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Forces Influencing Technical Mathematics Curriculum Implementation: Departmental Heads' Understanding of Their Practices to Enact Roles and Responsibilities

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Abstract: This qualitative study explores forces influencing the practices of Departmental Heads (DHs) in enacting their roles in implementing and managing Technical Mathematics (TMAT) curriculum. TMAT was piloted in a few South African schools in 2016 and later scaled to others. Since its inception, learner performance has been uneven, raising questions about the processes of managing and implementing the curriculum. We use Samuel's Force Field Model to understand forces influencing DH practices in their quest to implement and manage the curriculum. Data were generated using one-on-one interviews and document analysis and thematically analysed using NVivo. The findings reveal that contextual and external forces are the main factors that influence DH practices when it comes to the implementation and management of the curriculum. These forces influence practices such that the roles and responsibilities are carried out mainly for compliance purposes. While in theory, DHs seem to believe in collaboration, they prefer working in silos and perceive that the success of the TMAT curriculum implementation should be at the hands of seasoned mathematics teachers. In addition, they seem to consider curriculum implementation and management to be solely about ensuring curriculum coverage. We argue that to ensure the sustainability and effectiveness of the TMAT curriculum, there is a need for the continuous professional development of DHs, such that they are able to balance external forces and internal forces.

Keywords: curriculum implementation; curriculum monitoring; curriculum sustainability; departmental head; technical mathematics

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1. Introduction

The introduction of Technical Mathematics (TMAT) in South Africa has been one of the major developments in the mathematics curriculum. TMAT was implemented in technical schools in 2016, a decade after the introduction of Mathematical Literacy in 2006. TMAT focuses on the technical aspects of the Pure Mathematics curriculum, while Pure Mathematics covers abstract mathematics. The perennial question with these new developments is whether Departmental Heads (DHs) as curriculum leaders understand their practices enough to enact their roles and responsibilities effectively.

In the context of South Africa, as noted by the Department of Basic Education (DBE, 2009), the curriculum monitoring strategy should be regularly evaluated to determine whether intended outcomes have been achieved for learners and teachers. The monitoring strategy sought to curb shortcomings of Curriculum 2005 (C2005) and the National

Curriculum Statements (NCSs), such as the lack of clarity in learning outcomes, inconsistent implementation across schools, insufficient teacher training, and the overemphasis on outcomes-based education (OBE) without adequately addressing content knowledge, resulting in uneven learner performance and gaps in foundational skills. Despite policy documents providing broad guidelines and approaches to change, Maree (2016) argues that it is the teachers who are implementing policy changes in classrooms and, therefore, their understanding of their practices is crucial in the process of curriculum implementation. Extending this argument, Tapala (2019) stresses that DHs who have the dual role of teaching and curriculum monitoring should be accountable for their roles and responsibilities, such as evaluating, monitoring, and developing their teachers, and for this to happen, the DHs need to know what is expected of them, and their practices should be the driving force in ensuring the sustainability of the curriculum.

According to Msibi and Mchunu (2013), curriculum changes have been implemented without adequately addressing the issue of teacher professionalism. They contend that the DBE's fixation with the curriculum, rather than teachers and their abilities, is the main cause of the curriculum implementation failures in the South African educational system. Bansilal (2002) maintains that well-trained teachers are essential in the educational process, which means that the success or failure of an education system depends on the quality of its teachers. Many studies (Jaca, 2013; Malinga, 2016; Ogina, 2017; Seobi & Wood, 2016; Tapala, 2019) have pointed to a lack of training for DHs, which makes it difficult for them to enact their roles and responsibilities. Tapala (2019) contends that for DHs to carry out their assigned responsibilities, it is critical that they receive pre-training prior to taking on the post of DH, and that they continue to grow professionally after being appointed to the position.

Given the trends in learner performance in mathematics, we argue that for curriculum sustainability and success for TMAT, the execution of DHs' roles is an area that needs exploration in order to understand what they do, how they do it, and why they do what they do. Understanding these intricacies will assist in future planning. With this in mind, we set out to answer the following research questions: What forces influence DHs' practices of implementing and managing the TMAT curriculum? Also, how do DHs perceive their practices when enacting roles and responsibilities to implement and manage TMAT?

2. Literature Review

According to the DBE (2011), the daily preparation of instruction and learning and the actions that assist it constitute education/curriculum management. Middle managers in South Africa, known as DHs, oversee and manage the teachers in their departments to guarantee that teaching occurs and that the curriculum is followed (Shaked & Schechter, 2017; Tapala et al., 2022). The Education Labour Relations Council (ELRC, 1998, p. 66) states that DHs are to "develop curriculum-related policies, control the work of teachers and learners, appraise subordinates, and manage subject work schemes". The primary responsibilities of DHs, as spelled out in the DBE's Personnel Administrative Measures (PAM) document (DBE, 2016, 2022), are to engage in class teaching, oversee the effective functioning of the department, and organise relevant or related extracurricular activities to ensure that the subject, learning area or phase, and the education of the learners are promoted in a proper manner (DBE, 2016, 2022). The DBE (2016) defines DHs as school managers responsible for certain subject streams. The DBE's PAM document defines the core duties and responsibilities of DHs, which vary depending on the needs and approaches of individual schools and include teaching DBE (2016). Accordingly, as the intermediary between subject advisors and teachers, DHs must manage curricular instructions for teachers, which is the core duty separating them from ordinary teachers. Therefore, they

work hand in hand with the school principal and deputy principal to ensure the smooth running of the subject they manage.

To be promoted as a DH in South Africa, a teacher must have strong subject knowledge, at least three years of teaching experience, and a minimum matriculation qualification with a three-year teaching qualification. Additionally, understanding the school's specific context and conditions is essential (Christian, 2013). While education management qualifications are not required, teacher unions and School Governing Bodies (SGBs) often influence the appointment process. The unions often participate in interviews and provide recommendations, while the SGBs are heavily involved in decision-making, which could undermine merit (Christian, 2013).

2.1. Curriculum Management

The DBE (2022) has highlighted key elements of curriculum management that DHs are expected to execute, which include curriculum supervision, evaluation and curriculum monitoring, staff support and resources, capacitating staff with the required skills, the creation of relevant learning activities, and providing quality assurance relating to learning and assessment. DHs play an important role in the assessment and development of teachers in accordance with the teacher evaluation system known as the Quality Management System (QMS). QMS is an essential tool used to measure the development and performance of teachers. In Switzerland, Shaked and Schechter (2017), affirms that DHs are middle managers responsible for the supervision and control of the teachers in their departments to ensure that teaching and learning take place and that the curriculum is implemented. DHs observe teachers at work and provide them with feedback after visiting their classrooms. Effective curriculum monitoring requires DHs to be knowledgeable about the teaching and learning of the areas they oversee; therefore, a candidate for the position of DH must possess subject matter competence (Tapala, 2019; Ogina, 2017; Seobi & Wood, 2016; Mampane, 2018). TMAT focuses on the hands-on application of mathematics concepts, requiring a different teaching strategy. If DHs lack the knowledge and expertise to implement and lead their departments, teachers will be left uncertain about implementing the necessary changes envisaged by the DBE. Hence, in the South African context, the DBE creates the curriculum, offers pacing recommendations via the Annual Teaching Plan (ATP), and supplies learning resources (textbooks), teaching resources (lesson plans), assessments, a programme of assessment, and tools for curriculum monitoring (school-based assessment). After the design is complete, schools are tasked with implementing it. It is, therefore, essential that DHs understand the full extent of their roles and responsibilities. As Leithwood (2016) alluded to, subject matter expertise, managerial prowess, and potent interpersonal abilities are essential managerial practices for DHs. According to Mthiyane et al. (2019), DHs must play a significant part in the development of teachers by serving as change agents and providing instructional leadership.

2.2. Curriculum Implementation

There is a significant body of international studies on curriculum implementation and management. In the United States, Elmore (2016) distinguishes between "implementation" as acting on established knowledge and "learning" as navigating the unknown. He critiques policy-driven reforms for prioritising uniformity, treating diversity as a problematic exception. Research by Miedijensky and Abramovich (2019) in Israel supports Elmore (2016) as they revealed that an exemplary school's implementation of the new curriculum was a gradual and structured process that executed many actions at each stage, and where the principal, DHs, and teachers were well qualified and fully committed. In the United Arab Emirates, Al-Husseini (2016) noted that frequent classroom observations and feedback

from DHs improved teachers' classroom practices and learners' performance. Similarly, in Australia, Roberts-Hull et al. (2015) reported that high-performing education systems emphasise content knowledge and subject-specific expertise.

In their study, du Plessis and Eberlein (2018) found that DHs of multi-subject departments face difficulties because they must be responsible for subjects that they may not have formal training in and find themselves burdened with a heavier workload than those in departments focusing on a single subject. On the other hand, Stephenson (2010) in New Zealand cited the lack of professional development initiatives intended to help DHs serve as curriculum leaders as an impending factor in curriculum implementation. In the United Kingdom, Brown et al. (2000) identified lack of time, space, specialist teachers, personnel management, staff morale, and homework policy as key challenges to curriculum management.

3. Theoretical Framework for the Study: Samuel's Force Field Model

In this study, we use Samuel's (2008) Force Field Model to understand how DHs reconcile the forces that operate in the sphere of implementation and teaching. The Force Field Model is used to understand how DH autonomy prevails as they enact their roles within the prescriptive Curriculum Assessment Policy Statements (CAPS). The theoretical framework provides a lens for understanding forces that enable or hinder DHs when enacting their roles and responsibilities. The success of curriculum management and the implementation of TMAT requires DHs to mediate the institutional and contextual forces within their schools, and their agency is important in knowing what to adapt, adopt, or neglect when these forces are in play. Figure 1 shows the constructs of the Force Field Model, which is modified for this study.

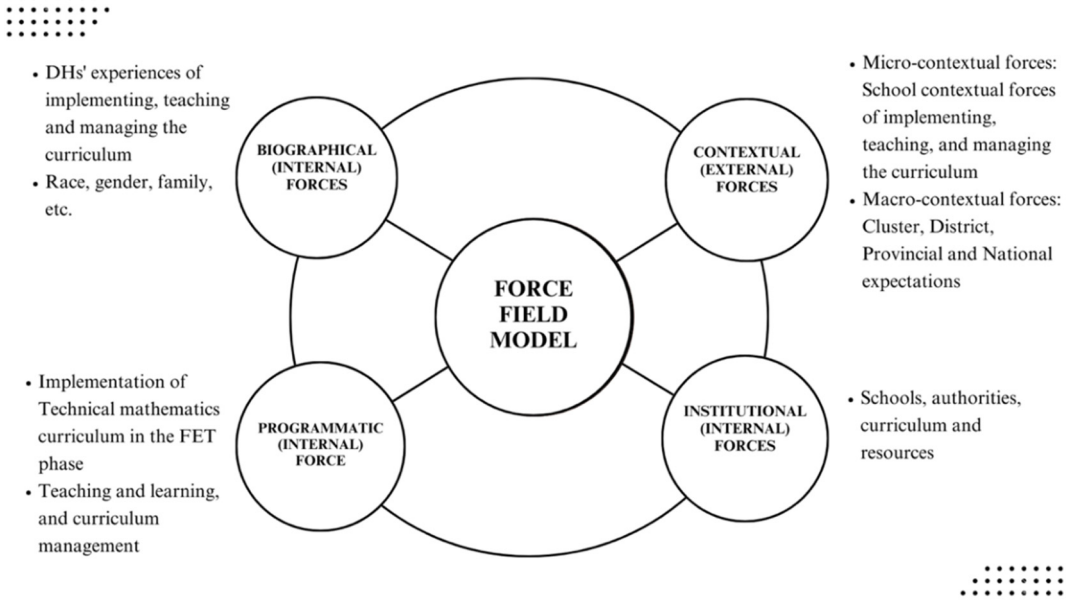

Figure 1. Modification of Samuel's Force Field Model to understand DHs' knowledge and practices in implementing and managing Technical Mathematics.

Samuel (2008) posits that teachers' behaviours are influenced by their unique life experiences and the contextual forces of their school environments. De Villiers (2021) emphasises the significance of teachers' biographies as internal authentic energy sources. According to Samuel (2008), teachers are products and processors of their history, affected by institutional forces and the broader socio-political context. These forces shape the ethos of institutions and impact teaching and learning quality. This means that characteristic

conceptions of professional teachers and DHs in the context of this study are the result of the force of their institutional expectations. To be specific, DHs' values and goals concerning the pedagogy and implementation of the Technical Mathematics curriculum are most likely to be shaped by the very prescriptive CAPS curriculum that they are required to implement.

Programmatic forces, such as curriculum interventions, also shape teaching expertise over time. The Force Field Model helps understand how various forces interact and influence DHs' roles and responsibilities and explains their dynamic interplay of influences. For this study, all forces—biographical, contextual, institutional, and programmatic—are crucial in comprehending DHs' enactment of their roles.

4. Methods

The aim of this study was to understand how and why DHs enact their roles and responsibilities to implement and manage the TMAT curriculum. In this study, we sought to understand DHs' interpretations of their world from both inside and outside (Jackson & Bazeley, 2019). This was a qualitative study in which we used semi-structured interviews to gain a deeper understanding of the phenomenon (Maree, 2016).

TMAT was integrated into the South African curriculum in 2016. A pilot phase was conducted in several schools before TMAT was expanded to all technical schools that offer technical subjects. Participants were chosen because of their involvement in the inception of TMAT, which suggests they possess greater knowledge of and expertise in implementing and managing TMAT. The sampled DHs were purposively selected in relation to their management position, their teaching role, and their experience in implementing Technical Mathematics. In the Pinetown District of KwaZulu-Natal, where the study was conducted, three schools offer TMAT, and hence, three DHs, one from each of the schools, were purposefully selected as study participants. Biographic information of the research participants is presented in Table 1, including age, teaching experience, experience as a DH, and teaching qualification/s.

Table 1. Participants' bibliographical information.

	Participant A	**Participant B**	**Participant C**
Participant (pseudonyms)	Mr Alpha	Mrs Beta	Mr Gamma
Age (years)	52	45	49
No. of years as DH	14	7	9
No. of years teaching TMAT	6	6	5

TMAT was initially piloted in Pinetown District in 2016. We obtained ethical clearance from the KwaZulu-Natal Department of Education and the University of KwaZulu-Natal Ethics Committee (HSSREC/00003217/2021) to carry out the study. Permission was secured from school principals and DHs, with informed consent from learners, and parental consent for their children's participation. Ethical considerations such as learner protection, voluntary participation, informed consent, anonymity, confidentiality, and transparency were addressed. Pseudonyms were used for school names, DHs, and learners to ensure anonymity.

This study was conducted by interviewing three DHs and analysing documents. Document analysis examined tools used by DHs for curriculum guidance and monitoring, such as files and ATPs. We used the computer-assisted qualitative data analysis software NVivo to assist with the coding and transcription of the data, providing an efficient and organised approach to managing the qualitative dataset (Jackson & Bazeley, 2019). Braun and Clarke (2006) outline that the analysis involved familiarising ourselves with the data,

generating initial codes, searching for themes, reviewing and defining them, and writing the report. Using NVivo ensured a rigorous and transparent procedure for organising, retrieving, and analysing data. This approach allowed us to identify and interpret key patterns and themes grounded in the dataset. Transcribed data were analysed to ensure alignment with interviews, maintaining authenticity. NVivo aided in coding transcripts and identifying themes from DHs' shared experiences, which were cross-checked by researchers for consistency. In order to gain a thorough understanding of DHs' practices and actions, it was necessary to triangulate their statements and documented practices. Themes that emerged were DHs' practices of teaching, managing, and monitoring Technical Mathematics curriculum; DHs' management of Technical Mathematics; DHs' implementation of Technical Mathematics; DHs' management of human resources (teachers); DHs' enactment of roles and responsibilities; and reasons influencing DHs to enact the roles in the way they do. During the coding process, we collapsed nodes and expanded them to ensure they were grounding transcripts from interviews and document analysis. DHs' commonly used words in the transcripts guided our initial node and code creation. This preserves participants' key themes and perspectives by keeping the codes accurate and close to the original transcripts.

5. Results

To respond to our research questions about how DHs enact their roles and responsibilities to implement and manage Technical Mathematics, why they enact their roles in the way they do, and the underlying reasons for how DHs carry out their roles and responsibilities, the results are presented under three broad themes that emerged from the data: managing TMAT curriculum, implementing TMAT curriculum, and reasons underlying reasons for how DHs carry out their roles and responsibilities.

5.1. Departmental Heads' Management of the Technical Mathematics Curriculum

To ensure the successful implementation of the envisaged curriculum, DHs should be clear about their roles and responsibilities and what is expected of them. The participants alluded to several expectations that they are aware of and managing, including monitoring curriculum coverage through checking teachers' daily/weekly progress on completing topics and keeping track of their ATP. When asked how they ensure effective management of the curriculum, they had the following to say:

> Mr Alpha: The expectations are quite high. As part of my responsibility, I need to ensure that I follow what is stipulated in the ATP. That is in terms of expectations by the DBE, we need to complete. We continuously have CASS (Continuous assessment) moderation where we have to take our portfolios together with our ATP. Our portfolios in this right here [showing his file], where we have to do all assessment tasks that are related to School Based Assessment (SBA). So I do the same to monitor the other teachers to ensure the curriculum is completed because that is what DBE wants.

As noted from the above, Mr Alpha's focus is on curriculum coverage and meeting the expectations of the DBE. Mr Gamma and Mrs Beta were of the same view and mooted the following:

> Mr Gamma: Managing means checking that the ATP is followed, CAPS curriculum is followed or confirmed to see that assessments are done on time, and moderation of assessments are done in keeping with the CAPS document.
>
> Mrs Beta: The Department is expecting reports on the subject, like when we go for moderations our work is checked on a regular basis. The DBE expects learners

to do well in the subject so they can get access to tertiary institutions, specifically in Universities of Technology and Technikons.

From the above responses, it appears that external forces are driving the DHs' management of the curriculum. Knowledge of their practices is not coming from within but rather is driven by the need to meet external expectations. This is similar to the findings of Mkhwanazi et al. (2018), namely that the DH monitoring of curriculum coverage is mainly carried out for compliance purposes, and thus becomes just a tick-box exercise. Similarly, the data drawn from document analysis revealed that DHs' practices in managing the curriculum implementation are driven by the need to comply rather than monitoring the actual classroom practices, as shown in the extracts from the ATP in Figure 2.

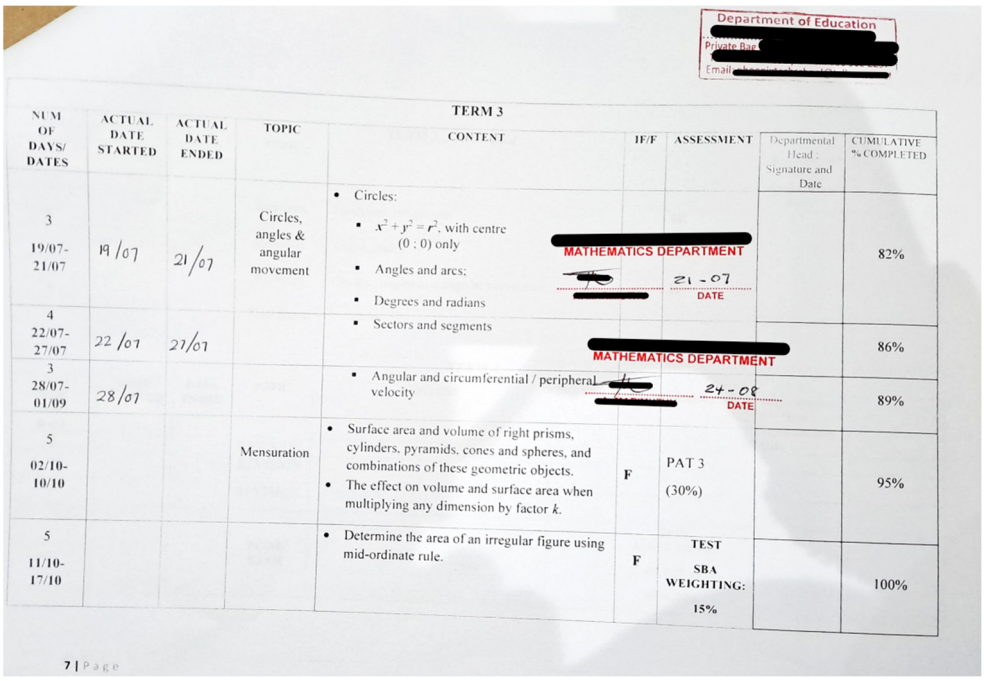

Figure 2. DBE TMAT Annual Teaching Plan for 2023.

Whereas in Figure 2 there is a stamp and signature in certain places, the signing dates are not consistent with the dates of completion. For example, in the first instance, the signing date corresponds with the date of completion. While it could be argued that monitoring and teaching should take place simultaneously, the evaluation of the implementation should happen after the teaching has taken place to ensure the integrity of the process. In other instances, as shown in the extract in Figure 2 above, there is no evidence of dates of monitoring and evaluation. Meanwhile, DHs in this study mooted that they use the ATP to manage curriculum implementation; evidence in Figure 2 indicates that this was not carried out for all sections, thus showing inconsistencies in ensuring curriculum implementation. The findings from document analysis indicate a gap between what the DHs perceived and actual practices when it comes to the implementation and management of TMAT.

In the Force Field Model, Samuel (2008) refers to various external forces, one of those being macro contextual forces where cluster, district, provincial, and national expectations influence the process. Drawing from the above responses, the findings showed that the DHs' practices in managing the TMAT curriculum are influenced by external expectations.

It is true that DHs as curriculum managers within the school have an obligation to external stakeholders; however, should internal forces, that is, the institutional needs, not be at the forefront for the efficacy and sustainability of the curriculum? DHs seem to put more emphasis on the need to comply, which suggests that external forces are defining

the process, devaluing the autonomy of an individual DH in the school setting. This was evident in the DHs' responses:

> Mr Gamma: DBE set dates for moderation. I think monitoring and management is also done on a term-wise basis, when educators go for moderation from Grade 10, 11 and 12. Moderation of past exam papers or if any assessments are done; together with content workshops that are done on a regular basis for the subject teachers.
>
> Mrs Beta: The Department is expecting reports on the subject, like when we go for moderations our work is checked on regular basis.
>
> Mr Alpha: We are all expected to do moderation, the DBE set dates, and I make sure by the time moderation comes the work is covered.

While the DHs allude to the processes of the DBE, none of them mention internal processes carried out to ensure that the TMAT curriculum is managed effectively.

5.2. Departmental Heads' Implementation of Technical Mathematics Curriculum

The DHs' agency in curriculum implementation when exposed to different factors imposed by the DBE and their school context was examined. Schools had to meet certain criteria so that TMAT and other technical subjects were populated in their schools. The DBE sets norms and standards aimed at the uniform implementation of TMAT across all technical schools in South Africa. The following responses reflect the DHs' views about the changes that came with the implementation of the TMAT curriculum:

> Mrs Beta: The changes are not dramatic; they are changes that one is able to handle. The content is mostly still the same, the changes that are there are the documentation, the types of documents that we use to record, and some of the things that are required by the SASMS (South Africa School Administration and Management System).
>
> Mr Alpha: To be honest to you, the implementation of the Technical Maths meant to revisit some topics that were no longer taught. They brought sections back that was taught previously. The newer educators who are joining the system would find a challenge, unfortunate for those educators in those schools. But fortunately for me, the educators that we have on the system have either been trained with those sections or they have done those sections. Like if you take an era back where learners were doing Mathematics at school, some didn't do geometry. So now with the introduction of geometry back into the syllabus, those teachers who did not do it will find it challenging to teach it. But if you take someone who did Mathematics and did geometry at school and university, they will manage. However, we have lots of workshops that take place on an ongoing basis for Mathematics. We have quite a bit of support.
>
> Mr Gamma: The challenges that we have encountered is the type of learners that we receive or that choose to do Technical Mathematics—some of the learners think TMAT is easier than Pure Mathematics. When you look at it carefully, it is not actually easier. The learners that take the subject with the aim of an easy pass, you find that they are struggling. They find that it is the same thing that is done in Pure Mathematics.

Mrs Beta considers the implementation of TMAT to be no different to that of Mathematics, while Mr Alpha and Mr Gamma alluded to the fact that there are some changes in the content that need to be taught and referred to the calibre of learners doing TMAT. In thinking about those changes, the DHs are drawing

from internal forces in terms of biographical forces and programmatic forces. For example, Mrs Beta and Mr Alpha are seasoned Mathematics teachers, and seem to experience no challenge with implementing TMAT in their schools. However, Mr Alpha is cognizant that new teachers might find it challenging, since there are topics they did not learn while at school. While Mr Gamma considers the programme structure to be no different to Pure Mathematics, he is wary that the calibre of learners plays a crucial role in its implementation, and thus institutional forces need to come into play to prepare learners accordingly.

Implementation at the classroom level requires teachers and DHs to have adequate knowledge of the subject so they can teach learners effectively. DHs are a crucial component in managing and implementing the developments regarding curricular changes (Tapala, 2019). Tapala (2019, p. 73) argues that "The issue is that the DHs like all educators are not trained on the new curriculum developments, rendering them helpless when it comes to training and developing their own staff". Regarding their practices in terms of implementing the TMAT curriculum, the DHs had the following to say:

Mr Gamma: I've got two seasoned educators that teach Technical Mathematics. So they know what needs to be done.

Mr Alpha: Most of the educators in this department right now are seasoned educators, who taught Mathematics; they are capable of implementing Technical Maths curriculum.

Mrs Beta: The teachers that I have are experienced in teaching Mathematics and fit in very quickly; teachers that struggle a bit are teachers that are teaching for the first time.

According to the DHs in this study, seasoned teachers do not need professional development; therefore, in the process of implementing the curriculum, it seems to be up to the teachers to decide what they do in their classroom. While this practice might be considered appropriate in allowing teachers autonomy, it is the DHs who have a responsibility to manage the curriculum. The question is, how are they able to manage it when they are not involved in the implementation? For effective and sustainable curriculum implementation, all stakeholders need to work together; however, it seems that the DHs participating in this study leave teachers to work in silos. In addition, the DHs seem to equate teachers' experience in the field to their competence in the subject matter and pedagogical knowledge. They posit that they only worry about new teachers in the field, suggesting that they only see the need to monitor the implementation of the TMAT curriculum when it is taught by a novice teacher.

The challenge with this notion is that TMAT is grounded more in application, while Pure Mathematics is grounded in the abstract—thus, all teachers, whether seasoned or novice, need to be supported for the effective implementation of the TMAT curriculum.

5.3. Underlying Reasons for How DHs Carry Out Their Roles and Responsibilities

The findings of this study suggest that DHs use different management styles when enacting their roles, which are influenced by the school contexts that they operate in. Staff support and expectations from the school principals, subject advisors, and the DBE inform the management style they adopt in their schools. In essence, the DHs were found to be using a top-down management style and shared instructional leadership (distributive leadership management), trying to find the balance between the two leadership styles, with different forces pushing and pulling them in different directions.

Mr Alpha uses a top-down management style, where he solely manages TMAT in his school. Rudhumbu (2015, p. 106) in Botswana attests that "Traditionally, the role of the

academic middle manager has been viewed as transmitters of top management views to the lower echelons of the organization". He enacts his roles and responsibilities by interpreting the curricular information to subject teachers he manages:

> Mr Alpha: I'm also teaching the Grade 11 and 12. So, I'm monitoring Grade 10 and that is the only area that I was teaching, which I'm not teaching right now, that was due to my loading. So therefore, I have to find myself knowing and being hands-on in terms of checking what they are doing. I did the analysis for terms one and two, so I know the results, but that doesn't necessarily speak to their content in terms of the syllabus.

The influence of the considerable pressure brought by the CAPS policy makers, school context, and expected roles of the DH was found to be forces that inevitably shaped Mr Alpha's enactment of an instructional leadership style. He argues that the management of TMAT is not that challenging, but ensuring that learners are performing well in the subject is:

> Mr Alpha: Managing it is not challenging, but what is challenging is to get interventions with educators for learners to pass.

Mrs Beta's instructional leadership style sought to include TMAT teachers in the decision-making process, and they are active participants in management of the subjects in their department. The DHs' roles and responsibilities in her school were overwhelming, since she managed all Mathematics, Science, Technology, and technical subjects:

> Mrs Beta: In our department, Science, Mathematics, and Technology, we have what we call subject specialists or subject heads. So, I do not take care of all the needs for all the subjects in my department. We have subject heads for Mathematics, Physical Sciences, Life Sciences and so on. So, my job as the DH becomes easier because I have people that are supporting me in running of my roles, I don't just do it on my own.

She affirms that distributing her management role eases her own role and makes the teachers understand the expectations of the school and the demands of the curriculum. Both teachers and the DH work towards the common goal of meeting standards while narrowing their focus on learners' attainment of the learning goals. The DH posits that she shares responsibilities with other teachers and feels that this is helpful in the implementation of TMAT in her school.

Mr Gamma used both the instructional leadership and shared instructional leadership styles. His management style did not fit into existing management styles, as he was found to be directive and also exercised some flexibility in terms of the extent to which teachers can execute roles in his department. He prefers to take ownership of his DH role, executing most of the management role and leaving out those roles that have no major or significant impact in the implementation of TMAT:

> Mr Gamma: We always talk about continuous professional development and keeping their best by reading up and always reflecting on their teaching methods, and so forth. Also working collaboratively with other educators. . . But at the end I need to ensure that everything is happening because I am accountable. Its my job that will be on the line. I am working closely with the Technical Mathematics subject advisor to ensure that we know what needs to be covered, what is not to be covered, and how they [teachers] cover the required content to the best of their ability. I delegate to them [teachers] smaller tasks.

While in theory, Mr Gamma seems to be keen on collaboration, he does not necessarily believe in delegating to teachers what he considers to be critical or what can jeopardise his job. Again, external forces seem to be influencing his decision-making when it comes to implementation and managing his partnership with teachers in ensuring that the curriculum is implemented effectively.

6. Discussion

The results of this study revealed how different contextual forces and programmatic as well as institutional forces influence DHs' practices in the management and implementation of the TMAT curriculum. While some encourage collaboration within their departments and are keen on distributing roles, they are pushed back by the need to secure their job and a lack of expertise in the subjects they manage in their departments.

When it comes to managing the curriculum implementation, the findings show that DHs' practices are influenced by programmatic forces, as they believe that seasoned teachers do not need support and that teachers who have been teaching Mathematics are capable of implementing the curriculum without support. Contradictory to the findings of Sengai (2021), that the DHs encourage teachers to work together in implementing the curriculum, in this study, it was found that the DHs are more inclined towards working in silos, believing that experienced teachers are capable of working on their own. In addition, in managing the TMAT curriculum implementation, the contextual forces are the pushing and pulling forces that influence DHs to execute the roles, as it was evident that they do not exercise autonomy and institutional forces but rather focus on meeting the expectations set by subject advisers. We therefore concluded that DHs' practices are driven by the need to comply rather than sustainability.

These findings resonate with those of Metcalfe (2015), who posits that in the quest to monitor curriculum coverage, DHs were mainly carrying out a tick-box exercise. Based on these findings, we concluded that while DHs are obligated to adhere to contextual forces; as immediate curriculum advisers in the school they need to draw more from internal forces, that is, institutional and biographical forces. They need to foreground working with teachers, both seasoned and novice, and utilise resources within their institution to ensure effective curriculum implementation.

7. Conclusions and Implications for TMAT Curriculum Sustainability

This study was conducted with three DHs who were among the first cohort that was involved in piloting the implementation of the TMAT curriculum. TMAT has now been scaled to other schools, highlighting the need for a larger study to understand the practices of DHs and the factors influencing these practices. Identifying areas where DHs require capacity development will enable the implementation of targeted interventions to support and ensure the sustainability of the TMAT curriculum.

To answer the research question about forces influencing DHs in enacting their roles and responsibilities to implement and manage TMAT, this study concludes that DHs' practices are influenced by external forces, the lack of confidence in novice teachers, and the belief that seasoned mathematics teachers are best suited to implement the curriculum. This suggests that for TMAT, there is a push for TMAT to be taught in the same abstract nature as Pure Mathematics, ignoring the application aspects. Being influenced by external forces suggests that DHs were not implementing the curriculum according to their school's needs, and their curriculum monitoring was mainly for compliance purposes, devaluing their autonomy and school setting. To answer the second research question of how they perceive their practices, this study concludes that they perceive their practices to be about

curriculum coverage and meeting the demands of external forces rather than effective curriculum oversight.

Drawing from the findings, we argue for the need for the continuous professional development of DHs when it comes to enacting the roles and responsibilities for effective curriculum implementation and management. Since TMAT has been rolled out and implemented in all the schools that offer technical subjects, it is imperative that the Department of Basic Education, Teacher Training Institution, and the schools that offer TMAT collaborate ensure that the existing DHs are continuously receiving professional development as well as in-service teachers teaching the subject. In addition, it is imperative that the graduates be inducted into the teaching of TMAT so that the DHs are not sceptical about their knowledge competencies of the subjects. Since TMAT was introduced six years ago, we, therefore, recommend a large-scale study to explore the evolvement of DHs' practices and also a comparative study with other countries to explore best practices to ensure the sustainability of the TMAT curriculum.

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