

Experiences of Role Players in the Implementation of Mathematics Teachers' Continuous Professional Development in South Africa

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KEYWORDS Mathematics Teachers' Professional Development. In-service Training. Content Knowledge. Pedagogical Knowledge. Professional Development Programmes

ABSTRACT This paper reports on the experiences of the role players on mathematics teachers' professional development (MTPD) in the post-apartheid era in South Africa. The pilot study which was in preparation for the main study sought to explore the status of existing MTPD practices as expressed by participants and elicit challenges in the implementation of such programmes. Five of the nine provinces in South Africa were involved in the study where a sample of 54 participants consisting of teachers, principals, subject advisors, district officials and ministry of education were involved. A teacher questionnaire as well as interview schedules for other respondents were used to collect data that were analysed using qualitative methods. Despite the existence of MTPD programmes in the country, as alluded to by different role players, a variety of factors, such as the interference by labour unions in their implementation, militated against the achievement of objectives these programmes were intended to attain.

INTRODUCTION

The teaching of mathematics in South Africa can generally be described in terms as captured by Wu (1999: 535), citing a landmark 1983 education document *A Nation at Risk*: "You can't teach what you don't know". Too many of our mathematics teachers, however, may be doing exactly that: teaching what they don't know. From the South Africa's historical perspective this state of affairs may not be unexpected, noting what happened at the introduction of Bantu Education in 1953. The apartheid-era Minister of Education at the time, Verwoerd, chose mathematics as the one subject not to be taught to the marginalised majority of South Africa when he indicated that there was no place for the Bantu (black people) in the European community above the level of certain forms of labour and actually questioned the logic of teaching the Bantu child the subject of Mathematics when it cannot use it in practice (Khuzwayo 2005; Kwizera and Iputo 2011; Pitoniak and Yield 2013; Horsthemke 2014). The legacy of this policy to the African teachers and learners of mathematics in the country is still recognisable in the mathematics classrooms. One of the ways to address the anomalies of the past is through teachers' professional development (TPD).

Professional development for teachers is an essential component of their growth and pro-

gression in the profession as they endeavour to offer quality teaching. Lew et al. (2012) indicate that there are strong demands placed on teachers to continuously update their knowledge and teaching skills due to, for instance, the introduction of a new curriculum or changes in the characteristics and learning needs of students. In the case of South Africa, however, the added pressure of having to change the legacy of apartheid comes to the fore. The ever-changing environment with which students have to content with as they learn puts added pressure on the teachers and education authorities on how to adapt TPD in order to meet these needs.

The contents of this paper are part of a much larger collaborative study, initiated by the Department of Mathematics Education at the University of South Africa (UNISA), on mathematics teachers' professional development (MTPD) in developed and developing countries involving two European countries (Ireland and Poland) two Asian countries (South Korea and Singapore) and seven countries from the African continent (six from Sub-Saharan Africa, viz. Botswana, Namibia, South Africa, Swaziland, Tanzania, Zimbabwe and one from North Africa, viz. Morocco). The countries were selected on account of their established professional development programmes for many years. The two of the developed countries, viz. Singapore and South Korea, for instance, have performed high-

ly in the Trends in International Mathematics and Science Study (TIMSS). This paper reports on the pilot study conducted in five of the nine provinces of South Africa, namely, Gauteng, Limpopo, Mpumalanga, Eastern Cape and North West. The experiences of role players in the implementation of MTPD was sought and documented in this paper.

The main objective of the collaborative study is to examine MTPD programmes of countries in international systemic assessments and professional development programmes with the view of learning from exemplary practices of MTPD programmes in use from participating countries in order to improve mathematics teacher development programmes in these countries. The overall aim is to propose a systemic and nationwide improvement of mathematics teacher professional development programmes for South Africa and other participating countries.

The following research questions were pursued in this pilot study:

1. What is the nature of MTPD programmes that exist in participating countries?
2. What are the challenges experienced in implementing current initiatives in MTPD programmes?
3. What aspects of MTPD programmes can be adapted from exemplary programmes for use in South Africa and other participating countries?

The significance of the study is captured in the highlighting of the different perspectives from which different role players come with regard to MTPD activities. The pilot study reveals the challenges in reaching a common understanding on these activities.

Theoretical Framework

According to Wu (1999), any improvement in education must start with improvement of the teachers already in the classroom and this may be achieved through TPD. Drawing on research and best practice, Desimone et al. (2002) identified six key features of professional development that they hypothesised as effective in improving teaching practice. Desimone et al. (2002) called the first three “structural features” and they characterised these in terms of the structure of a professional development activity while the other three, called the “core features”, were characterised as the substance of the activity.

Structural featured professional development activities such as the formation of a study group, mentoring relationship (Richter et al. 2013), committee working on a task, internship (Jacobs 2012; Tam 2014), teachers networking (Singh and Pandey 2013), individual research project, or teacher research center – contrasted to traditional workshops, courses, or conferences – are categorised as the reform type. The effectiveness and sustainability of the reform type of TPD activities augurs well for the improvement of education especially in the case of South Africa where the legacy of apartheid had caused such immeasurable harm. Wu (1999) highlights the following concern with regard to the development of teachers in the field only through short sessions of a few weeks’ duration for the South African context: the race against time normally associated with these traditional type of TPD, particularly in mathematics, raises the question of how something that took more than four decades of ‘teachers’ non-learning and/or mis-education’ can be overcome in a measly three to four weeks and/or a handful of meetings in a year. It is apparent that such traditional type of TPD activities, particularly in consideration of the legacy left behind by Bantu Education, is tantamount to a waste of resources and time.

The second of Desimone et al.’s (2002) structural feature is categorised in terms of the duration of the professional development (Lumpea et al. 2012) and includes looking at the total number of contact hours that participants spend in the TPD as well as the span of time over which the activities take place. This view reiterates that of Wu (1999) who stated that substantive knowledge, whether mathematical or not, may not be learned overnight and consequently, teachers needed mathematical reinforcement over an extended period of time, say, one day each month for a year. The last category for structural featured activities relates to the degree to which the activity emphasizes the collective participation of groups of teachers from the same school, department, or grade level, as opposed to the participation of individual teachers from many schools (Desimone et al. 2002). Mathematical presentations in TPD programs should be tailored in accordance to the needs of teachers of specific grade levels for the purpose of teaching meaningful mathematics (Wu 1999; Acquah et al. 2013).

The other three features identified by Desimone et al. (2002) are called core features and

they relate to characteristics of the substance of the activity. The first one looks at extent to which the professional development activities offer opportunities for active learning or opportunities for teachers to become actively engaged in the meaningful analysis of teaching and learning where, for instance, they review students' work or they obtain feedback on their teaching (Desimone et al. 2002; Nasser et al. 2013). Wu (1999) argues that mathematics instruction in professional development should not be delivered only in the unidirectional style from professor to students and therefore active participation of those involved is required (Desimone et al. 2014). According to Wu (1999), MCPD should increase teachers' *understanding* of mathematics by *keeping its imple and relevant*. Wu (1999) adds that the MCPD must teach substantive mathematics and not just a collection of projects which can be easily modified for immediate use in a classroom. The second core feature refers to the degree to which the activity promotes coherence (Desimone 2009) in TPD, by incorporating experiences that are consistent with teachers' goals, aligned with state standards and assessments, and encourage continuing professional communication among teachers (Desimone et al. 2002; Desimone et al. 2014). The sixth and last of these features relates to the degree to which the activity has a content focus, where the improvement and deepening of teachers' content knowledge in mathematics is developed (Naidoo et al. 2008).

Desimone et al. (2002) found that the six key features of professional development were related to increases in teachers' self-reported knowledge and skills and they accounted to changes in teaching practice. According to Desimone et al. (2002), the core features worked through the structural features such that reform type activities were more likely to have collective participation and longer duration. In this study the extent to which experiences of the role players in the South African context exhibited these six features were investigated. One the features of TPD that Wu (1999) suggests but not indicated in Desimone et al.'s (2002) framework is that of the payment of teachers participating in professional development, arguing that the low salaries of teachers necessitates this.

Learning support materials have also been identified as an essential element of TPD (Sele-sho and Monyane 2012; Moodley 2013). Marsigit (2007) suggests that there is a need for as-

essment prior to conducting TPD programmes as indicated by teachers who expressed the view for such programmes to be based on teachers' needs. Other factors identified as having a positive effect on TPD programmes are government support, financial support and/or incentives (Hu and Roberts 2013) and monitoring (Nasser et al. 2013), whilst lack of resources (Khan et al. 2014), overcrowding (Kheswa et al. 2014), contribute to the adverse implementation of these programmes. Nabibya (2013) also found teacher labour unions to be playing a critical and positive role in the successful implementation of TPD programmes.

METHODOLOGY

Qualitative and quantitative research methodologies were pursued for this study such that triangulation of collected data from different role players – not only between the different but also amongst the same role players – with regard to TPD and more specifically MTPD can be done.

Research Design

The research design for the study was a survey in which data were obtained by means of a teacher questionnaire and interviews for the other participants. The questionnaire provided quantitative data while the interviews elicited qualitative data. The exploratory design was used to determine the nature of MTPD programmes that exist in South Africa. The study also explored the views and roles of the practitioners, contribution of role players and the challenges experienced by the practitioners in the implementation of the mathematics professional development programmes.

Sample

The participants of the pilot study consisted of a convenience sample ($N = 54$). In a convenience sampling process the researcher works with "whoever happens to be available at the time" (Gay et al. 2011: 140). It was felt that this non-random sampling technique would be appropriate at the pilot stage in order to optimize the elicitation of data collection for analysis and to enhance the instrument refinement process. This sample consisted of mathematics teachers ($n = 17$), school principals ($n = 11$), subject advi-

sors for secondary schools ($n = 14$), district officials ($n = 9$) and provincial officials (ministry) ($n = 3$). The rationale for including all these participating groups was to explore the nature of MTPD at various levels of implementation, and to triangulate data from these sources. Triangulation essentially involves cross-checking for internal consistency and reliability (Gall et al. 2010).

The study was piloted in five of the nine provinces of South Africa. The five provinces were Gauteng, Limpopo, Mpumalanga, Eastern Cape and North West. The distribution of participants in terms of the provinces is provided in Table 1.

Table 1: Distribution of study participants (N = 54) in terms of provinces Instruments

	East- ern Cape	North West	Gau- teng	Mpu- mal- anga	Lim- popo
Teachers	8	4	0	5	0
Principals	3	1	2	3	2
Subject advisors	6	3	3	2	0
District officials	5	1	0	1	2
Ministry	2		1		

The instruments used in the pilot study consisted of a teacher questionnaire and interview guides for teachers, principals, subject advisors, district officials, provincial officials and service providers. Different instruments were used to elicit and acquire comparable views of participants on MTPD. The items in each of the instruments were constructed and modified mainly by the researchers to collect cross-sectional data on participants' experiences, views, needs, and expectations regarding MTPD activities.

Teacher Questionnaire

The questionnaire probed teachers and motivated them to think more critically on the influence of MTPD on their abilities to perform effectively at classroom level. In this research tool, participants were not given responses to choose from and instead, they provided individualized responses that were largely influenced by their practice. Essentially, items sought teachers' views on the MTPD they had experienced. This included specifically the MTPD workshops and meetings they had undertaken in the past three years that preceded the study. Some of the items

in this section were: *What are the benefits of MTPD in your practice as a teacher?*; *What challenges do you face in implementing MTPD initiatives after attending?*; etc. A sample of teachers' responses to these items is documented in the analysis section of this paper.

Interview Guides for Other Participants

Except for teachers, all other participants were interviewed. All items in the interview guides were developed by researchers mainly to address the research questions of the study. Different items were constructed for each group of respondents, and were posed to address issues pertained to each category of participation.

RESULTS AND DISCUSSION

The following are responses of the participants of the pilot study with regard to their experiences on MTPD which are accompanied by the discussion.

Teachers' Responses

Less than half of the teachers (8 out of 18) who participated in the pilot study responded to the question on what TPD meant to them while the rest left the space blank. In line with Desimone et al.'s (2002) framework of describing TPD, the majority of the teachers who responded to the question described it as a guiding, empowerment, enrichment, enhancement and development tool of content knowledge and teaching. It is likely that looking at TPD as "guiding" points to the *mentoring relationship* (Richter et al. 2013) key features of TPD and empowerment denotes *internship* (Tam 2014) while the enrichment, enhancement and/or development tool of content knowledge and teaching refers to opportunities for *active learning* (Desimone et al. 2014). The teachers also described TPD as tool to close any existing gap in the content knowledge and teaching practices and this refers to the core feature called *content focus* (Desimone et al. 2014). In addition, the teachers also viewed TPD in terms of what it would do to/for them and in highlighting collaboration with other professionals they reflected another of Desimone's (2009) core feature, namely, *coherence*. TPD was also described by teachers as the means by which they acquire resources, teaching skill and

content knowledge for their own development or use.

With South Africa having undergone several curriculum changes since the advent of democracy in 1994, culminating in the present one Curriculum and Assessment Policy Statement (CAPS), as expected, the teachers listed National Curriculum Statement (NCS) and CAPS training as some of the kind of MTPD they had participated in. The school districts, sub-districts and ETDP setas (skills development government entities) were identified as providers for the MTPD programmes in the form of school-/cluster-/district-based workshops or in-service training.

The teachers in this pilot study mentioned the provision of learning support materials by TPD providers as crucial in the implementation of a successful MTPD (Moodley 2013). The importance of this aspect in the South African context illuminates the fact that a sizeable number of schools where the pilot study was conducted were in rural areas and these schools were also poor. The teachers also appreciated the unpacking of challenging topics and viewed this as benefits of being involved in the MTPD programmes. They also indicated the acquisition of content knowledge, pedagogical content knowledge and skills to present (interpret and/or implement) the curriculum as valuable to them (Naidoo et al. 2008; Acquah et al. 2013). According to these teachers, their participation in MTPD programmes influenced their practice in terms of motivation as well as the quality of skills and knowledge in the teaching and learning of mathematics. They indicated that they were encouraged “to go back to the learners to help them”, had gained the confidence to present some mathematics topics and also felt free and positive about their work. They described their teaching and learning of mathematics after participation in the MTPD programmes in terms of “easy”, “understandable” and “effective” (Desimone et al. 2002).

The majority of the teachers identified the Department of Education as the source of financial support for their MTPD while others mentioned the school, non-governmental organisations and individuals (Hu and Roberts 2013). Apart from financial support to participate in MTPD programmes, teachers identified other kinds of support such as professional, motivational and the provision of transport, facilities and/or resources (Hu and Roberts 2013) and

were of the view that the financial support would also augment their meager salaries (Wu 1999). The adequacy of the support provided for the teachers to participate in MTPD programmes was seen as positive by the majority of the teachers in the pilot study while fewer felt support was not enough. Those who viewed the support in the negative cited distance, lack of transport and food and awkward times as the reasons for their negative perception of the support they received.

The strengths of MTPD programmes were identified as their ability to empower teachers with new approaches in teaching and learning and provide them with the confidence to teach the content (Desimone et al. 2014). The shortage or lack of resources was cited as the weakness of the implementation of MTPD programmes (Khan et al. 2014). Improvement of teaching skills and learners' performance were highlighted by teachers as successes in their classroom practice after attendance of or involvement in MTPD programmes. Overcrowding was identified by teachers as an impediment for the successful implementation of MTPD initiatives (Kheswa et al. 2014).

Subject Advisors Responses

The majority of subject advisors (8 out of 9) who participated in the pilot study pointed to the inclusion of MCPD programme activities in the school policy.

The subject advisors pointed out the existence of a variety of MTPD activities in the country in the form of workshops, in-service training and projects such as Dinaledi Schools which are run nationally by the department of education. The Dinaledi School Project was established to increase the number of matriculants with university-entrance mathematics and science passes. The strategy involved the selection of a number (around 500) of secondary schools for Dinaledi status and providing them with the resources and support to improve the teaching and learning of these subjects (O'Connell 2009). Activities of MCPD are normally conducted in accordance with teachers' needs identified through cluster meetings between subject advisors and teachers to address gaps in terms of content and pedagogy in mathematics teaching (Desimone et al. 2014). It is critical to note that the kind of TPD described

by the subject advisors contrasts with one of Desimone et al.'s (2002) key features for the characterisation of the structure of a TPD activity, viz. the reform type in terms of the mentorship and internship elements. The duration (Lumpea et al. 2012) of the MTPD programmes as described by the subject advisors highlights the differences the advisors have with teachers where the latter expect these activities to occur, using one of the teachers, words, "now and then".

Some of the subject advisors were confident that the implemented MCPD programmes improve the teaching and learning of mathematics in the schools citing teachers' increased confidence in handling content knowledge and pedagogical issues in delivering the lessons as evidence to this effect (Naidoo et al. 2008; Acquah et al. 2013). Others felt that more effort was required to improve the situation while still others pointed out the difficulty of measuring effectiveness because the duration of MCPD programmes was not adequate to determine the improvements, indicating that the measurements can only occur at the end of the year (Nasser et al. 2013). The subject advisors, as also observed and stated by teachers, alluded to the shortage of facilitators to these workshops as challenges they face in the implementation of MTPD such that, in some instances, higher institutions of learning were contacted to conduct the MTPD programmes. Otherwise, the services of experienced expert teachers were sought to meet this challenge. With one of the main purposes of the MTPD programmes being to capacitate novice teachers and under-qualified teachers who were disadvantaged by past injustices of apartheid, the subject advisors lamented on the irregularity, inadequacy and/or unavailability of time to conduct these programmes (Lumpea et al. 2012) mainly due the existing policy at provincial level which prohibits teachers from engaging with these programmes during contact time. The acute shortage of facilitators with requisite skills to conduct MTPD activities together with other administrative issues hinder the formulation of evaluative mechanisms to measure the effectiveness of the MTPD offered. Some of the challenges highlighted by the subject advisors as debilitating to MTPD initiatives were the redeployment and/or appointment of trained teachers to other schools, re-allocation of trained teachers to other phases or subjects, inconsis-

tencies in training methods, inaccessibility of training venues (Khan et al. 2014) and unsustainability of training programs due to, say, funding. The enthusiasm of teachers who get the opportunity to share ideas amongst themselves in order to close the content and pedagogic knowledge gaps improved occasionally and the slight but not adequate improvement in learner results in mathematics were highlighted by subject advisors as the advantages of MTPD programmes.

The subject advisors suggested the following for the improvement of MTPD programmes:

- ♦ The improvement of the retaining of trained teacher in schools.
- ♦ The reduction of temporary employment of teachers in the provinces through fast-tracking their permanent status.
- ♦ Structured training of teachers (Desimone et al. 2002; Desimone et al. 2014).
- ♦ The involvement of institutions of higher learning in the training programmes and supply of qualified teachers
- ♦ The involvement of all schools in the programmes and not just a selected few.

Principals

The most striking response from the principals with regard to MTPD activities was in associating the latter to the government initiated evaluative system called Integrated Quality Management System (IQMS). The IQMS policy was introduced in the South African education system as an innovation to enhance the delivery process of a quality education in schools (DBE 2011). One of the tenets of IQMS, and not necessarily the major part, was to determine and assess the competence of teachers for the purposes of identifying areas for further development (Senge 1990; Steyn 2014). Some of the principals indicated that they used IQMS as a tool to assess professional development of their teachers, but they expressed doubts about the effectiveness of the instrument, as they argued that it is used mainly for performance measurement system (PAS), the component that evaluates individual teachers for salary progression, affirmation of appointments, rewards and incentives (Hariparsad et al. n.d). The mentioning of IQMS in relation to TPD was conspicuous by its absence in the responses by teachers and subject advisors. The principals also mentioned

that there was no follow up (Nasser et al. 2013) on issues such as attending workshops to determine the impact the training had on the classroom performance.

Ministry

Of the five provinces that participated in the study, only three officials from the ministry of education (MOE) from two provinces were available for the pilot study with one responding positively to the existence of a general policy on TPD in the country, interestingly, differing in opinion from a colleague in the same province. Pertinently, the MOE officials mentioned IQMS as one of the tools used by the department in terms of TPD together with accredited and/or non-accredited short courses. In terms of mathematics, the officials pointed to allocation of bursaries to teachers to do Advanced Certificate in Education (ACE) qualifications and requisitioning service providers to conduct workshops as examples of the provision of MTPD programmes (Hu and Roberts 2013). The MOE officials however highlighted the challenges in the implementation of TPD programmes experienced generally by the education department due to teacher labour unions. Contrary to the findings of Nabibya (2013), the MOE officials reported on the role of the unions in deciding whether or not teachers should attend a workshop. For example unions discouraged teachers from attending workshops conducted during school holidays. The criteria used by the MOE to select MTPD service providers were almost similar in the two provinces since they looked at the experience of experts who would be conducting the workshops.

CONCLUSION

The results from the pilot study suggest that the existence of MTPD programmes in South Africa as expected of a country that was negatively affected by the past policies of apartheid is apparent. The activities of the different role players in the MTPD programmes point to their concerted and sustained effort to attain the goals in the policies that were drafted to redress the injustices of the former regime. It is in the implementation phase of these policies, however, where the envisaged objectives are compromised due to a variety of factors ranging from the ca-

capacity, not only of service providers but the facilitators themselves, to the inadequacy of resources such that concerted efforts of the role players in MCPD programs may not be adequate to address the main purpose that MTPD programmes are meant to alleviate.

RECOMMENDATIONS

The kind and level of intervention for the improvement of the teaching mathematics in South Africa requires prioritisation in the same way - or even better, as fixing is often harder - that the apartheid regime under Dr Verwoerd was determined to deny the marginalised majority of the country access to the subject as captured in his famous speech. Accordingly, MCPD programmes in South Africa should be modelled on the key features of professional development and they must be based on approaches of teacher development which offer ways of unlocking doors to accessing mathematics for marginalised teachers and learners who were denied this fundamental right by the legacy of apartheid.

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