was conducted. The interview protocol contains three sections: the demographic section, open questions, and specific questions. The demographic section dealt with the background of the interviewees, the open question section focused on the general knowledge of the issue in the program, and specific questions focused on answering the research question directly. After making initial contact with the various stakeholders and setting up appointments with them, the researcher organized the interview session with the help of research assistants. All the participant were provided with a written informed consent letter, which they consented to by appending their signatures. Participants were interviewed face to face on a certain date, time, and venue agreed upon with them. The entire conversation was audio recorded with the consent of the participants, in addition to note-taking by both the researchers and research assistants, and later, it was re-examined for better understanding.

2.2 Data Analysis

Reflexive thematic analysis by Braun and Clarke (2006, 2021) was used to investigate recurrent concepts and perspectives, resulting in logically consistent themes. This was made possible by using NVivo 14, a popular program for analyzing and managing qualitative data. NVivo allowed for careful application of codes to data

portions, allowing for the comparison of themes across various stakeholder groups. The analysis aimed to identify key themes that emerged from the semi-structured interviews, enabling a deeper understanding of the perspectives and experiences of the participants. In keeping with Braun and Clarke's (2006, 2021) approach, this study employed six phases of reflexive thematic analysis, which highlights the significance of researcher reflexivity throughout the process. NVivo helped with this by letting the researcher evaluate and improve codes repeatedly, which led to the emergence of rich and subtle themes.

The six phases of the Braun and Clarke reflexive thematic analysis include transcript familiarization, generating initial codes, generating initial themes, revision of potential themes, naming and definition, and reporting. The researcher initially engaged in the preliminary phase of familiarizing himself with the data. This entailed reviewing the transcripts to become acquainted with them, taking notes, and creating annotations. Following familiarization with the data, the researcher generated the initial codes as the second phase in the reflexive thematic analysis. The themes developed in the third phase were reviewed in the fourth phase to arrive at the final themes that were scrutinized and defined in the fifth phase. In achieving the study's objective, the analysis of semi-structured interview transcripts obtained from the participants is presented.

3. Results and Discussion

After analysing data from the semi-structured interview, the researcher identified several important themes. These themes highlight the main gaps in technology in the implementation of the program. These themes include: Gaps in curriculum and industrial alignment; Gaps in modern teaching and learning resources; Gaps in cutting-edge equipment and tools; Teachers' competence and expertise; and technological advancement in automobiles. Table 1 illustrates the relationship between the RQ and the emerging themes.

Table 1 Major research question and emerging themes

Research Question	Major Themes
What gaps in technology can be perceived in the implementation of auto-electricity/electronics in the MVM program in terms of meeting the needs of automobile industries?	Gaps in Curriculum and Industrial Alignment Gaps in Cutting-Edge Equipment and Tools Gaps in Modern Teaching and Learning Resources Teachers' Competence and Expertise Technology Advancement in Automobile

3.1 Theme 1 - Gaps in Curriculum and Industrial Alignment

This theme addresses the gaps in the MVM program's curriculum regarding the technological requirements of the contemporary automobile industry, specifically in auto-electricity/electronics. It addresses the study's RQ by highlighting the necessity for alignment between curriculum content and the prevailing practices and technology in the automobile industry. It also highlights the gaps in technology as a result of a lack of partnership or collaboration with the automobile industry or firms to guarantee that the technology required in the program aligns with industry standards. Furthermore, this theme encompasses two sub-themes that directly address the research question.

3.1.1 Sub-Theme 1 - Automobile Companies Partnership for Technology Alignment

This sub-theme highlights the gaps in technology resulting from a lack of collaboration between the automobile industry and technical colleges to ensure that the technology required in the program aligns with industry standards. This is the most highlighted gap in technology, which was mentioned and acknowledged by all the interviewees. By establishing partnerships with automobile firms, students can gain hands-on experience, internships, and access to cutting-edge automotive equipment. This helps bridge the gap between what students learn in school and what employers need, especially with new technologies like electric cars. Some of the interviewees' remarks are highlighted below.

Interviewee 09. No partnership to guarantee that the technology required in the program aligns with industry standards. **Interviewee 04.** Not at all, no one, nothing like that, at least I know that this company has nothing like that. **Interviewee 08.** I don't know of any for now, because these industries are very far from us. So, there is no partnership or collaboration for now, as far as I know. **Interviewee 16.** Well, I will recommend the need for this program to really partner with companies who are manufacturers or abreast with modern technologies. So, they

will partner with them and bring to our doorsteps modern technologies that will help to equip both these students and the teachers.

3.1.2 Sub-Theme 2 - Curriculum Content

The curriculum's content and how well it aligns with the technological requirements of the automobile industry are the primary focus of this sub-theme. Outdated teaching materials, an inadequate focus on modern technologies, and inadequate exposure to industry-standard diagnostic instruments and software are among the most common causes of content gaps in the curriculum.

Interviewee 15. Let me make a specific example, if you look at our current curriculum, they are still talking about the pushrod and rocker arms, which you don't see in modern cars. [...]. So, the curriculum is till design that we are still using the ancient and old pattern of teaching old machines that were brought 60 years ago, that is what we are still using to teach them. [...], the curriculum is one of the major gaps in technology [...]. **Interviewee 01.** Collaboration with industry's expert, will for me help. Again, I do not know exactly what is in their curriculum, but they should always try to upgrade or refine or enrich the curriculum with the latest in the automobile industry.

Figure 1 illustrates theme 1, sub-themes, and the associated codes that describe the gaps in curriculum and industrial alignment.

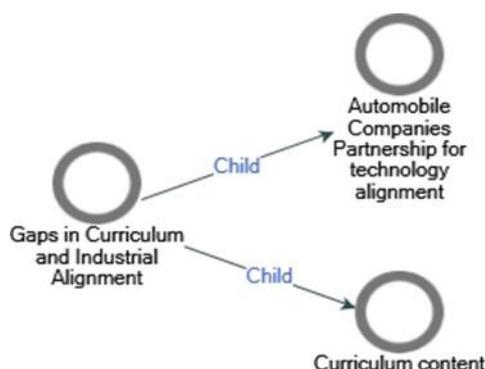


Fig. 1 Gaps in curriculum and industrial alignment

3.2 Theme 2 - Gaps in Cutting-Edge Equipment and Tools

This theme encompasses the gaps in advanced tools, equipment, and facilities within the MVM program, specifically in the areas of auto-electricity and electronics, which hinder its ability to meet the technological demands of the automobile industry. It addresses the RQ by highlighting specific areas where the program falls short in offering students practical experience and exposure to cutting-edge technology. The sub-themes focused on the gap in access to diagnostic and programming tools, modern facilities and equipment, and practical applications in modern vehicles.

3.2.1 Sub-Theme 1 – Access to Diagnostic and Programming Tools

This sub-theme highlights a significant gap in programs' access to diagnostic and programming devices, which is crucial for students to meet the demands of the contemporary automobile industry. This sub-theme encompasses technological gaps in several areas, including diagnostic and programming tools. The lack of current diagnostic and programming tools leaves students ill-prepared to handle the technologically advanced diagnostic systems widely used in modern automobile workplaces. Additionally, modern diagnostic devices and equipment present gaps in the technological standard equipment needed for the repair and maintenance of contemporary vehicles. Some of the interviewee statements are reflected below.

Interviewee 06. [...], those modern tools that are required to diagnose faults and to fix those faults. We need them here to be provided. **Interviewee 01.** [...], and not only the lab, they need running programmes to practice as regards the electronic components of modern vehicles. **Interviewee 02.** I told you that when the students came here, all the tools, especially the diagnostic tools we are using here, were new to them. So, we have modern diagnostic digital tools and other modern training facilities, which I believe they should have like a sample of a modern vehicle. **Interviewee 09.** I perceive the gap in the modern devices. The technology in the modern devices is very important especially in diagnosing vehicle to detect faults. **Interviewee 03.** You see, if they don't have these modern diagnostics tools with inbuilt technology to diagnose faults in modern vehicle, it is a gap and a problem to the students.

Interviewee 13. You know, in modern automobile technology, it has grown to the stage of using auto start diagnosis. It is used in detecting faults in vehicles very easy. This instrument is not here. It would have been so simple for us to show the students to make them show more interest. So, we lack tools and equipment.

3.2.2 Sub-Theme 2 – Modern Facilities and Equipment

This sub-theme presents the technological gaps in the program that result in failure to meet current industrial standards in terms of availability and utilization of cutting-edge facilities and equipment. From the data analysis, modern facilities in programming and coding of vehicles and keys and modern technological equipment and facilities represent the two major significant areas of technology gaps that derive this sub-theme. From the findings, gaps in modern technological equipment and facilities were the most highlighted areas of technological gaps in the program. Below, you can see some of the participant statements.

Interviewee 06. The modern facilities that they use in advanced countries to trace faults in vehicle, do some system programming and coding like vehicle key, we do not have such technology here. [...]. So, we have gap of technology in the use of modern tools and teaching facilities. **Interviewee 07.** The gap is too broad because what we are operating here at the moment is manual, there is no technology here. The gap is too wide. When we talk about the trend of technology in other places but in our college here, I think the only thing we or I can say my dear is that the gap is too broad here. For example, no modern workshop, the one we have the zincs are leaking. No modern tools in the workshop. **Interviewee 12.** We are doing our best we make sure that even when we don't have this latest equipment, we do our best to work with the ones we have to see if we can go higher or go further by making sure that one or two vehicles who are of modern days technology are around, we take the students to go and look and see if they can gain one or two experience not to leave them behind. Even though we cannot practicalize them fully, we try to upgrade the local way make sure we did not leave them behind. For example, in this our college, technologically the equipment we have here are all obsolete.

3.2.3 Sub-Theme 3 – Practical Application in Modern Vehicles

This sub-theme highlights the gap in practical training opportunities that align with the technology of modern vehicle models. This problem hinders students' ability to apply classroom theory to real-world situations since they lack hands-on experience with contemporary automobiles. Students will not get the chance to become acquainted with the most recent automotive technology unless they work on modern vehicles.

Interviewee 09. [...], functional modern vehicles with the new model technology we don't have to practice. **Interviewee 12.** Currently, the gap is enormous because we don't have such modern vehicles in our college to practice with. **Interviewee 12.** [...], we do our best to work with the ones we have to see if we can go higher or go further by making sure that one or two vehicles who are of modern days technology are around, we take the students to go and look and see if they can gain one or two experience not to leave them behind. **Interviewee 20.** You can imagine a workshop that is using 1998-2000 model cars. These are over 10 years, 5 years behind technology. Those cars of 90s and 2000s do not possess most of the technologies most cars of today have.

Figure 2 illustrates theme 2, sub-themes and the associated codes that describe the gaps in cutting-edge equipment and tools.

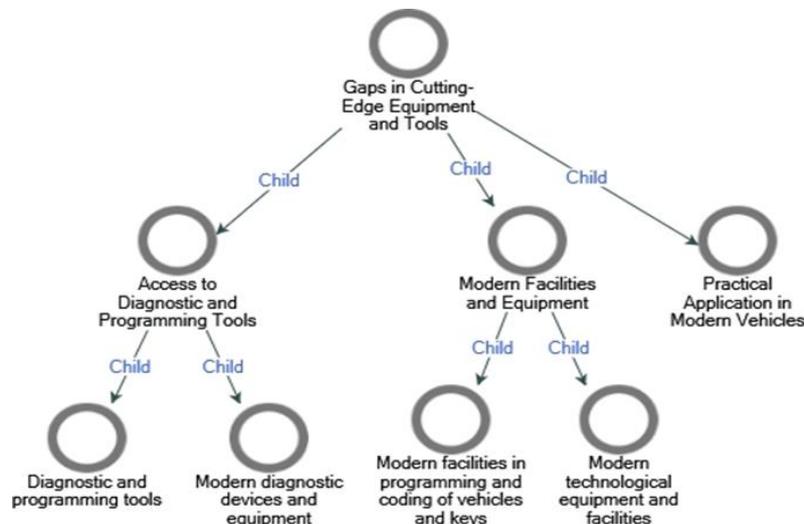


Fig. 2 Gaps in cutting-edge equipment and tools

3.3 Theme 3 - Gaps in Modern Teaching and Learning Resources

The study found in this theme a gap in sufficiently updated technological teaching resources, equipment, and facilities, making it challenging for students to acquire practical skills and industry-relevant knowledge. It portrays the need for updated instructional materials and learning aids to transition students from classroom theory to real-world practice as automotive technology evolves. This theme encompasses sub-themes that pinpoint key areas where the program is not aligned with contemporary teaching standards. These sub-themes encompass deficiencies in practical live model vehicles, the need for modern teaching and learning equipment and facilities, and the need for technology-enhanced teaching and learning environments. Students are at a disadvantage in acquiring the practical skills required to work with modern automotive systems if they do not have access to modern teaching resources, such as digital simulators, multimedia aids, and tech-mediated instructional methods. This will ultimately affect their preparedness to meet industry demands.

3.3.1 Sub-Theme 1- Live Model Vehicle for Practical

This sub-theme presents the gap in the use of live model vehicles considered essential for experiential learning. The study found that students of the MVM program in technical colleges are unable to gain practical experience with real-world automobile systems because they lack access to modern automobiles to work on. This gap in live model vehicles as training equipment results in students having limited exposure to real diagnosis, repair, and maintenance procedures essential for their preparation in dealing with modern vehicle technologies. Some of the participants' remarks are reflected below.

Interviewee 15. For me, if you look at the curriculum given to us by the government, we are supposed to have a live vehicle where the students are exposed to after the class activities to see and experience how the vehicle works practically. But there is no live vehicle for the students to see how the things are been work. **Interviewee 11.** I put them through by showing them how to do it because I know that they are not used to the vehicle yet. **Interviewee 08.** [...], having equipment made available and the students' carrying out practical activities on a live modern vehicle.

3.3.2 Sub-Theme 2 - Modern Teaching and Learning Equipment

The study presents gaps in modern facilities and instructional resources in meeting the technological requirements of the automobile industry in this sub-theme. It includes gaps in electronic teaching and learning facilities such as projectors, computerized diagnostic instruments, interactive simulators, digital whiteboards, etc.; multimedia instructional facilities such as visual aids, video tutorials, and animation-based materials. Gaps in these areas make it difficult for teachers to deliver more captivating and engaging lessons on certain abstract essential topics.

Interviewee 15. Secondly, the college instructional materials are not there. For instance, the projectors, a computer system, a pointer and other multimedia devices and other instructional device that are supposed to enhance the learning of auto-electrical/electronic but they are not there. They even went to the extent that we should be using YouTube to be teaching the students sometimes. But there is no provision for them. [...]. Those are the issues, we are still using archaic and aged, old pattern of teaching. Up till now we are still using the pattern of looking at the chalkboard in teaching and technology has upgraded that pattern of teaching, we are going to another age where things are done as fast as what we expect them to be. Here we are still in a very backward approach in the use of technology in teaching. [...]. So, we need to upgrade to modern approach of teaching and modern technology in vehicle, [...], gaps in multimedia instructional facilities, gap in modern technology in term of modern live vehicle and gap in audio-visual instructional materials.

Interviewee 18. In the modern way of teaching for example we need to use all these white board, smart board, projectors, computers and so on. All these things are not found in this college. They are very far from us here. **Interviewee 01.** In as much as the world is evolving, even faster than some of us can keep track of, most of these schools still find it difficult to upgrade. They can't boast of e-learning. If the students are not in the classroom, learning and teaching cannot take place. In other words, they lack modern technology in teaching and learning especially e-learning and ICT. You know what happened during covid 19 lock down. Some schools cannot keep teaching and learning because they lack the technology and facilities to do that. You will hardly see any teacher in those colleges use projector to teach.

3.3.3 Sub-Theme 3 - Technology Enhanced Teaching and Learning Environment

This subtheme underscores the significance of a technology-mediated learning environment, integrating digital tools into regular instruction to equip students for a digitally driven automotive workforce. This subtheme highlights the gaps in modernized technology-enhanced classroom settings, which are essential for preparing students to meet the demands of modern automobile industries, particularly in auto-electricity/electronics. Furthermore, it also involves gaps in utilizing internet resources, simulation software, and virtual labs.

Consequently, this hinders students' ability to learn through digital modules and simulations, which are particularly beneficial for practicing diagnostics and troubleshooting without the need for an actual vehicle.

Interviewee 17. The gap I perceived is the training environment. I think it is far behind compared to what they have in western world for example, what we have is still purely analogue, normal classroom teaching.

Figure 3 illustrates theme 3, sub-themes, and the associated codes that describe the gaps in modern teaching and learning resources.

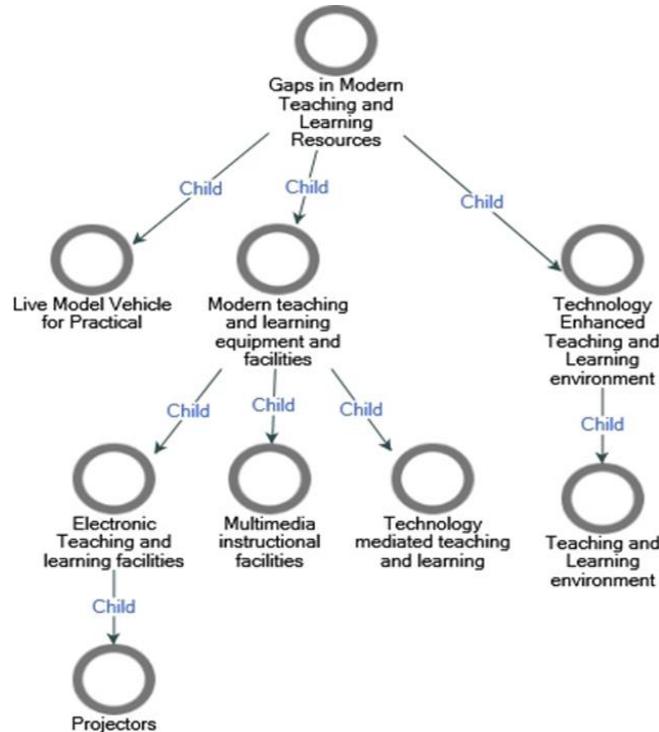


Fig. 3 Gaps in modern teaching and learning resources

3.4 Theme 4 - Teachers' Competence and Expertise

The study's data analysis revealed a gap in the level of knowledge and expertise among teachers when it comes to addressing technological changes in the contemporary automobile industry. Furthermore, the study delves into the teachers' level of skill and practical knowledge in evolving automobile technology, particularly in the auto-electricity/electronics aspect of the MVM program. This theme essentially addresses the research question, as the competency of teachers directly impacts students' ability to acquire relevant knowledge for the contemporary automotive sector. As vehicle technology advances, it is imperative that teachers possess a thorough understanding of modern automobile technology and digital systems. Two sub-themes underpin this theme: competent and experienced teachers, and expert teachers and personnel.

3.4.1 Sub-Theme 1 - Competent and Experienced Teachers

This sub-theme explains the gap in teachers who are knowledgeable and experts in auto-electricity and the latest automobile technology. Primarily, it focuses on the gap in teachers' knowledge and experience in auto-electricity/electronics and the latest technology. The study found that the majority of teachers do not possess the latest knowledge and do not have sufficient practical experience with contemporary technologies, such as advanced diagnostics and automotive programming. This gap hinders their capacity to equip students with practical knowledge and skills that are essential to the ever-changing demands of the automobile industry. Some of the participants' statements are reflected below.

Interviewee 01. Let me also say this, I use to also interview them when they newly came to know the level, they can apply their knowledge and skills. Most of the students have complained that most of their teachers are not really abreast with new technologies in modern vehicles. **Interviewee 04.** The teachers involved too are not abreast of the latest technology in the industry. That is why they cannot give what they do not have. [...]. I said the teachers and the school cannot give what they do not have. **Interviewee 02.** I think that availability of correct and competent teachers and who are good in the technology of these modern vehicles and their component is very important. When the teacher know they will be able to teach the students. If they don't upgrade themselves, I do not think the student in the college will learn. **Interviewee 08.** More training should be given to the teachers to

upgrade their knowledge of this electrical/electronics. This is because, most of us are so knowledgeable on the mechanical aspect. So, in this auto-electrical/electronic aspect, we need more training. [...]. Also, let the government employ more competent teachers and experts to help in handling the practical aspect of the course. In the same way to enhance or to let the students learn more practical skills, they need to be taught with a well-qualified and competent teacher.

3.4.2 Sub-Theme 2 - Expert teachers and personnel

The study's findings revealed a shortage of expert teachers capable of covering advanced areas in auto-electricity and electronics, such as vehicle programming, mechatronics, and high-voltage systems. Teachers with extensive field experience and strong technical skills are scarce, thereby depriving students of the opportunity to learn intricate diagnostic and repair techniques. To help students make a seamless transition into professional employment, expert teachers offer both fundamental knowledge and insights into industry practices. For students to make a seamless transition into career fields, expert teachers not only impart fundamental knowledge but also give insights into the practices that are prevalent in the industry.

Interviewee 16. One of the major challenges which is very eminent is having a vast teacher or instructor who is both practically and theoretically inclined at the same time. Having a complete competent teacher who will be able to do the both theory and practical effectively. The teachers are not equipped to handle most practical aspects. You know this modern vehicle requires advanced practical knowledge. Because you cannot definitely give what you do not have. Well, the gaps I perceived should be primarily in the areas of having a well-equipped or qualified personnel who will help in upgrading the knowledge of individuals that are interested in this field. The personnel who are abreast with the modern technology in the field of automobile technology. **Interviewee 13.** They also need knowledge of workshop and also need outside knowledge of experts because most of us here we are not expert in practical skills. So, for the student, even as we carry out practical here, we also recommend and take them to practical workshop outside the school. The workshop where they can find experts that know more than us the teachers. In the area of practical, it's not all the electrical practical we do. The ones that are difficult to us, we take them to outside workshop where we have the experts to direct us to make the students to meet up with the new technology in the system. **Interviewee 04.** The teachers I can also tell you that most of them are not really experts and they are not upgrading in terms of equipping themselves with the latest technology in the area. [...]; they don't have expert as teacher so they cannot produce good students.

Figure 4 illustrates theme 4, sub-themes, and the associated codes that describe the gaps in teachers' competence and expertise.

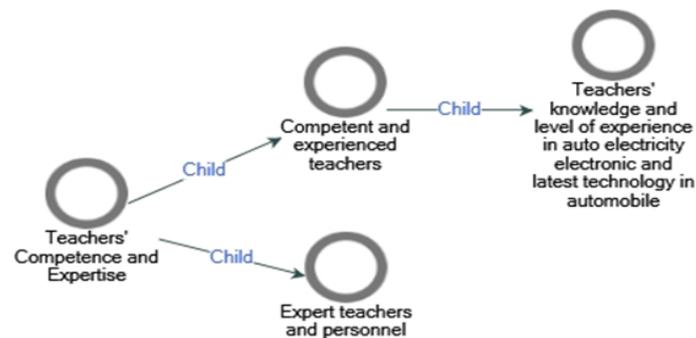


Fig. 4 Gaps in teachers' competence and expertise

3.5 Theme 5 - Technology Advancement in Automobile

This theme highlights the gaps in integrating modern automobile technology into the MVM program, thereby limiting students' understanding and proficiency in the modern systems crucial to the modern automobile industry. The theme pinpoints the areas where the MVM program lacks alignment with the latest developments in auto-electrical/electronics, thereby addressing the RQ. The theme also includes sub-themes that target specific gaps, such as the components of modern automobile technology, the latest and evolving technology in automobiles, and students' interest in technology.

3.5.1 Sub-Theme 1- Components of modern automobile technology

The study reveals gaps in exposure to components that are relevant to modern automobile technology in the program's implementation, such as advanced sensor networks, computer-based control units, electric vehicle components, etc. Consequently, MVM students are unable to gain practical skills and knowledge to identify,

handle, and maintain these components, which leaves them ill-prepared for the technologically demanding requirements of the contemporary automobile sector. Students lack the opportunity to gain expertise with these specific components, putting them at a disadvantage when they enter the industry, where engagement with these types of systems is increasingly crucial. Below are some of the participants' remarks.

Interviewee 02. When the students came here, I noticed that they don't know much about many components in this modern vehicle and I think it is because they are not being taught in the schools or show them some of these things in the schools. For example, in hybrid vehicles and some engine components. **Interviewee 20.** It's one thing to mention the names of these auto-electricity/electronic components we encounter with in the YouTube play and all that. But without these students been able to like see if live in the workshop becomes a challenge when they go out to outside workshops to be able to assess some of these electricity/electronic components like the sensors, [...].

3.5.2 Sub-Theme 2 - Latest and Evolving Technology in Automobile

This sub-theme discusses the significance of imparting to students the most recent advancements in the automobile industry, given how quickly technology is developing in this field. Data analysis showed that the program has a serious technological gap when it comes to assessing current trends and recent developments in the automotive industry, such as CNG vehicles, hybrid systems, and electric and autonomous vehicles. Students are unable to acquire the skills and knowledge necessary to properly service contemporary automobiles due to a lack of exposure to new technology, which limits their comprehension of these systems. Without exposure to these innovations, students will lack the necessary skills to meet industry standards, including the ability to diagnose and repair the complex electronics found in modern vehicles.

Interviewee 01. You will hardly see any teacher in those colleges use projector to teach. Again, for instance, you know cars are drifting towards electric vehicles and hybrid, and I do not know what they are teaching them in schools. But I think whatever they still do in school is still based on petrol, of which the automobile industry is moving beyond petrol to CNG to electric vehicles and others. For students, if they are not exposed to the evolving technology in the industry in their colleges, when they come out, they will find it difficult to cope with the modern vehicles. The engines may be the same, but then, the technologies associated with the operation of the engine that they need to know in order to be able to work on those vehicles. If you ask me, I will say that they are not learning those technologies in the colleges because, when they come here, it is almost that they are starting afresh.

Interviewee 03. what you see in the old model may not be what you see in the modern ones. So, when they come these days, they always find it difficult in dealing with those vehicles with body sensors and most of these components like gearbox, sensor and module. Most of our vehicle here uses weather to control the light and windscreen wipers. So, when they come, they are really challenged with different vehicle technology altogether from what they have learnt in the school. Every day we have new technologies in motor vehicles, so sometimes the technology of vehicle they learn in school is not what they will see when they graduate or when they come here. The motor vehicle technology is advancing every day.

3.5.3 Sub-Theme 3 - Students' Interest in Technology

Data analysis has shown a lack of students' interest and readiness to explore the latest automobile technology. This gap highlights the value of exposing students to contemporary automotive technology, fosters an active learning environment, and gives them the self-assurance and desire to seek out more skill development opportunities in the sector.

Interviewee 04. There are another issue people do not always talk about. That issue or will I call it gap? That is the student interest in the technology matters a lot. I discover that most students sent here are always after the stipends they will receive from the government for industrial attachment. They are not even interested in the tools nor the job itself, they just want to cover up from the training. [...]. So, the students' interest and intention must be understood.

Figure 5 illustrates theme 5, sub-themes, and the associated codes that describe the gaps in technological advancement in automobiles.

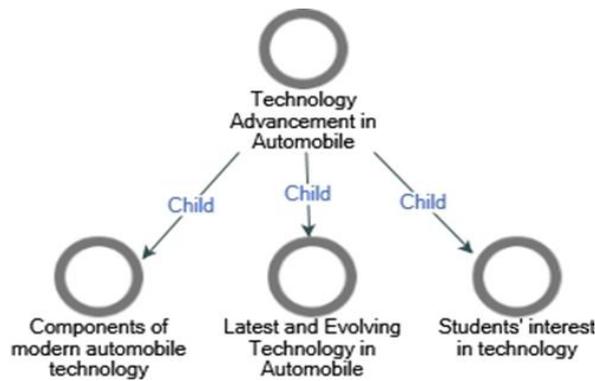


Fig. 5 Gaps in technology advancement in automobiles

3.6 Analysis of Findings

Based on the data analysis, the study revealed five (5) major technological gaps perceived in the implementation of auto-electricity/electronics in the MVM program. Figure 6 presents these gaps and their references

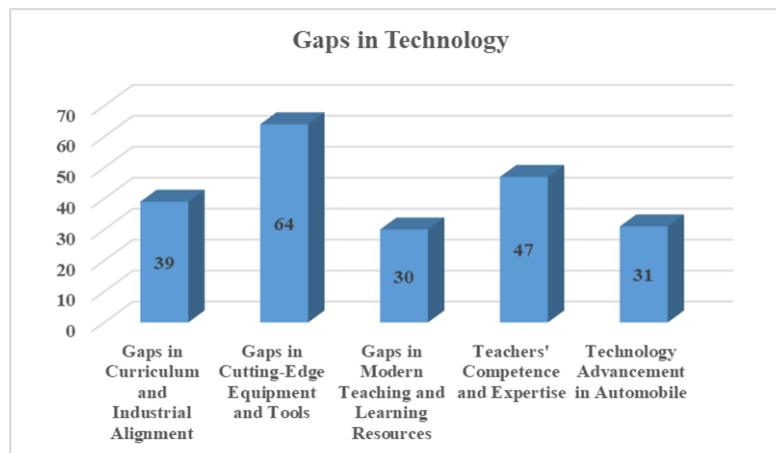


Fig. 6 Gaps in technology in the implementation of auto-electricity/electronics in motor vehicle mechanic programs in terms of meeting the needs of the automobile industry

Figure 6 shows gaps in cutting-edge equipment and tools (64) have the highest references, making it a significant gap, suggesting a major lack of contemporary diagnostic equipment and tools. The second most referenced is the teachers' competence and expertise (47), indicating a potential gap in the teachers' knowledge of contemporary automobile technology. The third is a gap in curriculum content and industrial alignment (39), indicating a misalignment between the curriculum content of the program and the needs of the industry and a lack of industrial partnership to ensure the technology used in the program aligns with the industry's standards. Fourth is the technology advancement in automobiles (31), indicating the program gap in keeping up with the advancement in automobile technology, such as electric vehicles, hybrid vehicles, etc. The fifth is the gaps in modern teaching and learning resources (30), indicating a lack of modern teaching and learning materials. The findings suggest the need to upgrade the tools and equipment and improve on the teachers' expertise to better meet the industry standards.

4. Discussion

The findings revealed several critical technological gaps impeding adequate implementation of auto-electricity/electronics in the MVM program, especially in meeting the evolving needs of the automobile industry. One of the significant gaps identified relates to the alignment between curriculum content and industry demands. Participants noted a gap in the curriculum of auto-electricity/electronics. They found that the most recent technological advancements in the industry did not align with what was taught in the classroom. To guarantee that the program stays in line with established and new industry requirements, a persistent issue was the lack of

a formal collaboration between the automobile industry and technical colleges. This finding corroborates the study by Okolo (2023), who argued that the automotive industry and MVMs need to collaborate to provide advanced diagnostic tools for automated cars, as current graduates of MVMW lack the practical skills required to diagnose, fix, or maintain contemporary vehicles. Therefore, by fostering closer collaboration with industries, the curriculum contents could be updated more frequently to incorporate the latest advancements in automobile systems, ensuring that students acquire the skills necessary to meet the demands of the modern automobile industry.

One of the most significant research gaps in this study is the lack of access to cutting-edge tools and equipment. This encompasses a lack of access to diagnostic and programming tools, modern diagnostic devices and equipment, modern facilities in programming and coding of vehicles and keys, modern technological equipment and facilities, and practical applications in modern Vehicles. As technology in automobiles is fast evolving, these gaps limit students' exposure to contemporary automobile technology. Lack of access to these technologies puts students at a disadvantage when they enter the workforce, since they might not have the practical experience needed to maintain and troubleshoot modern automobile systems. These findings align with the study by Opeyemi and Benjamin (2020), who argued that MVMs lack the computer abilities to use automotive digital diagnostic tools, making diagnosing, repairing, and maintaining current vehicles difficult. Also, maintenance practices are below global standards. It is also in line with the study by Idris et al. (2020a) who argued that the MVM program lacks modern facilities for training.

Gaps in teaching and learning resources were also identified by this study, especially in relation to hands-on training and instructional processes. For auto-electricity/electronics instruction to be effective, live model automobiles that replicate real-world problems and situations were considered essential. However, students could not receive enough exposure to the entire system of contemporary automobile technologies if these vehicles are not present in teaching settings. Furthermore, contemporary technology-enhanced learning tools like interactive learning platforms, simulation software, and digital resources supporting conventional teaching methods are frequently not integrated into the actual classroom environment. Particularly in an area where experiential learning is crucial, integrating these technologies could enhance student engagement and offer beneficial virtual experiences that close the knowledge gap between theory and practice. These findings corroborate the study by Eromosele (2023), Ike et al. (2020), whose study revealed a significant difference in the average achievement scores of students taught vehicle electricity technology using traditional techniques and those taught using computer-aided design.

Furthermore, one of the most important factors in resolving these technological gaps was found to be the competence and experience of teachers. The interviewees raised concerns regarding the supply of qualified teachers who are knowledgeable about the most recent advancements in automobile technology. A number of participants pointed out that the automobile industry's rapid technological development necessitates teachers who are knowledgeable in conventional mechanics and innovative areas like electric vehicle technology, automotive software programming, and smart system integration. Employing and regularly training teachers with specific knowledge of the most recent advancements in automobile technology is crucial to guarantee that the MVM program is effective and relevant. This will ensure that graduates are ready for the opportunities and difficulties in the automobile industry by bridging the gap between the training given to students and the changing needs of the industry. These findings corroborate the studies by Abdulkadir et al. (2020), Legg-Jack and Alant (2022), Martubi et al. (2022), Ujevbe et al. (2020), who argued that there is a lack of sufficient technical expertise held by MVM teachers.

Additionally, the swift advancement of technology in contemporary automobiles, especially in areas like autonomous systems, electric vehicles, and hybrid car technologies, poses serious obstacles for educational programs attempting to stay relevant. The study revealed that although some students are generally not very interested in automotive technology, there is frequently a gap between what they study in school and what the industry uses, since they are not exposed to the newest advancements and changing technologies. This is in line with the study by Amaechi and Thomas (2020), who argued that technical institutions in Nigeria must update their curriculum to reflect the most recent developments in motor vehicle mechanics' practical abilities. According to the study, closing these technological gaps necessitates modernising curriculum materials and physical resources and creating a more flexible and dynamic learning environment that can keep up with the rapid advancements in technology in the automobile industry.

5. Conclusion

In conclusion, the study reveals significant technological gaps in the implementation of auto-electricity/electronics in MVM programs as regards the industry demands. These gaps include gaps in curriculum and industrial alignment, cutting-edge equipment and tools, modern teaching and learning resources, teachers' competence and expertise, and technological advancement in automobiles. The study underscores how urgently the auto-electricity/electronic in the MVM program needs to address these gaps by investing in current training

equipment, modernizing curricula, collaborating with industry more closely, and providing teachers with continuous training. Particularly noteworthy is the mismatch between the automobile industry's rapid advancement in technology and the current methods of instructional delivery, underscoring the urgent need for more adaptable and dynamic training frameworks. The study unequivocally shows that tackling these issues calls for a multifaceted strategy that includes improved teacher professional development programs, increased investment in cutting-edge training materials, stronger industry-education partnerships, and more adaptable curriculum structures that can successfully adapt to technological advancements. To keep up with the changing demands of the automobile industry and promote long-term technological progress in automotive training, MVM programs must undergo this extensive overhaul so that technicians are adequately trained to maintain and service modern vehicles.

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Conflict of Interest

Authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The authors contributed equally to the research.

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