Research in Social Sciences and Technology

https://ressat.org

E-ISSN: 2468-6891

Volume: 10 Issue: 1 2025

pp. 426-441

Investigating Teachers' Integration of Technology in Automotive: A Case in Technical Schools

Koketso Morudu[a]

a. Durban University of Technology, South Africa.

Email: KoketsoM@dut.ac.za

10.46303/ressat.2025.23

Article Info
Received: June 12, 2024
Accepted: August 26, 2024
Published: February 4, 2025

How to cite
Morudu, K. (2025). Investigating Teachers' Integration of Technology in Automotive: A Case in Technical Schools. *Research in Social Sciences and Technology*, 10(1), 426-441. https://doi.org/10.46303/ressat.2025.23

ABSTRACT
The study aimed to examine how teachers in technical schools in automotive classrooms integrate technology, employing a case study research approach. The Technological Pedagogical Content Knowledge (TPACK) model coined by Mishra and Koehler (2006) was used to underpin the study as a framework. It emerges as a useful construct for researchers working to understand technology integration in learning and teaching. We collected data by conducting face-to-face interviews with automotive teachers and making observations during the study period. Interviews were thematically analysed through verbatim quotes, and observations were analysed descriptively. Existing literature provides various factors that contribute to the difficulties of teaching and learning automotive. The aim and purpose of this study were to examine and explore automotive teachers' knowledge in terms of how they integrate technology in automotive. The participants who were regarded as knowledgeable and experienced in automotive were selected using a convenient sampling method. The study made use of a case study approach. The data collected was thematically analysed and presented using categories such as teachers with experience showing enhanced technology integration, teachers engaging in active learning, teachers showing positive attitudes towards the integration of technology, and teachers believing in blending classroom and workshop teaching styles. The teachers emphasised access to the workshops, machinery, and knowing how to use them. The findings suggest that innovative strategies, including but not limited to being proactive, improvising, and seeking assistance, can be used to integrate technologies. The study reveals that the teachers attempted to use various innovative strategies for integrating educational technologies into their instructional methods. Teachers were in pursuit of integrating content, pedagogy, and technological knowledge for successful teaching. Automotive teachers need to be TPACK specialists to successfully integrate pedagogy, content, and technology into their teaching to maximise the process of knowledge construction. The study suggests that technical schools offering automotive courses, the Department of Education, and other key stakeholders should implement innovative strategies to facilitate the complete integration of technology. Furthermore, it recommends that teachers receive continuous training in using innovative technology. The study recommends that technical schools offering automotive, the Department of Education, and other key stakeholders implement innovative strategies to help in the complete integration of technology. Furthermore, it recommends that there should be continuous training in the use of innovative technology for teachers.

KEYWORDS
Automotive; TPACK; teachers; technical schools; technology.

INTRODUCTION

Automotive is an elective subject within the broad mechanical technology offered in technical high schools at Further Education and Training (FET), from grades 10–12. According to the Curriculum Assessment Policy Statement document (Caps Doc, 2014), "in the engineering world, automotive serves as a fundamental foundation for future engineers in terms of the construction, design, repair, maintenance, and operation of the automotive and manufacturing industries" (p. 9). Automotive involves the integration of both theory and practice during teaching. Therefore, it embraces practical skills and the application of scientific principles. Due to this, it is essential that workshops be equipped with proper and functional equipment in technical schools that offer automotive.

According to Vorona-Slivinskaya et al. (2020), the old traditional teaching methods and approaches are not emphasising learners' skills to acquire knowledge, which is why learners tend to struggle with acquiring technical knowledge. Kreisman and Stange (2020) argue that technical schools offer technical knowledge and skills that prepare learners to perform tasks of a particular work in various jobs such as a trade, a craft, or as a technician or engineer. Sutherland (2019:233) contends that there is a shortage of skilled artisans in South Africa (SA). This has become a problem that should be addressed due to the fact that it affects the country's economy. Learners in technical schools studying automotive have the hope that they will contribute meaningfully to the country's economy. According to Abe and Chikoko (2020, p. 3), technical skills that are offered in technical schools play a "crucial role in the endeavour to meet the skill shortage and drive for the economy." Technical schools provide foundational knowledge and skills for the future of artisans. An automotive artisan is a person who undergoes thorough training to acquire sufficient knowledge and skills to undertake tasks in the automotive industry. Furthermore, Abe and Chikoko (2020:4) contend that prioritising the effectiveness and quality of technical schools is crucial for ensuring the production of human capital.

From my recent teaching experience, I have noticed that technical teachers play a major and key role in the production of skilled artisans; therefore, it is of utmost importance for them to ascertain that they have positive attitudes towards automotive. Furthermore, automotive teachers should have strong, not just foundational, technological pedagogical content knowledge (TPACK) to enhance their instructional practices and ensure that learners are properly trained with sufficient knowledge for the industry. According to Koehler and Mishra (2009), TPACK is a technology integration framework that identifies three types of knowledge (pedagogical, content, and technological) that teachers need to combine for a successful technology-integrated lesson. Consequently, the teacher offering automotive must be a trained subject specialist; they can be an artisan, technician, or even a qualified technical teacher in a mechanical-related area. A teacher should "have industry-related experience, and proper workshop management skills are essential" (Caps Doc, 2014:14).

Furthermore, Koehler and Mishra (2009) allude to the fact that TPACK shows us that there is a relationship between technology, content, and pedagogy, and the purposeful blending of them is key to promoting a better understanding of the collaboration between technology and pedagogy. Sutherland (2019) alludes to the fact to the fact that the issue of having a severe shortage of artisan skills locally forces the country to hire expatriate technical-skilled artisans as such skills are not available in SA. Consequently, the unemployment rate keeps rising because, instead of local people occupying posts, non-SA nationals do. Berger and Girardet (2020) contend that teachers classroom management styles, motivation, attitudes, knowledge, beliefs, and practices have a significant impact on learners' engagement and influence their learning outcomes. As such, poor performance by learners in that instance can be caused by teachers' incapacity to deliver the theoretical and practical components of the curriculum to students. Furthermore, Kreisman and Stange (2020) maintain that students in some instances are unable to make a transition between theory and practice with confidence and effectiveness; the cause of this difficulty in making the transition from theory to practice arises "from a failure of the teacher to integrate both theory and practice into the same course in the curriculum in ways that are relevant and meaningful to the learners" (p. 20).

LITTERATURE REVIEW

According to Pambudi and Harjanto (2020), within technical subjects, it is essential to notice the need for the integration of theory and practice to be of utmost importance. They further assert that practical knowledge is a reinforcement of the concepts acquired through theoretical knowledge. Therefore, in order for knowledge that was acquired through a lesson in the classroom to be strengthened and well understood, practical steps should be followed to enable learners to relate to visible objects. Consequently, for better results in knowledge construction, practical work plays a major role in the development of knowledge and deeper understanding. Manubag et al. (2023) argue that in technical vocation, the latter is pinned down to the educators' technological pedagogical knowledge as well as the inclusion of necessary equipment for skill training. Gamble and Young (2009:98) argue that vocational curriculum needs to be structured around both conceptual knowledge, which they refer to as context independence, and practical knowledge, which they refer to as context dependent. By context independence, they try to show that, on numerous occasions, conceptual knowledge can be taught on its own, whereas by context dependence, in the case of practical, dependence indicates there is a need to ground and anchor practical with theory for it to be successful. The teaching of automotive differs from that of all other familiar subjects.

Ozer (2020) asserts that the teaching methods of vocational education differ from those of other learning areas. Furthermore, he shows that vocational education's main goal is problem solving; thus, both results and procedures are equally crucially vital in its teaching; hence, it should be taught through involved activities. Teaching automotive involves learners being actively engaged in the design and development of solutions to problems; hence, it is

established "affectionately as a hands-on and mind-on learning area" (Ozer, 2020:5). Vorona-Slivinskaya et al. (2020) argue that although experience may be the foundation of learning and make the teacher more knowledgeable, it does not automatically or even necessarily always lead to active learning. Therefore, it does not matter whether the teacher has vast experience in the field or not; it is important for him or her to be fully active and allow hands-on participation from students. Vorona-Slivinskaya et al. (2020:259) state that "Using an active learning environment can enhance the integration of practice and theory in the classroom." Furthermore, they describe active learning as using instructional activities, encouraging students to actively participate, and enabling critical thinking. In simple interpretation, learners should be more involved in the lesson through participation than listening; the teacher should aim to develop learners' skills.

During automotive lessons, "students should be involved in higher-order thinking (analysis, synthesis, and evaluation) and should be engaged in activities that involve action, collaboration, discussion, and observation; greater emphasis is placed on learners' exploration of their attitudes and values" (Kreisman & Stange, 2020:30). Automotive involves activities that should "allow learners to clarify, question, consolidate, and appropriate new knowledge" (Berger & Girardet, 2020, p. 202). Based on my understanding, an active learning environment should promote learners' interest in the subject and encourage their participation; it is therefore based on the teacher's ability to enable the environment for productive learning. Teachers' attitudes towards their subject of specialisation play a role in how they talk about the subject, how they present content, and how enthusiastic they are towards the subject. In terms of automotive, a teacher who makes his or her students sense that he or she is enthusiastic about teaching the subject and confident in the learner's learning abilities is a good teacher because not only is he or she enjoying the subject, but he or she has the potential to make the learners enjoy it too and therefore develop positive attitudes towards it. Ozer (2020) suggests that teachers should foster experiences that require students to become active learners and scholarly participants in the learning process. Freire (1970, 1994) likewise argued that learning requires the active participation of the student and that knowledge arises out of a shared process of inquiry, interpretation, and creation.

According to Mishra and Koehler (2008), TPACK is not just a tool used to facilitate teaching and learning processes; it is a necessary and compulsory knowledge that every teacher must have. Zhang and Tang (2021) state that teachers who lack technological knowledge fail to connect the learning process, which leads to effective teaching and learning. Therefore, technical knowledge is important as it enables access to effective teaching and learning. Vorona-Slivinskaya et al. (2020) argue that while technology is readily accessible in most elementary classrooms, teachers are not using it effectively to impact student learning. This then means that there is a need to pinpoint the precise characteristics of knowledge associated with presenting content through technology to better prepare teachers to successfully integrate technology into their daily instructional practices. Technical teachers need a set of specific

professional knowledge, which "includes knowledge of concepts and theories behind each practical application as well as methods to expand that knowledge to create a new one" (Sutherland, 2019, p. 235).

Furthermore, amongst the teacher's specific professional knowledge should be technological knowledge, which is an important competency required by every vocational teacher "to produce alternative instructional methods" (Pambudi & Harjanto, 2020:216). Therefore, we no longer view technological knowledge merely as a tool to aid in teaching and learning processes, but rather as an essential and mandatory knowledge that every teacher must possess (Mishra & Koehler, 2008, p. 17). According to Berger and Girardet (2020, p. 205), learners, as future technicians, must understand both the mechanical systems in vehicles and the electrical or electronic systems. Consequently, he alludes to the idea to the idea that learners will develop diagnostic skills that will allow them to repair faults in vehicles. For effective teaching, teachers should be equipped with the necessary technological knowledge that allows smooth learning in classrooms and workshops because teaching and learning in a technical school involve theory and practice. Teachers may spend most of their time supervising and observing learners as they grapple with theory and practice, a crucial aspect of teaching and learning in vocational education. However, Abe and Chikoko (2020:6) argue that occasionally learners perform poorly due to a lack of practice, and I believe it is the teachers' responsibility to make sure that learners receive sufficient practical knowledge and skills.

On the contrary, the smooth running of the school also plays a role; teachers might have a phobia that "if the equipment they use for demonstration gets damaged, it might be a process again to get it fixed" (Abe & Chikoko, 2020:8). However, I still maintain that practical works are of paramount and vast importance. Basically, it is vital that pupils receive a thorough foundation of knowledge and skills that will allow them to learn new things when necessary and be able to adapt to diverse working environments.

THEORETICAL FRAMEWORK

The study aimed to investigate the integration of technology by teachers in technical schools. The nearest model that emerged as fit for vocational education was the professional knowledge framework proposed by Mishra and Koehler (2006), known as TPACK. In the TPACK framework, emphasis on technological knowledge and technology integration in the whole process of teaching and learning is most important. The name TPACK "embraced the idea that pedagogy, content, and technology should not be treated separately from each other but should be considered as a whole for good teaching with technology" (Thompson & Mishra, 2007:78). TPACK refers to the skill of simultaneously incorporating technology, pedagogy, and content into a lesson. TPACK can be described as:

The knowledge of the dynamic, transactional negotiation among technology, pedagogy, and content and how that negotiation impacts student learning in a classroom context. Cox (2008) asserts that the essential features of TPACK are (a) the use of appropriate technology (b)

in a particular content area (c) as part of a pedagogical strategy (d) within a given educational context (e) to develop students' knowledge of a particular topic or meet an educational objective or student need (Cox, 2008, p. 24).

We selected the TPACK model as a foundation to investigate how teachers incorporate the use of technical equipment into their instruction. Looking at how the automotive industry has improved, vehicles nowadays rely on hi-tech electronics for controlling most systems in the car, from the engine management (a push-start button is installed and keys are no longer used to turn on the ignition) to entertainment systems and climate control (the car detects the temperature that suits the driver, e.g., if it is cold outside, the car switches the heater on and vice versa). According to Naiker (2017), auto technicians must understand both the mechanical systems in vehicles and the electrical or electronic systems. He further argues that these technicians need to develop diagnostic abilities that will enable them to perform problem-solving (repair and maintenance) on any vehicle. For effective teaching and making sure that learners leave FET with sufficient knowledge, teachers need to be armed with teaching skills that accommodate modern and recent conditions in terms of how the automotive industry has advanced, and the "teaching resources have to be specifically designed to allow the creation of technology-based/infused training" (Naiker, 2017, p. 8). Teachers' technical skills should include the effective use of innovative instructional strategies, such as the use of simulators and electronic training boards, to teach certain topics. Automotive lessons involve a lot of hands-on applications with regards to building experience and promoting collaboration between teacher and learner as well as within learners themselves.

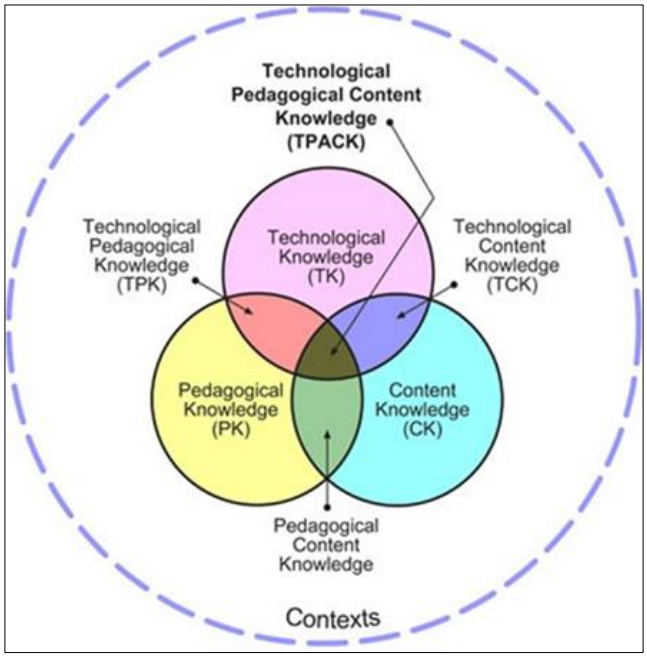
The use of ordinary teaching aids such as textbooks, periodic charts, maps, and others can be regarded as material that is apparent in traditional classrooms. The way lessons are presented should progress, especially in subjects like automotive. Digital technologies can be used in classrooms to enhance understanding and how knowledge is presented. Most schools have the use of digital educational technologies such as tablets, smartboards, educational simulators, web-based learning sites, etc. With such tools, teachers already have an advantage because learners in our classrooms are intrigued and are so interested in technology, and "good teaching requires an understanding of how technology is related to pedagogy and content" (Mishra & Koehler, 2006, p. 1022). They further suggested that TPACK specifically focuses on the "interrelationship among pedagogy, content, and technology to build up a common language among scholars and allow systematic research of technology integration in teaching" (Mishra & Koehler, 2006, p. 1023). Figure 1 below represents the total educational package of TPACK.

The model below was proposed to consist of seven sub-teacher knowledge domains, namely: content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technology knowledge (TK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPACK). TPACK was described by Mishra and Koehler (2008) as the basis of effective teaching with

technology, which requires an understanding of the representation of content using technologies, pedagogical techniques that include technologies in constructive ways to teach, and how technology can address problems that students face. Thus, the TPACK framework requires that teachers develop technical knowledge and skills and that they select appropriate technology during the teaching process. According to Mishra and Koehler (2006), to integrate technology effectively, a teacher must be fluent in all seven dimensions of professional knowledge, as alluded to above. The TPACK model is viewed as important because a teacher's professional knowledge of the curriculum in terms of automotive involves a lot of high-tech machines and technical equipment, particularly in practical training, and that requires high technological knowledge.

Figure 1.

Technological pedagogical content knowledge framework



(Source: Mishra & Koehler, 2009)

Therefore, teachers should understand the TPACK model so that they can transfer proper knowledge to learners. According to Figg and Jaipal (2012), TPACK enables multi-disciplinary integration, which is currently taken as a separate entity by most teachers. TPACK enables teachers to develop detailed, fluent, and flexible knowledge and allows them to think about the appropriate technology to be used during lesson presentations. in Naiker (2017) argues that TPACK knowledge is required to enable teachers to integrate technology in education. Furthermore, Chai et al. (2013) argue that meaningful use of ICT in the classroom requires teachers to integrate technological affordances with pedagogical approaches for the specific subject matter to be taught. Furthermore, Mishra and Koehler (2006) assert that educators have placed significant emphasis on integrating educational technologies to facilitate the development of connections between TK, PK, and CK. According to Chai et al. (2013), "with the increasing use of TPACK, it is necessary for teachers to understand the relationship between

TPACK, TK, PK, and CK" (p. 60). Whereas Wang and Chen (2006), as cited in Chai et al. (2013), argued that "some level of proficiency in technological skills was needed for teachers to integrate technology effectively" (p. 60). Therefore, a high level of TK is important for teachers to integrate TPACK.

The research questions of the study are as follows:

- How do teachers apply their subject expertise and their teaching skills to enhance the teaching and learning of automotive?
- What effects does the integration of technology bring in teaching of theory and practice of automotive?

METHODOLOGY

The study used a case study research approach due to the purpose that the "research was structured into observing and understanding participants' belief systems, perspectives, experiences, as well as attitudes and values" (Bricki & Green, 2007, p. 1). This case study design was guided by the TPACK framework proposed by Mishra and Koehler (2006). Creswell (2009) argues that a case study herein is defined as research that explores in-depth information and reports case themes and descriptions of innovative strategies for integrating technologies into vocational teaching.

Participants

Gorard (2001) defines a population as a group of participants one wishes to study. Thus, the population of this study was technical schools that specifically offered automotive in Johannesburg North District (JN-D10). Whereas sampling, as explained by Casteel and Bridier (2021), refers to the "activities involved in selecting a subset of persons or things from a larger population" (p. 344). Initially, eight (8) technical schools were conveniently sampled, with a target of one (1) teacher per school, bringing the total to eight (8) automotive teachers in total. However, of the sampled schools, only three (3) positively responded to being part of the study. As a result, three technical schools in JN-D10 provide the foundation for this study's automotive focus. Hence, the study was conducted on three (3) automotive teachers. Table 1 below shows the participant details.

Table 1.

Participants information

Pseudonym	Automotive teaching experience	Grade taught	Gender	Qualification	Taught theory/Practical
T1	2	10-12	Female	B Ed	Both
T2	6	10-12	Male	B Ed	Both
T3	10	10-12	Male	Advanced diploma	Both

The participants from whom data was collected included three automotive teachers from three technical schools. We specifically interviewed and observed the participants to understand how they integrate technology, enabling learners to comprehend more content and avoid unnecessary misconceptions. The observations were used to complement the semi-structured interviews and to look for themes and patterns that could be used to strengthen the findings that were obtained from the semi-structured interviews. Bricki and Green (2007) assert that observational data is very useful in overcoming discrepancies between what people say and what they actually do. The TPACK framework was used to group the themes and patterns."

Data Collection Instruments

The study employed semi-structured interviews and observation methods to collect the data from the teachers who taught automotive. According to Bricki and Green (2007), the techniques within an interview should aim to be credible, in the sense that the way questions are asked should be reasonable and generate valid or truthful accounts of phenomena. Creswell (2009) argues that findings from an interview "are reliable and can be used with confidence because they reflect what the research set out to answer" (p. 184). We conducted a semi-structured interview with the teachers to gather data on technology integration in automotive. We chose this type of interview to enable us to ask follow-up questions when additional information was needed. The fundamental reason for this was to probe the teachers to gain useful insight into their thoughts and opinions by aiming to discover effective feedback that could be useful in completing the study. In response, the interview provided a platform for the participants to share their perspectives on automotive education. "The semi-structured interview method allows participants to stay focused on the subject at hand, thereby avoiding distractions and facilitating a two-way conversation" (Sephokgole et al., 2023:448). Furthermore, we developed an observation schedule to gather information and observe during the actual automotive lessons. After conducting an interview with a participant, the researcher conducted classroom observations to gain a deeper understanding of the lecturers' actions, rather than relying solely on their verbal responses. The observation assisted in discovering how teaching in automotive occurred in terms of how the teacher conducts their lessons and how learners engage with the content. In addition to the observation schedule, notes were taken based on the teacher's remarks on the topic during teaching and learning.

Analysis

The teachers' interview and observation data were thematically analysed to identify themes that helped address the research questions. For this study, the data collection and analysis processes were performed asynchronously; data was collected first, followed by analysis. We used the observation data to supplement the information from the interviews. The primary objective of scrutinising the interview data was to identify recurring trends, which aided in comprehending the inventive methods employed for integrating technologies in the automotive industry. Meanwhile, the researcher used classroom observations to witness the integration process in action. To present the study's findings, the researcher became more engaged in the

transcribed data by searching for patterns that were relevant to the study. The inductive approach helped the researcher find the emerging themes in the participants' statements (Braun & Clarke, 2006). The inductive essence of qualitative data analysis implies that the researcher begins the analysis with detailed, tangible raw data before progressing to the next level. We analysed the study using the analytical steps proposed by Braun and Clarke (2006). They argue that the processes of data organisation, transcription, coding, interpretation and reduction, presentation, and drawing help the researcher verify the conclusion of the study.

Following the data analysis, in an attempt to ensure reliability, after the data was collected, the researcher checked the transcripts several times to be certain that they did not contain evident errors that could be made during transcription. Furthermore, the researcher made sure that there was no drift in the definition of codes; this was done by constantly comparing the data with the codes. In addition, for validity, data collection tools were developed in a way that aligned with the framework chosen. In addition, the researcher used member checking or respondent validation, as proposed by Stahl and King (2020:27), to determine the accuracy of the findings. The researcher e-mailed the final report and descriptions of themes to participants to determine whether they feel that the themes are accurate. It was not the raw transcripts that were sent for checking; instead, the researcher sent parts of the polished product of the themes and data. Thereafter, the participants were provided an opportunity to comment on the findings, and the participants confirmed that the findings represented them.

FINDINGS AND DISCUSSION

The interviews with the teachers were recorded, and an observation schedule along with notes were used for analysis purposes. The interview questions were interrelated to each other, to the research questions, and to the observation schedule. Within the whole data, four themes were extracted, which will be presented individually below. The interviews and observations helped generate data for the two research questions asked in the study.

Theme 1: Teachers with experience show enhanced technology integration.

Observing how the teachers applied their subject expertise in their classrooms and workshops, it became clear that their teaching had improved over the years. The teachers know what is relevant in terms of what learners should know, the way they present their lessons to the learners, and how the learners engage with the topic at hand. Given the experience that T3 and T2 had in their schools, they became more enthusiastic about the subject and how they made it look easy in terms of motivating learners to do work and engage in the lessons. What was noticed about the teachers was that they encourage learners to engage and be active with regards to the topic at hand. Boud et al. (1993), as cited in Wrenn and Wrenn (2009) argue that "experience is the foundation of learning and makes the teacher more knowledgeable" (p. 259).

Which is why, as the experience grew, the teachers had various ways to teach and deal with learners. In contrast, Boud et al. (1993), as cited in Wrenn and Wrenn (2009), further argue that experience does not automatically or even necessarily always lead to active learning.

Therefore, it does not matter whether the teachers have vast experience in the field or not; it is important for them to be fully active and allow hands-on participation from students. However, it was observed that teachers always strived for better engagement with the learners.

It was evident that teachers' effortlessly integrated technology into their lessons to facilitate learning and kept on employing effective teaching through the use of educational technologies. During the lessons, the teachers always tried to gather previous knowledge from the learners before they could move on to the topic of the day. At some point, T3 would start the lesson by asking the learners, "*Remember what we did when we were dealing with the four strokes of an engine? What is the second stroke, and what is its importance?"* After he got the correct answer, he then proceeded to say, *"Ok, given that situation, we are going to talk about the firing order of an engine."* This was a good technique, as it brought learners' prior knowledge into the picture for better understanding. He then took them to the workshop, where they observed the firing order on the simulation board, where they got to see how the spark gets distributed. In addition, teachers teaching styles involved the use of good pedagogies where learners could easily follow and be cleared upon their misconceptions; the teachers attempted to merge content and their pedagogies with technology, which is what Mishra and Koehler (2006) argue for productive and progressive learning to occur. The teachers adopted the use of computers, projectors, videos, and simulators in their teaching, and it appeared that learners followed better as they could ask questions and also answer questions asked by the teachers.

Theme 2: Teachers engaging in active learning

It was evident from the data that the teachers showed that technology education's main goal is problem solving, thus both results and procedures are equally vital in its teaching; hence, the teachers taught through involved activities. When the teachers were teaching, they actively involved learners in the design and development of solutions to problems; hence, automotive is established "affectionately as a hands-on and minds-on learning area" (Kreisman and Stange, 2020, p. 32). During the interviews, T2 alluded to the fact to the fact that *"to ascertain that learners are actively engaged in the lesson, I always prepare the tools and material to be used, and I am always in the workshop with the learners to supervise,"* whereas T1 proceeded to say, *"I prefer to come earlier, as I need assistance from colleagues and the internet sometimes. I watch videos in terms of how tasks are performed just to remind myself. I prepare the machines I'll need to use with the assistance of my learners and colleagues because these engines are heavy. I do this to make sure learners are able to actively engage with the engine and other machines."*

In simple interpretation, teachers went all out to engage and involve learners in their lessons through participation more than listening; from the data, it was deduced that their main aim was to develop learners' skills. Sutherland (2019) argues that during automotive lessons, "students should be involved in higher-order thinking (analysis, synthesis, evaluation) and should be engaged in activities that involve action, collaboration, discussion, and observation... Greater emphasis is placed on students' exploration of their attitudes and values" (p. 233). T3

then alleged that *"For me, I do a lot of hands-on tasks with the learners, because I feel they learn easier when they see and touch the actual parts. These folks like to work with these machines, some of them their family members are mechanics, I don't want to limit the content I give."* An active learning environment promoted students' interest in the subject and encouraged their participation; it is therefore based on the teacher's ability to enable the environment for productive learning. Furthermore, using an active learning environment "can enhance the integration of practice and theory in the classroom" (Pambudi Harjanto, 2020:19).

Theme 3: Teachers show positive attitudes towards the integration of technology.

The teachers used videos through the projectors in the classroom when they needed to present new knowledge to learners; furthermore, they used educational technologies (prototypes and simulators) so that learners could see the principles in operation, for example, the firing order of an engine. Teachers believed that technology helped them in terms of their lesson presentations. Teachers felt positive about the integration of technology and rated the educational technologies as excellent resources because they claimed that they made their job easier. T3 attested that *"In most cases, to better prepare them mentally, I tell the learners which videos they should watch on their cell phones; because that's one thing they enjoy using, so I might as well use that to my advantage. I give them links, then they would have an idea in terms of what is to be done in class."* It is argued that:

The essential features of TPACK are (a) the use of appropriate technology (b) in a particular content area (c) as part of a pedagogical strategy (d) within a given educational context (e) to develop students' knowledge of a particular topic or meet an educational objective or student need (Cox, 2008, p. 65).

Furthermore, T2 said *"For me in most cases, I prepare my lessons on a PowerPoint then I present them in class through my laptop and a projector. Isn't that simplicity? I keep the presentations; I know I would use them in the future. I use them to critique my teaching, they help me see if there's important information I might have missed then I am able to integrate that in my next lesson."*

According to Mishra and Koehler (2006), TPACK specifically focuses on the interrelationship among pedagogy, content, and technology. It is evident how teachers aimed to build a common language amongst learners, and during their lessons, they took it upon themselves to make sure that technology integration helped them and enabled successful knowledge presentation and acquisition. T1 then said *"My lessons would be a disaster without technology, because in most of my lessons I include pictures and videos so that learners see actual things I am talking about… as a lady, I use some of engineering animation apps which assemble engine parts, like putting together a piston. I use these because I sometimes struggle to move the engine around and dismantle it by myself."* According to Zhang and Tang (2021), teachers who lack technological knowledge fail to connect the learning process, which leads to effective teaching and learning.

Theme 4: Teachers believe in blending classroom and workshop teaching styles

Pambudi and Harjanto (2020) assert that practical knowledge is a reinforcement of the concepts acquired through theoretical knowledge. After a lesson, the teachers preferred to take learners into workshops where they would demonstrate the principles presented during the lesson; in some cases, during a lesson, they referred to examples that were observed in the workshops. T2 alluded that *"As am working with certain topics, I would later show them a video, so they get to understand the concept beforehand, to get an understanding, we then move to the workshop to do the actual hands-on task. It works better for me."* Whereas T3 said "*The way in which my timetable is structured, I have days where I deal with theory and other's which deal with practical work, say for example am talking maintenance, I'd teach the theory related to that, then during my practical days, we do the actual servicing on the engine. I start with the theory because I want them to also know what is required of them."* Therefore, it became evident that knowledge that was acquired through the lesson presentations of content in the classroom was strengthened through observations in workshops. Teachers used practical work so that learners could relate to visible objects and have a better understanding of concepts. T1 alluded that *"In most cases I show them videos, and show the demo on the software, then I give them an activity related to the topic which they complete in the workshop. Like last week, I gave a task on 'crankshaft measurements', I made them strip the engine, so they have access to the crankshaft for measurements. I don't think this would have been successful without access to the workshop."* In the workshops, it was evident that the teachers took it upon themselves to make sure that learners had a clear and good theoretical background in terms of equipment usage; they made this their imperative duty. Pambudi and Harjanto (2020) assert that "effective use of the workshops requires teachers with a certain degree of skills in order to adjust the machines accordingly and to troubleshoot problems in the workshop" (p. 5).

From the data gathered, it was evident that the teachers emphasised access to the workshops, that they worked well with the machinery, and that they used them in most cases. The research findings indicated that having a positive attitude towards technology is motivational and acts as a driving force for teachers to integrate educational technologies into their instruction. Looking at automotive as a subject, educational technologies can be used in different ways. However, it is further noted that teachers with more experience use educational technologies in an advanced manner. It became evident that teachers need continuous training as a strategy to integrate technology more intensively into their teaching. This will give new teachers and those reluctant to adopt technology a chance to learn these skills and have the knowledge; additionally, it will advance those who are already integrating it. Sephogole et al. (2023, p. 448) argue that continuous training is important because it ensures that small gaps are covered and that the teachers' efficiency in integrating technology and the productivity of quality learners are improved.

CONCLUSION

The study sought to investigate teachers' integration of technology in automotive in JN D10 technical schools. The study examined the existing teaching approaches employed to incorporate technology into the automotive industry. The findings show that teachers rely on technology and machines in the classroom and workshops. Teachers' lesson presentations reveal they attempt to fuse together their content knowledge, pedagogical knowledge, and technological knowledge for successful teaching, which is what the TPACK framework emphasises. Furthermore, the teachers advocated for creating an active learning environment in order to promote learners' interest in automotive, and this in turn encouraged learners' participation; as such, the teachers had the ability to enable an environment for productive learning. Furthermore, it was evident that the workshop plays an important role in automotive teaching and learning. In summary, findings indicate that learning as an objective within automotive is achieved to the best of the teachers' abilities given that there is active learning and learners are engaged throughout the lesson with the use of technology.

The data provides evidence that the lesson objectives of teachers are best met through the integration of technology. It further proves that the use of workshops is of paramount importance in terms of learners acquiring knowledge and skills to foster higher-order thinking. On the other hand, Kreisman and Stange (2020) allude to the fact to the fact that students in some instances are unable to make a transition between theory and practice, and with confidence and effectiveness, the cause of this difficulty arises "from a failure of the teacher to integrate both theory and practice into the same course in the curriculum in ways that are relevant and meaningful to the student" (p. 40). Therefore, it is important for teachers to complement theory with practice so that the maximum results of learning are met. Based on the success of teachers' lesson designs, the sequencing of lessons within the classroom also allowed teachers to develop the technical skills necessary for learners to operate workshop machinery, in addition to content knowledge. The study recommends that technical schools offering automotive should incorporate innovative strategies that facilitate technology integration. We should encourage automotive teachers to incorporate technology more frequently and effectively. In addition, teachers' strategies should focus more on improving their pedagogical methods, more specifically shifting from the traditional way of teaching to active and engaged learning, where students can learn constructively using techniques such as learning through doing and experiments. Lastly, the Department of Education, technical schools offering automotive programs, and other key stakeholders must implement innovative strategies to facilitate the complete integration of technology. This would assist in making sure that there's less frustration, anxiety, and lack of motivation in classrooms during teaching."

REFERENCES

Abe, E.N., & Chikoko, V. (2020). Exploring the factors that influence the career decision of STEM students at a university in South Africa. *IJ STEM Ed* 7(60). https://doi.org/10.1186/s40594-020-00256-x

Berger, J.L., & Girardet, C. (2020). Vocational teachers' classroom management style: the role of motivation to teach and sense of responsibility. *European Journal of Teacher Education*, *44*(2), 200–216. https://doi.org/10.1080/02619768.2020.1764930

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Bricki, N., & Green, J. (2007). *A Guide to Using Qualitative Research Methodology.* https://fieldresearch.msf.org/handle/10144/84230

Casteel, A., & Bridier, N. (2021). Describing Populations and Samples in Doctoral Student Research. *International Journal of Doctoral Studies, 16*, 339-362. https://doi.org/10.28945/4766

Chai, C.S., Koh, J.H.L., & Tsai, C.C. (2013). A review of technological pedagogical content knowledge. *Educational Technology & Society, 16*(2)

Cox, S. (2008). *A conceptual analysis of technological pedagogical content knowledge.* Brigham, Brigham Young University.

Creswell, J.W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). California: Sage.

Department of Education. (2014). National Curriculum Statement - Grades R-12: Curriculum and Assessment Policy Statement (CAPS). Pretoria, South Africa: Department of Education. https://www.education.gov.za/Curriculum/PolicyDocuments.aspx

Figg, C., & Jaipal, K. (2012). TPACK-in-Practice: Developing 21st Century Teacher Knowledge. In P. Resta (Ed.), *Proceedings of SITE 2012--Society for Information Technology & Teacher Education International Conference* (pp. 4683-4689). Austin, Texas, USA: Association for the Advancement of Computing in Education (AACE). Retrieved June 11, 2024 from https://www.learntechlib.org/primary/p/40349/.

Freire, P. (1970). The adult literacy process as cultural action for freedom. *Harvard Educational Review, 40*(2), 205–225. https://doi.org/10.17763/haer.40.2.q7n227021n148p26

Gamble, J., & Young, C. (2009). The Relationship between Knowledge and Practice in the Curriculum and Assessment. Concept Paper commissioned by Umalusi.

Gorard, S. (2001). Research Methods in Educational Research: http://lst-iiep.iiep-unesco.org/cgi-bin/wwwi32.exe/[in=epidoc1.in]/?t2000=019163/(100).

Kreisman, D., & Stange, K. (2020). Vocational and Career Tech Education in American High Schools: The Value of Depth Over Breadth. *Education Finance and Policy,* 15 (1), 11–44. https://doi.org/10.1162/edfp_a_00266

Manubag, M., Kilag, O.K., Peñalosa, B., Timtim, J., Padilla, J., & Abendan, C.F. (2023). Empowering Skills Development: Exploring the Role of Technology Management in Technical Vocational Education Enhancement.

Mishra, P., & Koehler, M.J. (2006). Introducing technological pedagogical content knowledge. In A*nnual meeting of the American Educational Research Association*.

Mishra, P., & Koehler, M.J. (2008). What is technological pedagogical content knowledge (TPACK).

Mishra, P., & Koehler, M.J. (2009). Introducing technological pedagogical content knowledge. In *annual meeting of the American Educational Research Association*.

Naiker, V.S. (2017) *The integration of Technical Vocational Education and Training lecturer's Technological and Pedagogical Content Knowledge in Automotive Repair and Maintenance: Towards a New Pedagogy* [Doctoral dissertation]. Tshwane University of Technology.

Ozer, M. (2020). Vocational Education and Training as "A Friend in Need" During Coronavirus Pandemic in Turkey. *Bartın University Journal of Faculty of Education, 9*(2), 1-7. https://doi.org/10.14686/buefad.713574

Pambudi, N.A., & Harjanto, B. (2020). Vocational education in Indonesia: History, development, opportunities, and challenges. *Children and Youth Services Review, 115*, 105092.

Sephokgole, R.D., Makgato, M, & Khoza, S.D. (2023) *Innovative Strategies for Integrating Technology into Agricultural Programmes at Technical and Vocational Colleges* https://doi.org/10.26803/ijlter.22.8.23 442-464

Stahl, N. and King, J. 2020. *Expanding Approaches for Research: Understanding and Using Trustworthiness in Qualitative Research*.

Sutherland, E. (2019). The Fourth Industrial Revolution – The Case of South Africa. *Politikon*, *47*(2), 233–252. https://doi.org/10.1080/02589346.2019.1696003

Thompson, A.D., & Mishra, P. (2007), Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers

Vorona-Slivinskaya, L., Bokov, D. & Li, O. (2020). *Visualization of Learning and Memorizing Processes Using Mobile Devices: Mind Mapping and Charting*. International Association of Online Engineering. https://www.learntechlib.org/p/218557/.

Wrenn, J. & Wrenn, B. (2009). *Enhancing Learning by Integrating Theory and Practice*: Volume 21, Number 2, 258-265: ISSN 1812-9129: Andrews University

Zhang, W. & Tang, J. (2021). Teachers' TPACK Development: A Review of Literature. *Open Journal of Social Sciences*, *9*, 367-380. doi:10.4236/jss.2021.97027.