Journal of Curriculum Studies Research

https://curriculumstudies.org

E-ISSN: 2690-2788

Volume: 5 Issue: 2 2023

pp. 136-150

Exploring the Effectiveness of Practical Assessment Tasks Towards Skills Development in Mechanical Technology Subject

Percy Thabiso Mhlanga*[a], Samuel Dumazi Khoza[a] & Ndlelehle Skosana[a]

* Corresponding author
Email: mhlangapt10@gmail.com

a. Tshwane University of Technology, South Africa

Article Info
Received: January 27, 2023
Accepted: April 06, 2023
Published: June 18, 2023

10.46303/jcsr.2023.22

How to cite
Mhlanga, P. T., Khoza, S. D., & Skosana, N. (2023). Exploring the effectiveness of practical assessment tasks towards skills development in mechanical technology subject. *Journal of Curriculum Studies Research*, 5(2), 136-150. https://doi.org/10.46303/jcsr.2023.22

ABSTRACT
In a nation like South Africa, where the GDP and economic development are among the lowest, the lack of skilled workers has a noticeable impact. Skilful workers continue to be imported into the country in fields that are critical to economic development. To have an economic sector that can compete with the current global market conditions and the changing technology, qualified manpower is needed. This study explored the effectiveness of the Practical Assessment Task in Mechanical Technology in secondary schools around Gauteng province. A qualitative research approach was employed whereby a case study research design was used. The study purposively sampled nine teachers from seven different schools located in three districts of Gauteng Province. The study deployed two data collection instruments where face-to-face semi-structured interviews and workshop observations were administered. The results of this study show that the lack of resources in Mechanical Technology and the time allocated for the subject is a major challenge that teachers face. These were made worse by a lack of teacher development in the subject. The said challenges have a major impact that delays proper skills development at the secondary school level, thus rendering the PAT ineffective in addressing skills development. The recommendation is that the Department of Education needs to implement a policy where resources would be prioritised and provide lasting and relevant training to the teachers.

KEYWORDS
Mechanical technology; practical assessment task; skills development; pedagogical content knowledge

INTRODUCTION

The fundamental objectives of any education system are to prepare learners with the knowledge and skills required for success in life (Greenhill, 2010). Mechanical technology is a discipline aimed at equipping learners with general mechanical skills, knowledge, and understanding of the properties of metals and their use, to help them with the selection of appropriate materials for projects (Amadi et al, 2015). The said subject focuses on concepts and principles in mechanical (motor, mining, shipping, rails, and power generation), environmental, and technological processes. It further embraces skills and the application of scientific principles. However, this subject aims to create and improve the engineering and manufacturing environment to enhance the quality of life and sustainable use of the natural environment. This notion is attained through skills development in schools using the Practical Assessment Task (PAT) to assess Mechanical Technology practical skills. In this assessment, the integration between practical and theoretical applications is put to the test. It should be noted that due to the high rate of unemployment in South Africa, skills development is an issue of discussion. As it stands, the current unemployment rate in South Africa leaves much to be desired with the youth being the most affected (Statistics South Africa, 2022). Developing more mechanically skilled learners would benefit the country in the most essential sectors that aim at skills development. This place demands on the educational system for a teacher that knows his subject (theory and practice) and a classroom or a workshop that is adequately equipped for the learning and teaching to take place.

Kilbrink and Bjurulf (2013) highlighted that to infuse theory into practice, teaching and learning should occur in different learning areas, namely, both in schools and workplaces. This conveys the connotation that mechanical technology skill development is mainly dependent on the ability to take practical action, intervene in the developing world, and generate new or enhanced products or systems. When learners are given more support to discover how things work, and how to make them function, a better chance is created for their technological capability to prosper. However, as it stands, the PAT is not assessing the skills effectively, hence this study aimed to investigate the effectiveness of the PAT.

These concerns have grown as far as University and College graduates who obtain the qualifications but still lack the relevant skills to meet the needs of the country, which leaves many of them unemployed. There has been an ongoing trend that seems to indicate that the lack of skills development in South Africa is due to the mismatches between educational achievement and job requirements which continue to give rise to under-employment (Mncayi & Shuping, 2021). According to Mncayi and Shuping (2021), the focus should change from skills demand to skills supply and ensure that the curriculum ensures that the graduates are adequately skilled to meet the needs of the labour market and the country's economy. This requires teachers who should work in a conducive environment that should enable them to teach effectively. This study focused on the teacher aspect to explore the effectiveness of PAT in Mechanical Technology.

The economy of South Africa is desperately in need of skills that can only be addressed through strict policies that can shape skills development at the root level (Mateus et al., 2014). These policies should be implemented effectively in the classrooms and be aligned with the industry's demand for synergy between the school and work. As it stands, the shortage of skills in the country, particularly in the youth, raises concern as to what is addressed by our PAT in Technical schools if skills development remains inadequate. Does the curriculum structure provide sufficient room for the learners to develop those critical skills needed by the country? This then led to the exploration of the effectiveness of the PAT for Mechanical Technology in addressing the skills shortage faced by South Africa.

LITERATURE REVIEW

The findings from the study by Abrahams et al. (2013) outlined the necessity of having practical work in engineering education. Other studies on practical assessment in engineering education at the secondary level have been conducted by Fan and Yu (2017) in Taiwan and the latest by Dintsios et al. (2018) in Greece. Both studies had different purposes. In Taiwan, the focus was to assess the effectiveness of the application of Science, Technology, Engineering, and Mathematics (STEM), which is commonly related to PAT in South Africa. Both studies showed a positive impact when using the STEM-integrated approach in engineering design and remote experiments in implementing practical tasks. Another study in England, by Toplis (2012), has suggested that practical work is effective with regards to enhancing learners' learning while focusing on increasing their sense of ownership within their subject and developing a scientifically inquiring mind. Furthermore, a study in Germany by Itzek-Greulich et al. (2015) indicated that practical work has a positive effect on learners' motivation inside or outside the school environment. This means that practical work encourages learners to be responsive to classroom activities and enables them to be self-entrepreneurs when leaving school. However, the challenge we faced in the context in which this study was conducted was that if the PAT did not develop the learners' skills, it could negatively impact the learners.

In a study by Galloway et al. (2013), they articulated that most learners in higher-class schools suggested that schoolwork dominated their day which in this study should be the PAT component as dominating their day. Relatively deep learning and engaging in practical work would give learners more interest and they would express willingness to sacrifice their time to successfully complete their work to maintain or increase their achievement status (Pope, 2001; Taylor et al, 2002). This type of learning is associated with the learner-centred approach. According to Dinh (2019), when compared to a learner-centred approach and a societal-based approach, the knowledge-based approach places the most emphasis on the systematic construction of specialized knowledge designed to develop the cognitive and intellectual abilities of a learner. This is needed for skills to be nurtured in learners which the PAT, in this instance, should inculcate. Furthermore, the teachers need to play an effective role in enhancing learners' interests and the delivery of knowledge and skills should be of prime importance.

Currently, South Africa is in a rather unusual position in economic growth and unemployment due to the lack of skills. According to Hippach-Schneider et al. (2007), German teachers focus more on the theoretical knowledge of the subject and extended general education in the context of future occupation, while the practical part is handled by skilled workers from enterprises, called trainers. This shows how Germany has been effectively implementing PAT in their respective technical subjects. In Denmark, practical training in the upper secondary system takes place in an enterprise that has been approved by the relevant trade committee (Cort, 2008). In South Africa, PAT remains at the school level, with no collaboration with industries to support the schools in exposing learners to the industrial setup and training that will prepare them for employment. In China, the education system provides good practice for technical subjects which gives the teachers room for implementation and responsibility. A study by Wu and Ye (2018), clearly articulated how teachers in China achieve the goal of PAT. Teachers create a conducive atmosphere in workshops to promote the simultaneous development of ability and quality with hands-on experience of modern machines and teaching apparatus combined with theoretical teaching, practical teaching, technological service, and production (Wu & Ye, 2018). Because of its applicability, comprehensiveness, modern quality, and simulation ability, this mode has helped the further development of vocational and technical education and has become an important means to develop a “double quality” teaching staff (Wu & Ye, 2018). This is not contrary to what is happening in South Africa in terms of workshop practice since some teachers create and promote an environment where learners can discover talent but due to challenges that schools are subjected to, it becomes difficult for teachers to promote quality integration of theory and practical work. Teachers use a certain method of teaching as a theory-and-practice approach. All these practices underscore the importance of pedagogical content knowledge (PCK), which is the underpinning framework in this study.

In Malaysia, the implementation of PAT, which is well-known as Practical Work Assessment, has proven to be very effective in skills development in the country, according to several studies. A study by Zainuddin (2019) indicated that upon the completion of primary education, there will be two education streams that will give learners options to choose from in pursuing their secondary level, namely, the academic stream and vocational stream-based education. The Malaysian vocational stream provides more specific vocational training for learners with a minimum of academic subjects and issues the Malaysian Vocational Certificate as preparation for the students to become highly skilled workers in industries (Zainuddin, 2019). Perhaps the aforesaid practices in various countries should serve as a yardstick for the current practices in South Africa.

The African context does not seem to resonate with the world context when it comes to technical secondary school practical work implementation. This is because several studies in respective countries in Africa have revealed similar challenges which are believed to be the root cause of the shortage of skills required by the evolving job market. African countries are well known for their high unemployment rate which contributes largely to poverty faced by most of

its people (Chinyemba et al., 2010). To eradicate the challenges faced by the countries, many African countries opted for the introduction of Technology education with a focus on skills development. In the African context, the Technology curriculum intends to be responsible for the development of learners' capabilities in terms of development, understanding, and manipulation of technology. However, the challenges that persist in the practical aspect (PAT) of the curriculum could remain unattended hence this study aimed to explore the effectiveness of PAT which could be the root cause of skills shortage among the youth.

In Malawi, teachers mentioned that they only taught theory because the Mechanical machines were out of order due to a lack of maintenance and poor resources which hindered the implementation of PAT (Chikasanda et al., 2010). This poses challenges because PAT requires equipment and materials for the learners to do projects that meet the specified standards. According to Adebola (2020), the fact that technical school teachers in Nigeria appeared to not be performing to the best of their ability in the delivery of their statutory functions, impacted the facilitation of the PAT. Adebola (2020) further mentions that a number of them show low commitment to duties and display laxity in discharging their responsibilities; some are truants, while some are not regularly present in schools during official hours (Adebola, 2020). These actions show teachers' poor perception of the impact of practical tasks on skills development. On the other hand, Mwaokolo (2003) affirms that the level and kind of training received in Technology education in workshops is quite different from what is required of learners afterwards. When teachers fail in their responsibilities, especially in subjects such as Mechanical Technology, learners are affected negatively, and the goal of skills development is therefore affected. This, therefore, raises concern about how teachers respond to PAT in a situation where resources are minimal in a country where skills are often spoken of in line with skills development.

THEORETICAL FRAMEWORK

To explore the effectiveness of PAT in skills development, this study employed Pedagogical Content Knowledge (PCK). According to Shulman (1987), PCK is defined as the knowledge that relates content to teachability. Shulman (1987) further explains his theory by elaborating on what PCK entails, stating that it includes the most valuable forms of representation of ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations - in essence, how the subject is expressed, formulated, and made comprehensible to others. In technical subjects such as Mechanical Technology, PCK plays a vital role as it reflects its significance in the practical component of the subject. Therefore, PCK was used to ascertain how Mechanical Technology teachers facilitate the PAT to explore its effectiveness towards skills development. The notion of PCK covers constructs like content knowledge (CK) and pedagogical knowledge (PK) which provides an effective PCK. Therefore, the teachers' CK was observed when administering the PAT, and PK was used to see how they teach the practical. These constructs assisted the study in reaching conclusions in exploring the effectiveness of PAT

in Mechanical Technology from the teachers' point of view, with the aim of skills development and recommendations in closing any existing gaps.

Research questions

- How effective is PAT in developing learners' skills in Mechanical Technology?
- What are teachers' challenges in conducting PAT in their Mechanical Technology classes?

METHODOLOGY

Research Approach

The nature of the problem that this proposed study aimed to address warranted the use of a qualitative research approach which refers to a systematic inquiry into social phenomena in their natural environment (Henning et al., 2004). According to Denzin (2000), qualitative research provides a deeper understanding of a complex phenomenon through rich descriptions and explanations from the perspective of the participants. Creswell and Creswell (2017) agree that qualitative research is concerned with understanding participants' views, experiences, beliefs, ideals, thoughts, and actions regarding social or human problems. Therefore, the qualitative approach was deemed relevant because the researchers had to understand what was happening in the Mechanical Technology practical class during the administration of PAT and the teachers' responses during face-to-face interviews assisted them in ascertaining this.

Research Design

The proposed study used a case study research design. Creswell (2014) defines a case study as a design and inquiry found in many fields, especially for evaluation in which the researcher develops an in-depth analysis of a case. This is often a programme, event, activity, process, or one or more individuals. The premise of the researcher was that these schools are of different quintiles, but they have similar problems with the subject under discussion. The study focused on both quintile 2 and 4 schools with highly populated workshops and less populated workshops. The researcher decided to holistically embed the cases of this study to examine the problem since a similar study was supported by Yin (2003). This created a more convincing theory for this study since Yin (2003) asserts that context is very important in a case study. This design was best suited for this study because it sought an in-depth perception of the effectiveness of the use of PAT in addressing the shortages in skills faced in South Africa, irrespective of the schools' quintiles.

Participants of the study

This study purposively sampled 7 schools from the three chosen districts in Gauteng province in South Africa. From these 7 schools, nine teachers formed part of the study which means one teacher per school but in some schools, it was more than one, because of the different specialisations under Mechanical Technology. The reason for the selection of the sample was the closer proximity and engagement with the educators teaching the subject in those districts. For the study, it was very important for us to consider experienced educators, new recruits, as

well as trade skills in the subject, as the key factors for good quality results. The teachers were named Teachers A, B, etc.

Data collection instruments

This study used two methods in the collection of data: semi-structured interviews and classroom observation. Data collection is defined as the technique for systematically collecting information about objects of the study including people and phenomena, and the setting where data is collected (Musharraf et al., 2012). Creswell (2014) alluded that the instruments to be used must enable participants to express their views. In this case, participants were allowed or given the leverage to express their views freely without being restricted which led to greater data validity. Data collection is perceived as the heart of any research design. The interviews aimed at answering research questions one and two. The observations aimed to find the challenges that teachers encounter in the implementation of PAT for proper skills development as well as checking the teachers' CK and their PK. The interview lasted 20 to 30 minutes while the observations took 30 minutes.

Data Analysis

Data analysis is the process of systematically searching and arranging interviews, transcripts, field notes, and other materials that have been accumulated to enable the researcher to reach conclusions and describe findings (Leedy & Ormrod, 2010). This study adopted thematic data analysis for both instruments. Maguire and Delahunt (2017) define thematic data analysis as the process of identifying patterns or themes within qualitative data immediately after the completion of data collection and transcription.

FINDINGS AND DISCUSSION

This study was about the effectiveness of Mechanical Technology PAT in skills development in secondary schools. The researchers considered it very important to analyse and identify the demographic information of the participants, namely, the teachers' teaching experience, age, and highest qualification. This would also support the use of the theoretical framework PCK. The researcher considered gender with the idea to attain balanced data. While 55.6% of the participants were male, 44.4% of the participants were females. The table below represents the demographic information of the participants:

Table 1

Participants' demographic information

Qualification type	Frequency	Percentage (%)	Gender	Frequency
Honours	1	11.1%	Males	5
Bachelor of Education	5	55.6%	Females	4
Diploma	2	22.2%		
N6/Other	1	11.1%		

Mechanical Technology is a well-known field that is dominated by males specifically in South African schools. The researchers felt that it would be interesting to bring the prospect of women into the study as equal to their male counterparts. The gender balancing gave the study an open understanding of the field as non-gender-based and open to everyone.

Interview data presentation

As the study aimed at exploring the effectiveness of PAT towards skills development in Mechanical Technology, the interview sessions we had with the participants revealed several issues, such as a shortage of resources for the execution of the PAT and the allocation of time for PAT.

When the teachers were asked about the challenges that affect the proper implementation of PAT in the workshop, they said the following:

> **Teacher F:** *"Purchasing resources such as PAT material is a problem in my school and another problem, we faced is the allocated time for PAT"*
>
> **Teacher A:** "*Resources and time frame are a serious challenge to some of us. The other problem is the generation of learners we are teaching these days, they don't have much interest and it boils from society".*
>
> The response from teacher A was supported by Teacher B from a different school where he indicated that:
>
> **Teacher B:** *"Lack of resources and poor teacher development is an existing challenge. This is also a huge problem where whenever we get to training, we do not get enough time to practice the said practical before we head to classes".*
>
> **Teacher E:** *"My challenge is the machines (resources), we don't have enough, and learners must wait for others to complete their project first in order to get a chance"*
>
> **Teacher G:** *"Teacher-learner ratio is very challenging in our school because we don't have resources, for example, you have two angle grinders and two inverters, but you have +/- 40 learners"*
>
> **Teacher H:** *"We don't have enough components, meaning resources, so it becomes difficult to compete for a task which leads us to go seek assistance from another neighbouring school with resources"*

The above responses revealed that most of the teachers do not have enough resources in the workshops, and they indicated that lack of resources was the biggest hindrance to the implementation of PAT. These responses produced one theme, namely, the lack of resources.

Lack of Resources

Most teachers were concerned about the issue of lack of resources which emerged as a key theme in the interviews. It appeared that most schools were faced with a similar challenge of not having enough resources for PAT and this seems to be an existing challenge in other countries, especially in African countries as supported by the literature. Skills development can only be effective if PAT is implemented accordingly and, therefore, becomes a challenge if proper resources are unavailable for the implementation. These were the concerns that

emerged from the participants. These challenges resonate with most technical schools in the African context, for example, the study conducted in Zimbabwean technical education by Chinyemba et al. (2010), indicated that numerous challenges were faced by technical teachers in implementing PAT at the classroom level and in assessing learners as some teachers cited poor support from the head of schools and inadequate material to implement practices in the workshop. These challenges comprised unsteady, unqualified teachers, inadequate teaching, support materials, equipment, and tools, highlighting examinations and an outdated curriculum (Chikasanda et al., 2010). This was supported by a study in Malawi where it was mentioned that teachers in other instances had to teach theory only because the Mechanical machines were out of order due to a lack of maintenance and poor available resources which hindered the implementation of PAT (Chikasanda et al., 2010). Most teachers were of the view that without resources for practical subjects such as Mechanical Technology, teachers became frustrated and failed to deliver their best. Maintaining tools or materials in working conditions can create a cheerful atmosphere and produce learners with positive attitudes (Vengidason et al., 2021).

According to the Department of Basic Education (2014) CAPS document, the resources to offer Mechanical Technology as a subject are the responsibility of the school. However, that places a strain on some schools offering the subject which do not have enough funding to equip the workshops with the standard operating procedure. The results further reveal that some other schools have resources that are not utilised because they have fewer learners whereas, on the other hand, there are schools that have more learners with fewer machinery. This has raised the argument about the teacher-learner ratio in the workshop which is not properly communicated in the CAPS document. These vast challenges faced in the South African context are viewed as damaging to education cycles for skills development. According to Mshelizah (2012), many problems that affect the teaching and learning in this area were attributed to poor maintenance and utilization of workshop facilities because of inadequate funds, shortage of well-trained personnel such as teachers, inadequate apparatus, machines, and equipment for practicals, etc.

Other responses to the question asked on challenges encountered by the teachers in the implementation of PAT were as follows:

> **Teacher B**: *"PAT and theory cannot be done as expected due to the limited time allocated to us, but the primary challenge now is the teacher-learner ratio, and that situation pushes us to just teach to finish and in that case weren't serving the purpose of the subject"*

Teacher C *brought in a new slide with time as a challenge in the execution of PAT and this was therefore backed up but a few teachers who also felt that time becomes a problem in their day-to-day execution of PAT, she was echoed by teacher D.*

Teacher D: *"Time is a number one problem because we do not have enough of it and some of us are not focused only on Mechanical"*

These responses also produced a theme where a great concern about the time allocated for the practical sessions was raised.

Time allocated

The participants indicated that time was limited for them to complete the PAT as well as the syllabus, meaning the theory part of the subject. Mechanical Technology is given four hours of contact time per week of which two hours are intended for PAT and the other two hours for theory (Department of Basic Education, 2014).

On the issue of the top-up training that teachers attend to assist them with PAT, all the teachers considered the arranged training as irrelevant to what was happening in the classroom. This is how the two of them responded:

Teacher C: *"I find the pieces of training that we often go to not helping. I come back as blank as I was before the training".*

Teacher D: *"These pieces of training are irrelevant trust me"*

Teacher development

The interviews also revealed that some teachers needed training in certain areas. A newly appointed Mechanical Technology teacher comes to the workplace with limited knowledge of practical assessment which indicates a need for further training. A study by Della and Meyer (2017) indicates that teachers were thoroughly trained to use different machines for Mechanical Technology such as lathe and milling machines. Findings from the present study revealed that the training offered to the teachers was on industrial Computer Numerical Controlled (CNC) machines that are not available in schools. This created a gap or a mismatch in training as teachers were trained on machinery that they do not use to teach learners in the workshop.

This response (*"Lack of resources and poor teacher development is an existing challenge"*) from teacher B further outlined that teacher development is also another problem faced by teachers in Mechanical Technology. This was also mentioned by teacher H who said: "*When it comes to an automatic gearbox, I am struggling. I need development".* This problem was further articulated by Maeko and Makgato (2014) that teachers should be well-trained to conduct practical sessions in the workshop so that learners can develop the required skills. She (Teacher B) further suggested that the teachers must be trained on how to execute the PAT before they implement it or administer it in schools with their learners.

Teacher B: "*Prior to the release of the PAT, we must have the training around January before we can start with the administration at schools with our learners because as things stand, we do training around June and by that time we will be wrapping up the year projects".*

Teachers need to be prepared for any challenges they may encounter during the administration. This would ease the pressure on them as they would know all the strategies to execute the projects without getting stuck. This suggestion was not unique as another participant echoed the same sentiments:

> **Teacher C:** "*Proper development must be done for the teachers and the teacher preparation or training is usually done very late; the PAT must first be done by teachers at the beginning of the year so they can have proper techniques"*

The above responses show that due to teachers' challenges in the administration of PAT, which range from lack of resources, issues around time allocation, and lack of teacher development, the teachers' PK is affected. According to Shulman (1987), several issues affect and promote the teachers' PK in the classroom and the availability of resources is one of them. As such, when one's PK is negatively affected due to the abovementioned factors, the teachers' PCK is limited. This study focused further on teachers' classroom observation of what happened in the Mechanical technology workshops where PAT is done.

Observation data presentation

During the workshop observation, the researcher noticed factors such as poor housekeeping and a lack of knowledge of the subject (content knowledge). It was noted that teachers need training in Occupational Health and Safety because learners' safety in schools is compromised and often ignored. There was poor handling of tools with not enough care or attention paid to them. Poor housekeeping emerged in a few schools as the floors were untidy and tools and other equipment were not kept where they should be.

Poor housekeeping

It was observed that most teachers were practising good housekeeping in their workshops with only three schools that presented a challenge in housekeeping. A clean and organised workshop promotes good hygiene and safety and teaches learners to take full responsibility for their workspace. As was echoed by Vengidason et al (2021), learners need to be aware of the standards of safety rules of the workshop. It would become a culture in a workshop to practice safety if the rules were emphasised professionally.

Content Knowledge

Most of the teachers presented a good understanding of the subject content hence they integrated the theory excellently with the practical tasks. This was echoed by Shulman (1986) that if the teacher's CK and PK are demonstrated adequately in the classroom, the teacher's PCK improves, and learning often becomes successful. This includes knowledge about scientific terms, facts, concepts, laws, principles, hypotheses, theories, and ideas as well as established practices and approaches toward developing such knowledge (Shulman, 1986). Perhaps these issues of lack of resources and inadequate time allocation could be the ones that coerce teachers to administer the same PAT over the years. The PAT is supposed to enable learners to explore different mechanisms and concepts in the Mechanical field which will make it easy for them to fit perfectly in the Engineering sphere.

IMPLICATIONS

South Africa is challenged by the rate of unemployment, low-skilled labour, and a weakening economy day by day. The country needs to start changing its tune and highlight the importance of quality education with more focus on producing skilled learners who will be a direct fit for the labour market or entrepreneurial sphere. An old study by Lauda (1988) indicated that Technology subjects are designed to respond to societal changes. He further outlines that many corporations rebuke the educational system for failing to provide an appropriate education for today's workforce. This means our education system should be channelled to prepare our learners for the changes in technology as we are currently in the Fourth Industrial Revolution (4IR) but our schools are not prepared. Countries like Kenya have already welcomed the partnership of private sectors as they have proven to be the investors in contributing to an innovative solution for the education sector and skills development to better meet the demands of the labour market (Nyerere, 2018). A recommendation from a study by Della and Meyer (2017) was that GDE should make use of graduate engineers according to the Resolution Circle model, to deploy engineers to technical high schools for six-month periods for them to assist teachers with the practical component and maintenance of machinery in the workshop.

CONCLUSION

This study concludes that the lack of resources in schools and the time allocated to PAT for Mechanical Technology impedes the implementation of PAT in schools which therefore affects skills development. During other challenges faced by teachers, it is likely that some schools fail to complete the PAT as expected. This study explored the effectiveness of PAT towards skills development in Mechanical Technology. The results indicate that skills development is not effective in schools due to challenges faced by the teachers in the implementation of PAT to develop learners' skills. The overruling challenge, which is a lack or shortage of resources, emerged to be the main problem hindering progress in most schools. In the first question, five teachers indicated that the PAT was not addressing skills development as it should, while the other four teachers indicated that the PAT is adequate to address the issue of skills development although there was room for improvement. These responses left the researchers with the conclusion that the PAT was effective but not at the required level to equip the learners with the necessary skills to survive through entrepreneurship. The interviews and observations discussed in this study revealed that practical sessions at schools were not taking place as expected due to the challenges mentioned. From these revelations, one can understand that learners leave school without being equipped with the proper skills, and this affirms the findings by Mwaokolo (2003), namely, that the level and kind of training the learners receive in workshops are quite different from what is required of them afterwards. The other issue identified as a problem is that some teachers focus more on theory because of a lack of tools or resources to execute the PAT which compromises learners' effective skills development. This supports the argument by Nze and Ginestié (2012) that the unavailability of equipment in the workshops impels teachers to replace practical sessions with theory.

Acknowledgements

The researcher would like to acknowledge the 7 schools from the three chosen districts in Gauteng and the 9 participants for making this study a success. The researcher would also like to thank the Tshwane University of Technology TVE department for making this study possible and express gratitude and appreciation to the Gauteng Department of Education for its continuous support of this study.

REFERENCES

Abrahams, I., Reiss, M. J., & Sharpe, R. M. (2013). The assessment of practical work in school science. *Studies in Science Education*, *49*(2), 209-251.

Adebola, O. O. (2020). In-Service Vocational Training and Service Delivery of Teachers of Technical Colleges in Ekiti State. *Electronic Research Journal of Social Sciences and Humanities*, *2*.

Amadi, S. W., Orlu, I., & Obed, O. O. (2015). Effect of Inquiry-Based Teaching Technique on Students' Performance in Lathe Machine Operation. *International Journal of Entrepreneurship Development Education and Science Research, 3 (2), 1-12*.

Chikasanda, V., Otrel-Cass, K. & Jones, A. (2011). Teachers' views about technical education: implications for reforms towards a broad-based technology curriculum in Malawi. *International Journal of Technology and Design Education,* 21(3), 363-379.

Chinyemba, F., Muzinda, A., Nhemachena, B., & Motsi, E. (2010). Continuous assessment of pupils' 'O'Level design project work in technical subjects in secondary schools in Zimbabwe. *Zimbabwe Journal of Educational Research,* 22(3), 276-291.

Cort, P. (2008). The Danish Vocational Training and Education System. *2nd edition, Copenhagen*.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approach*. Sage publications.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed.). Sage.

Della T. M., & Meyer, J. (2017, September). Benefits of a properly managed engineering work integrated learning internship: A case study. In *2017 IEEE AFRICON* (pp. 720-724).

Denzin, N. K. (2000). Aesthetics and the practices of qualitative inquiry. *Qualitative Inquiry*, *6*(2), 256-265.

Department of Basic Education. (2014). *Curriculum Assessment Policy and Systems*. https://www.education.gov.za/Curriculum/CurriculumAssessmentPolicyStatements(CAPS).aspx

Dinh, H. (2019). Towards a Knowledge-rich Curriculum. *Journal Of Curriculum Studies Research*, *1*(1), 54-70. https://doi.org/10.46303/jcsr.01.01.5

Dintsios, N., Artemi, S., & Polatoglou, H. (2018). Evaluating Stars Temperature Through the BV Index Using a Virtual Real Experiment from Distance: A Case Scenario for Secondary Education. *International Journal of Online Engineering*, *14*(1).

Fan, S. C., & Yu, K. C. (2017). How an integrative STEM curriculum can benefit students in engineering design practices. *International Journal of Technology and Design Education*, *27*(1), 107-129.

Galloway, M., Conner, J., & Pope, D. (2013). Non-academic effects of homework in privileged, high-performing high schools. *The journal of experimental education*, *81*(4), 490-510.

Greenhill, V. (2010). 21st Century Knowledge and Skills in Educator Preparation. *Partnership for 21st-century skills*. USA: AACTE.

Henning, E., Van Rensburg, W., & Smit, B. (2004). Finding your way in qualitative research. Pretoria. *RSA: Van Schaik Publishers*.

Hippach-Schneider, U., Krause, M., & Woll, C. (2007). *Vocational education and training in Germany: short description* (No. 138). Office for Official Publications of the European Communities.

Itzek-Greulich, H., Flunger, B., Vollmer, C., Nagengast, B., Rehm, M., & Trautwein, U. (2015). Effects of a science centre outreach lab on school students' achievement–Are student lab visits needed when they teach what students can learn at school? *Learning and Instruction*, *38*, 43-52.

Statistics South Africa, (2022), *Quarterly Labour Force Survey* Q2: 2022. https://www.statssa.gov.za/?m=2022

Kilbrink, N., & Bjurulf, V. (2013). Transfer of knowledge in technical vocational education: A narrative study in Swedish upper secondary school. *International Journal of Technology and Design Education*, *23*, 519-535.

Lauda, D. P. (1988). Technology education. *Instructional Strategies for Technology Education*, 3-15.

Leedy, P.D. & Ormrod, J. E. (2010). Practical Research: Planning and Design, 9th Ed. NYC: Merril.

Maeko, M. S., & Makgato, M. (2014). Skills training through hands-on practical activities in civil technology - a case study of three technical schools in South Africa. *TD: The Journal for Transdisciplinary Research in Southern Africa*, *10*(3), 323-339.

Makgato, M. (2011). Technological process skills for technological literacy: a case of few technology teachers at schools in Tshwane North District D3, South Africa. *World Transaction on Engineering and Technology Education*, *9*(2), 119-124.

Mateus, A. D., Allen-Ile, C., & Iwu, C. G. (2014). Skills shortage in South Africa: Interrogating the repertoire of discussions. *Mediterranean Journal of Social Sciences*, *5* (6), 63-63.

Mncayi, P., & Shuping, K. (2021). Factors affecting labour absorption in South Africa. *Journal of Economic and Financial Sciences*, *14*(1), 10.

Mshelizah, I. A. (2012). Problems of improper maintenance and utilization of mechanical technology workshops, facilities and equipment in technical colleges of Bauchi state. *ATBU Journal of Science, Technology and Education*, *1*(1), 112-117.

Musharraf, S. G., Shoaib, M., Siddiqui, A. J., Najam-ul-Haq, M., & Ahmed, A. (2012). Quantitative analysis of some important metals and metalloids in tobacco products by inductively coupled plasma-mass spectrometry (ICP-MS). *Chemistry Central Journal*, *6*(1), 1-12.

Mwaokolo, P. O. E. (2003). Related thoughts in vocational education. *The development of world experiences. AWKA: Marpat Educational Research and Publishers*.

Nyerere, J. (2018). Youth Unemployment in Kenya: Incorporating Entrepreneurial and Transferable Skills in Education. *Youth Entrepreneurship and Africa's Sustainable Industrialization*, *125*.

Nze, J. S. B., & Ginestié, J. (2012). Technical and vocational teaching and training in Gabon: how future teachers build their vocational identity? *International Journal of Technology and Design Education*, *22*(3), 399-416.

Pope, D. C. (2001). *Doing school: How we are creating a generation of stressed out, materialistic, and miseducated students*. New Haven, CT: Yale University Press.

Shulman, L.S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher, 15,* 4-14.

Shulman, L.S. (1987). Knowledge and teaching: foundations of the new research. *Harvard Educational Review, 57*, 1-22.

Taylor, L., Pogrebin, M., & Dodge, M. (2002). Advanced placement-advanced pressures: Academic dishonesty among elite high school students. *Educational Studies: Journal of the American educational studies association*, 33, 403-421.

Toplis, R. (2012). Students' views about secondary school science lessons: The role of practical work. *Research in Science Education*, *42*(3), 531-549.

Vengidason, S., Nashir, I. M., Jing, R. T., Ismail, M. A., Nallaluthan, K., & Subramaniam, T. S. (2021). Importance of Safety in a Workshop at Schools for a Safe and Effective Teaching and Learning Sessions. *Journal of Technical Education and Training*, *13*(3), 155-161. https://doi.org/10.30880/jtet.2021.13.03.015

Wu, X., & Ye, Y. (2018). *Technical and vocational education in China*. Springer Singapore, 175-204.

Yin, R. K. (2003). Case study research: Design and methods (3rd ed.). Thousand Oaks, CA: Sage.

Zainuddin, S. (2019). *Investigation into the Effectiveness of Practical Work in Achieving Curriculum Objectives for Engineering Studies in Secondary Education* (Doctoral dissertation, University of Lincoln).