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Grade 9 Technology Teachers' Ability to Facilitate Mini - Practical Assessment Tasks through 9E Instructonal Model in Technology Classroom

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Abstract - This study used a case study to explore the ability of Technology teachers' ability to facilitate Mini-Practical Assessment Tasks through 9E instructional model in the classroom. The 9E instructional model played an important role to understand the challenges faced by the Grade 9 Technology teachers when facilitating the design process. The study employed a qualitative research approach to gather non-numerical data. Hence, the study used case study to explore the challenges faced by Grade Technology teachers when facilitating mini-Practical Assessment Tasks (PAT) in the classroom. A total of ten Technology teachers who were teaching the Technology subject were purposively sampled and interviewed. Data was collected using semi-structured interviews. The interview tape-recorded data was manually transcribed into word form. The data was textually analysed and displayed as verbatim quotes from the interviews. The findings of the study revealed that most of the teachers experienced challenges when engaging with the learners, as well as in the provision of materials and equipment, using topic-specific strategies, relating the content with the learners' real-life experience, and connecting the learners' everyday experience with the content. They also had difficulties in providing clear explanations that limit misconception, and could not summarise the concepts, and use the learners' ideas to identify and correct misconception when facilitating the mini-practical assessment tasks in the classroom. The study further found that most of the teachers who struggled to teach Technology education actually lacked a science Technology background.

Keywords : *Explore challenges, facilitating mini-practical assessment task, 9E instructional model, design process, resources, practical skills.*

INTRODUCTION

The Mini-Practical Assessment Task (Mini-PAT) is a set of assessment tasks that is designed for different activities with the aim of developing the learners' critical thinking skills. The core of these activities is to develop the learners' real-life problem-solving skills (De Jager, 2011). Within the context of reforming the Curriculum Assessment Policy Statement (CAPS) for Technology education in General Education and Training (GET), several attempts have been made to improve the way in which practical assessment tasks are carried out (Department of Basic Education (DBE), 2011).

The latest improvement of policy on teaching and learning involves the effective implementation of the curriculum (Mbongwe, 2016). The improvements place several obligations on Technology teachers to facilitate Mini-PAT and to develop technological problem cases that will enable the learners to manufacture a corresponding product design or artefact (Rauscher, 2016). According to Mbongwe (2016), this approach has placed challenges on Technology teachers to identify and develop tasks since they are not able to monitor and assist learners as they go through the design process. Although many issues were improved, one of the challenges with the Mini-PAT for Technology teachers is the lack of content knowledge to assist in improving the practical skills of teaching and learning (Kubheka, 2018). Schwichow, Zimmerman, Croker and Härtig (2016) argue that most Technology teachers have a challenge of measuring the learners' skills that are acquired in the design process when facilitating the Mini-PAT. Based on this, this study sought to explore the Grade 9 Technology teachers' ability to facilitate Mini-PAT.

MINI-PAT IN TECHNOLOGY EDUCATION SUBJECT

The hands-on practical tasks in the Technology subject refer to the practical activities that result in tangible outcomes such as the model, an artifact, or an ornament (Khubheka, 2018). Recently, there are many teacher development programmes that were conducted by DBE in South Africa to familiarise the teachers with hands on practical tasks (Hirca, 2017). However, the teachers still find it difficult to teach practical tasks. Also, Kubheka (2018) outlines that the lack of educational resources, the inadequate training of Technology teachers and even the overcrowded classes are some of the challenges that hinder the teaching of mini-PAT. Gumbo (2020) further highlights that Technology teachers have limited pedagogic knowledge and skills in teaching the technology design process. Nkosi (2020) observed that during the lesson observations, the teachers were able to provide the learners with the Mini-PAT as required by the CAPS, but all the teachers were not familiar with certain stipulations of the subject policy. Kola (2021) supports that it is important that Technology teachers understand the content to be taught. The author further indicates that planning helps the teachers to set appropriate tasks and provide the learners with well-structured activities. As such, the learners will be able to demonstrate the ability to comprehend specific knowledge, skills, and values. According to Anderson & Putman (2020) challenges experience by technology teachers include lack of technology knowledge.

According to Nkosi (2020), it is important that the teachers engage leaners in activities that will use the design process. Mobara (2018) concluded that the challenges faced by the Technology teachers are the lack of resources and the difficulty in grasping the technology concepts as a result of inadequate prior learning. Rauscher (2016:11) indicated that, "Technology teachers in South African Schools seem to have poor grasp of the complexity of this important part of knowledge that is specific to Technology". However, Jujuju (2021) indicates that the teachers have to be equipped with the knowledge of invoking prior knowledge, and that needs to be integrated for the benefit of learning. Based on the presented arguments, the study sought to understand the challenges that the Technology education teachers faced when facilitating the subject.

Little literature around this focus has been short sighted. However, there are several studies done in technology education in South African schools. For instance, most of the studies looked at critical thinking skills (Kola, 2016); the integration of the indigenous knowledge system in technology teaching and learning (Gumbo, 2014); an emancipation framework for Technology education teachers (Mapotse, 2015); pre- service teachers in technology education (Ramaligela, Ogbonnay & Mji, 2019); The teaching and learning of Technology: Spotlight on sectional drawing among student teachers (Makgato, 2015) and the difficulties of student teachers in the engineering graphics and design course (Khoza & Makgato, 2016).

9E INSTRUCTIONAL MODEL

To explore how the Grade 9 Technology teachers facilitate Mini-PATs in the classroom, this study used the 9E Instructional model (Ramaligela, Ogbonnaya & Mji, 2019). Ramaligela et al. (2019) expanded the Eisenkraft (2003) 7E model to the 9E instructional model to investigate various settings. The 9E model can be used to investigate how knowledge is constructed through classroom practice. According to Ramaligela et al. (2019), the 9E instructional model is a measure to evaluate classroom instructional activities. Hence, this study will use the 9E instructional model to understand how technology teachers facilitate the design process skills in a constructive manner. As indicated by Ramaligela et al. (2019), the phases of the 9E instructional model are compatible with the Technology IDMEC design process. The phases that will be adapted from the 9E Instructional model are **elicit, engagement, exploration, enlightening, elaboration, evaluation, explanation, enclosure, and exchange** because the phases remain relevant to constructivist theory.

Table 3.1: The IDMEC technology design process and adapted 9E instructional model

IDMEC design Process and attained skills	9E phases involved (adapted)
Investigation **Skills involved:** **Research** **Collecting information** **Analyse information** **Compare relevant information**	Elicit Engaging Exploration Enlightening Exchange Evaluation Enclosure Explanation Elaboration
Design **Skills involved:** **Collection of information through design** **Working drawings** **Compiling list of specification and constraints** **Drawing flow charts**	Elicit Engaging Exploration Enlightening Exchange Evaluation Enclosure Explanation Elaborating
Making **Skills involved:** **Identifying tools and materials** **Listing safety precautions** **Measuring** **Scales** **Financial constraints**	Elicit Engaging Exploration Enlightening Exchange Evaluation Enclosure Explanation Elaborating
Evaluating **Skills involved:** **Effectiveness** **Verifications.** **Evaluate materials** **Safety of materials** **Strength and stability** **Comparing** **Evaluate instruments** **Assessment**	Elicit Engaging Exchange Evaluation Enclosure
Communicating **Skills involved:** **Presentation and demonstration (Sketches, plans, budget, model, and artistic impression)**	Engaging Enclosure Explanation

In this study, the **elicit phase** was explored within the investigation, design, make and evaluation stages where the teacher considered the learners' prior knowledge. The teacher uses different modes such as classroom interaction, pre-assessment, and multimedia strategies. The **engagement phase** was explored within the investigation, design, making, evaluating and communication stages where the teacher involves the learners throughout the lesson as active participants. The teacher uses provoking questions, problem-based methods, demonstration, and the discussion method to stimulate the learners' curiosity, interest, and attention. The **exploration phase** was explored within the investigation, design, making and evaluation stages where the teacher initiates activities and discusses the background and provides material as well as equipment. The teacher also addresses the learners' misconceptions. The teacher uses different modes such as conceptual connection, procedural connection, or equivalent representation to present new concepts.

The **enlightening phase** was explored within the investigation, the design making and the evaluation stages where the teacher refers to the use of the topic-specific strategies. The teacher uses different strategies such as graphic presentations, visual representations, object presentations, static representations, and simulation methods to teach different concepts. The **elaboration phase** was explored within the investigation, design, making and evaluation stages where the teacher relates real-life experiences with the new concept within the classroom context. The teacher uses the learners' previous knowledge, personal experience, or their local knowledge to build their understanding of the new concept**. The evaluation phase** was explored within the investigation, design, making and the evaluation stages where the teacher determines the evidence of the learners' learning by assessing them. The teacher uses different evaluation modes such as the practical tasks, a concept focused task or a lesson outcome evaluation task to assess the learners' understanding of the different concepts. The **explanation phase** was explored within the investigation, design, making and the evaluation stages where the teacher explains to clarify the learners' misconceptions. The teacher uses different modes, such as argumentative, justification, descriptive or interpretive methods to explain different concepts. The **enclosure phas**e was explored within the investigation, design, making, evaluation, and communication setups where the teacher summarises the concepts. The **exchange phase** was explored within the investigation, design, making and evaluation stages where the teacher uses the learners' ideas to identify misconceptions and further use them to correct the misconceptions. The teacher uses the learners' responses to build an understanding of the different concepts and also to correct the learners' misconceptions. As indicated earlier, the study adapted the 9E instructional model.

Research questions

1. How does the 9E instructional model influences Grade 9 Technology teachers when facilitating the design process?
2. What are the challenges faced by grade 9 Technology teachers when facilitating the Mini-PAT through 9E instructional model?

Research methodology

This study employed a qualitative research approach to gathering non-numerical data, while focusing on meaning-making and on human elements (Denzin & Lincoln, 2005). This qualitative study was positioned on Stake's (1995) perspective of case study design, looked at grade 9 Technology teachers when facilitating the design process. design process. This study selected ten Technology teachers. The ten teachers participated in the interviews. Data was collected using semi-structured interviews. The interview tape-recorded data was manually transcribed into word form. The data was textually analysed and displayed as verbatim quotes from the interviews. The verbatim quotes were suitable for the study because they are commonly used in educational research as they provide descriptive data (Carol & Iben, 2014). The interview transcripts were coded by reading through the data, categorizing the data into codes and interpretation by using memos for clarification (Stucky, 2015). The coding helped to compile the descriptive information during the study. The categories were drawn from the 9E conceptual framework because the researcher started to detect patterns in the data and to develop conclusions.

DISCUSSION AND RESULTS

Elicit phase

The elicit phase was explored within the investigation, design, making and the evaluation stages where the teacher considered the learners' prior knowledge. The study found that during the interviews, 7/10 teachers indicated that they were able to elicit the learners' prior knowledge in the investigation stage, while 6/10 got it in the design stage and 7/10 in the evaluation stage. However, the teachers did not indicate how they elicit the learners' prior knowledge during the making and the communication stages. During the investigation stage the teachers indicated that to elicit the learners' prior knowledge they use questions and baseline assessments to find out what they have been taught which assists them to assess the learners' prior knowledge. During the design stage the teachers revealed that they elicit the learners' prior knowledge through diagrams and drawings. During the evaluation stage the teachers indicated that they establish the outcome of the activities.

The study further found that most of the teachers use different teaching modes to elicit the learners' prior knowledge through questioning and baseline assessments.

Engaging phase

The engagement phase was explored within the investigation, design, making, evaluating, and communicating stages where the teacher involves the learners throughout the lesson as active participants. During the interviews, the study found that most teachers indicated that they were able to keep the learners as active participants in the design stage. However, most of the teachers were unable to indicate how they keep the learners active in the investigation, making, evaluation and communication stages. During the design stage, the teachers indicated that they involve the learners in the drawing sketching and using instruments.

Exploration phase

The exploration phase was explored within the investigation, design, making and evaluation stages where the teacher initiates the activities and discusses the background and provides material and equipment. The teacher addressed the learners' misconceptions. The study found that during the interviews most teachers indicated that they were able to introduce new concept to the learners when facilitating the design stage. However, the teachers did not indicate how they introduce the new concept to the learners when facilitating the investigation, making and the evaluation stages. During the design stage, the teachers indicated that to introduce a new concept to the learners, they give the learners activities on drawings, where the learners draw dimensions and use correct instruments.

Enlightening phase

The enlightening phase was explored within the investigation, design, making and the evaluation stages where the teacher referred to the use of the topic specific strategies. The study found that during the interviews, most teachers were able to relate the different concepts to the topic during the investigation stage as well in the making stage. However, most teachers were found not to be able to relate the different concepts during the design and the evaluation stages. During the investigation stage, the teachers indicated that they compare and explore new information in relation to other subjects. During the making stage, the teachers indicated that they implement the creativity of the learners in the availability of materials and combining information to make the final product.

Elaboration phase

The elaboration phase was explored within the investigation, design, making and the evaluation stages where the teacher relates real-life experiences with the new concept within the classroom context. The study found that most teachers during the interviews were able to connect everyday experiences in the investigation stage. Hence, in the making and in the evaluation stages they had equal chances to connect everyday experience and in the design stage the teachers were not able to connect everyday experience. The study further found that most teachers were able to support the learners to use tools, build and test the product when facilitating design, as well as in the making and evaluation stages. During the investigation stage, the teachers indicated that they connect everyday experiences with the topic by identifying the problem and collecting information then by linking real life with classroom practice. The teachers further indicated that in the design stage they support the learners to use tools, build and test the product by using instruments to measure and help the learners to carry out practical activities by demonstrating to carry out these activities. During The making stage, the teachers indicated that they support the learners on safety precautions and choose the right material and during the evaluation stage the teachers indicated that they compare and test the product.

Evaluation phase

The evaluation stage was explored within the investigation, design, making and the evaluation stages where the teacher determines the evidence of the learners' understanding of different concepts. The study found that during the interviews most teachers were able to evaluate the learners' decision and problem-solving techniques during the investigation stage. During the investigation stage the teachers indicated that they allow the learners opinions and use the rubric. The study also found that most teachers were also able to evaluate the learners process during the evaluation stage. During the evaluation, the teachers indicated that when they evaluate the learners' progress, they use formative or summative assessments to monitor the learner's progress.

Explanation phase

The explanation phase was explored within the investigation, design, making and the evaluation stages where the teacher clarifies the learners' misconceptions. The study found that during the interviews most teachers were able to facilitate different concepts to enhance the learners' understanding when facilitating the investigation stage. During the investigation stage the teachers indicated that they give learners a chance to explain what they have gathered and clarified the learners' ideas from the information they gathered.

Enclosure phase

The enclosure phase was explored within the making, evaluation, and the design stages where the teacher summarises the concepts. The study found that during the interviews most teachers were able to summarise the concept in the evaluation and communication stages. During the evaluation stage, the teachers indicated that they test the one that is strong and the one that is weak and compare them. During the communication stage they indicated that they present the final product and indicate the advantages and the disadvantages. They conclude by talking about the entire process.

Exchange phase

The exchange phase was explored within the investigation, design, making and the evaluation stages where the teacher use the learners' ideas to identify misconceptions and further use them to correct those misconceptions. The study found that during the interviews most teachers were able to use the learners' ideas in the investigation stage. During the investigation, the teachers indicated that they let the learners present and use their ideas and whenever the learners give examples the teachers use the learners' ideas to clarify misconceptions.

CONCLUSION

The main purpose of this article is to explore the influence of the 9E on grade 9 Technology teachers when facilitating the design process in the classroom. The study found that most of the teachers were unable to teach using the 9E model. The study found that many teachers face challenges when facilitating the Mini-PATs through the 9E model since they were unable to engage learners, provide materials and equipment, use topic-specific strategies, relate the content with the learners' real-life experience and connect the learners' everyday experience with the content, provide clear explanation that limit misconception, summarise the concepts, and use the learners' ideas to identify and correct misconceptions.

The study explored the main purpose through research question***: 1. How does the 9E instructional model influences Grade 9 Technology teachers when facilitating the design process 2. What are the challenges faced by grade 9 Technology teachers when facilitating the Mini-PAT through 9E instructional model?*** and the data found that most teachers said that they are able to facilitate the Mini-PATs through the 9E. The study further indicated that the teachers were able to indicate how they assess the learners' prior knowledge, use topic specific strategies to teach different concepts, and relate real-life experience with the new concept to build the learners' understanding of the new concept. Hence, this study concludes that most of the teachers experience challenges when facilitating the Mini-PATs in the classroom.

RECOMMENDATIONS

The teachers should be provided with adequate resources that enable them to utilise their critical thinking skills when teaching the design process and the teachers should be limiting the use of textbooks to facilitate the mini-PATs. The teachers should be well trained in practical skills to be afforded opportunities to practice real-life situations similar to what the learners' experience in the classroom.

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