

The Effectiveness of Mathematics Professional Development in Swaziland

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ABSTRACT This study describes Mathematics Continuing Professional Development (MCPD) in Swaziland and outlines a study that was conducted to analyze the effectiveness of MCPD practices in the country. An in-depth study was conducted on 23 teachers who were purposively selected from 10 different secondary schools. The ten principals of the schools also participated in this study. Data was collected through semi-structured interviews. The teachers' experiences of MCPD were conceptualized and analysed according to the work by. The study revealed that teachers willingly participated in MCPD activities. It also revealed that principals did encourage and support MCPD activities provided for the teachers. However, the study revealed that teachers needed more time to get involved in MCPD activities and wanted to be given opportunity to participate in planning of these activities.

INTRODUCTION

Mathematics Continued Professional Development (MCPD) is very essential for improving and sustaining the quality of mathematics teaching/learning. In order to maintain high levels of quality learning of the subject, teachers need to be engaged in consistent and effective continued professional development in addition to competent initial training. MCPD is essential since there is a shift from thinking of preparing learners to live within the world as it exists to thinking of preparing learners to structure the world to suit their living (Bartell 2013). Moreover, MCPD needs to focus on research-based knowledge (Paola et al. 2014). Effective continued professional development is that which seeks to respond to the conditions in which learners live (Duncan-Andade 2011). This study outlines the process of MCPD in Swaziland. The study begins by a brief overview of pre-service of mathematics teachers and then moves on to describing MCPD strategies employed in the

country as described by those involved in MCPD. The paper study was trying to ascertain the effectiveness of MCPD activities in Swaziland.

Kahle (1999) for instance, asserts that professional development is both a starting point and a central focus of the initiative step of reforming mathematics and science education in the context of technology. She further remarks that: Learners are only as good as their teachers regardless of how up-to-date their technology, or how innovative their programs. But if teachers are not given adequate opportunities to learn through sustained professional development they have the little chance to meet the ever increasing demands of our technological society. For this reason, professional development for teachers is a critical component of improving schools and our nation's teachers (Ministry of Education and Training 2013).

With the new technology like Geometer Sketchpad and GeoGebra, the learning of mathematics especially geometry can be made very easy and effective for learners but this can only happen if teachers have been afforded opportunities to learn how to use these programs. Continued professional development can provide such opportunities.

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Pre-service Training of Mathematics Teachers

Pre-service training for primary school mathematics teachers is offered in three teacher training colleges. All the three colleges are run by the Swaziland government but indirectly affiliated to the University of Swaziland. The certification for the graduates of the colleges is done by the University of Swaziland. Teachers obtain a three year Primary Teachers Diploma (PTD). Student teachers do all subjects offered in primary schools in their first two years of study and they specialize in two subjects in their final year (Ministry of Education and Training 2013). Those who specialize in mathematics, also take science.

The University of Swaziland does not directly offer pre-service training for primary school teachers but offers it through the three colleges. The university offers a Bachelor of Education degree (BEd) for primary school teachers who hold diplomas and who wish to upgrade themselves. To do their BEd degrees teachers need to take further four years of study either part time or full time. This means for primary school teachers to obtain their first degree, they need to spend at least seven years of training.

One of the three colleges also offers a pre-service program for secondary school teachers. The college produces about twenty five mathematics and science teachers who graduate for the Secondary Teachers' Diploma (STD) each year. These teachers can further their education by enrolling for the Bachelor of Education (BEd) degree with the University of Swaziland which also takes four years full time.

The University of Swaziland produces mathematics teachers with Post Graduate Certificate in Education (PGCE). This post graduate certificate is done by people who have completed Bachelor of Science or Bachelor of Social Science with a major in mathematics. The PGCE is either one year full time or two years part time. In addition to the PGCE group, the University of Swaziland also produces mathematics teachers with direct entry into Bachelor of Education which also takes four years of full time learning.

In-service Training of Mathematics Teachers

MCPD for primary school teachers is provided by a department in the Ministry of Education and training called In-Service Department. The department does in-service training for all

subjects and issues involved in the primary education. It has centres spread in all four regions of the country. Although the department does in-service for primary school teachers in many different subjects including school management, the department has officers who are responsible for in-service training of mathematics teachers. These officers facilitate and monitor MCPD activities taking place in cluster schools.

Teachers organize their own workshops in these clusters. In-service officials attend these cluster workshops as consultants in the subjects. The workshops are held approximately once in three months. The cluster workshops are usually short, they take about half a working day.

In-Service Training for Secondary School Teachers

The in-service training of secondary mathematics teachers is provided by the in-service department of the University of Swaziland (UNISWA). The in-service department often works with the inspectors in organising workshops for teachers. Working with other professionals in providing MCPD is one of the department's objectives.

Activities of the Department

Four local staff members were put in place during the Science and Mathematics Advisory and Regional Training (SMART project). Activities of SMART were supposed to continue, but this was not the case due to shortage of funds to sustain it. Teachers were given transport fares and were provided with refreshments. The University could not sustain the funding but kept the four staff members to continue with the activities. The department collaborated more with the Ministry of Education through the Inspectorate in running its activities. Activities were then planned and executed jointly with the Inspectorate.

These activities of the department at UNISWA are as follows

(a) National Workshops for Teachers

The department organises 4 national workshops for senior secondary schools per year. These are held at UNISWA, two in the first and

two in the second term of the school calendar which has three terms. The first term workshops are held during school time. The second term ones are held during school holidays.

The in-service provider draws programmes for workshops from the needs of teachers, and the inspectors. In all the programmes the Inspectorate is involved and take a big role in actual workshops.

The Senior Inspector and the regional Inspectors identify professional needs for teachers through school inspections. They analyse and forward those requests to the maths in-service provider at the University. Together with the Inspectorate, programmes are then devised for the teachers.

Resource persons are inspectors and the maths in-service provider at UNISWA.

These workshops are held at the University of Swaziland. They last for one day at a time. Teachers fend for themselves. The department provides the workshop material free of charge to the teachers. Travelling to UNISWA is generally not a problem since it more or less centrally located.

(b) Regional Workshops

There are four regional workshops for high schools and three regional workshops for Junior Secondary teachers per year. Regional workshops are held in the four regions. These are held during school time.

The planning is similar to the one for National workshops.

(c) School Visits

The department visits about 5 school per term to update and get information from teachers.

(d) Material Development

The department develops any material that it considers useful for teachers. Some of these are developed with the teachers.

Needs for Workshops

Workshops' needs originate from mainly three sources (Fig. 1).

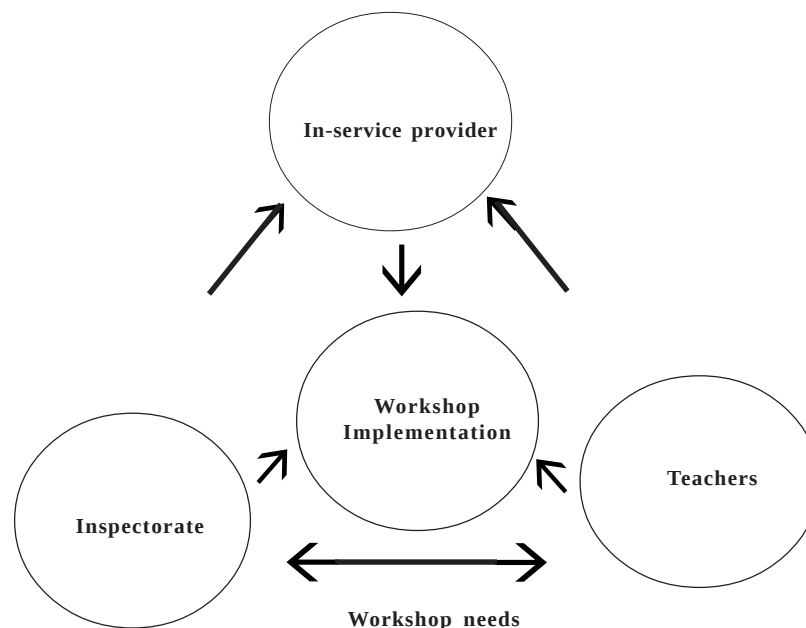


Fig. 1: Workshop needs framework

- (a) The ministry of education
 - (b) The teachers
 - (c) In-service providers.
- These needs are generally on:
- (a) *Curriculum innovations*
Changes in the syllabuses
Problems encountered by students
 - from examinations statistics
 - from actual marking
 - (b) *Pedagogy*
Teaching approaches
Problems with the content.

Problem Statement

In-service training of mathematics teachers in Swaziland is taking a top-down approach. Normally, topics covered in workshops come from inspectors and in-service providers from the University. These officers draw information on which topics to be covered from observations as they visit schools. Although teachers are given opportunities to suggest topics to be dealt with, they often suggest the same topics each time which compels the in-service providers to suggest and bring new topics.

The capacity of the infrastructure at the University also accommodates only up to 75 people per session. This has a potential of having teachers who do not get an opportunity to attend mathematics workshops provided by the University and the Ministry of education and training. This leaves a question on whether teachers actively and meaningfully participate in MCPD. If they do, which MCPD do they attend and how do they benefit from such MCPD activities. The study, therefore, seeks to evaluate the effectiveness of available MCPD for mathematics teachers in Swaziland. The study wanted to answer the following research questions:

1. What qualifications are held by secondary mathematics teachers in Swaziland?
2. Do teachers attend MCPD workshops?
3. How far are teachers' expectations achieved by the MCPD workshops they attend.

Theoretical Framework

The theoretical construct of situated learning was used to interpret the story of challenges in mathematics continuing professional development in Swaziland. The situated learning con-

struct views learning as participation in discourse and communities of practice (Molefe and Brodie 2014; Earl and Ben 2009; Earl and Katz 2006; McLaughlin and Taberts 2006; Katz et al. 2009). From the situated learning perspective, learners, teachers in the case of this study, succeed when their learning process is situated, which means that the situation in which domain knowledge is taught corresponds to the situation in which it was developed and is still used (Knobelsdorf and Tenenbergh 2013; Borko and Koellner 2008). This was taken from the first level of Guskey's model of professional development (Guskey 2000). A questionnaire trying to elicit if time spent in workshops was effectively spent may provide a reasonable participants' reaction in such continued professional development activities. In the case of this study, a semi-structured interview schedule was used in place of a questionnaire because of demographic advantages in our context. Situated learning continues from the natural form of learning in which the master-student relationship focused on practicing contextual knowledge in conducive situation which allows the student to construct reasonable meaning of the activities involved (Knobelsdorf and Tenenbergh 2013; Katz et al. 2009).

The situated learning theory posits that learning is thought to be co-constructed and influenced by both the students and teachers (Ticknor 2012). Teachers in these MCPD activities should not be positioned as recipients of knowledge, rather than professionals who were co-constructing and negotiating knowledge about their teaching practices (Saigal 2012). The co-construction of knowledge takes place as participants and professional development providers actively and meaningfully participate in activities that are well organized for it. According to Lave, as cited by Ticknor (2012: 309), the situated learning perspective views that:

Learning is transformation through increasing participation in social practices, and a mechanism for learning would need to take account of the goals of the individual in joining, or being coerced into joining, the social practice, and the specificities of the practices in terms of situated meanings and situated ways of being.

The environment must be conducive for participation. Putman and Borko (2000: 4) say:

How a person learns a particular set of knowledge and skills, and the situation in

which a person learns, becomes a fundamental part of what is learned.

An individual's successful participation or failure in participation in a mathematics classroom should not be viewed as exclusively attributed to a student's ability or the instruction they receive (Ticknor 2012).

The study tried to evaluate MCPD in Swaziland using the Guskey model of professional development.

Data Collection

The researchers selected 23 teachers from 10 different schools through purposive sampling method. The researchers went to schools which were headed by principals who were mathematics majors. The researchers also solicited information on MCPD from the principals of the 10 schools through structured interviews. The data was collected through semi-structured interview schedule with individual teachers. The semi-structured interviews were soliciting information on the teachers' qualifications, their attendance of MCPD activities and their perceptions of such activities. A semi-structured interview for principals solicited information of effectiveness of MCPD practices as viewed by the principals.

ANALYSIS AND DISCUSSION

Figure 2 shows the qualification of the teachers that participated in this study. There are nineteen teachers who were willing to tell their qualifications. Three of them declined to reveal their qualifications. The figure shows that there are nine teachers who hold at least a degree in mathematics and a certificate in education. These are teachers who have enough content and pedagogical content knowledge for teaching mathematics in the secondary schools. However, this makes only 39% of the sampled teachers. This indicates a strong need for MCPD so that these teachers are given opportunities to share knowledge with the 61% of the teachers who are not adequately qualifications to teach senior secondary mathematics.

The data collected indicates that teachers do attend MCPD activities. These activities happen nationally, regionally, in clusters and within schools. All the interviewed teachers indicated that they have, at least once, attended workshops organised by the In-Service Department of the University of Swaziland in collaboration with the ministry of Education and Training inspectors. Some teachers also indicated that they also participate in workshops that are voluntar-

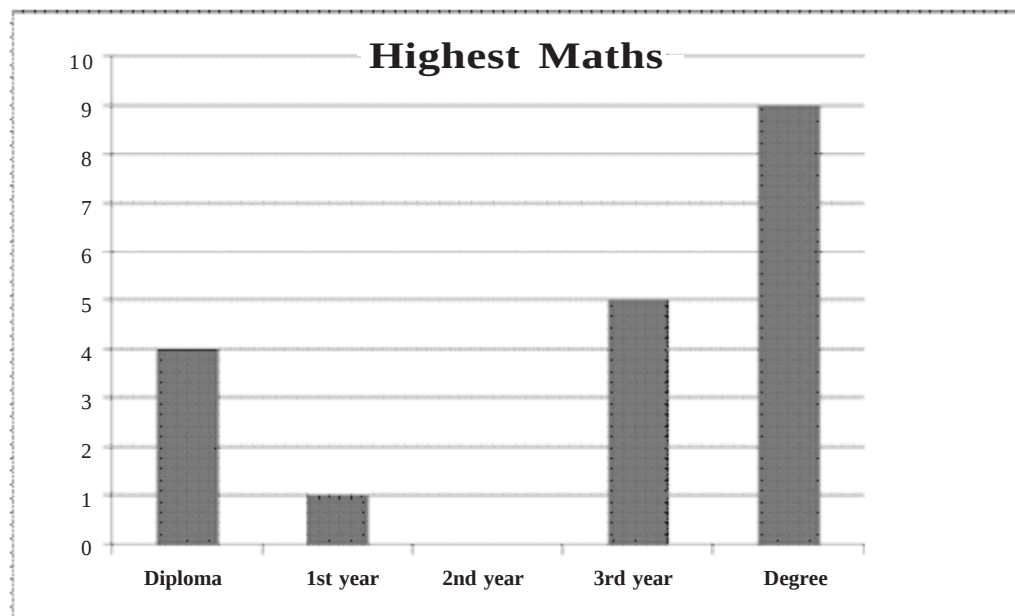


Fig. 2. Teachers' highest qualifications

ily organised by teachers in small groups of neighborhood schools called clusters. For instance, when they were asked if they had participated in any MCPD activity and to mention the activity if they have ever participated, two teachers said:

1. Maths workshops at UNISWA, Valley schools association (cluster)
2. Yes. UNISWA In-Service training, maths and science workshops (cluster).

Some principals (seven of them) indicated that they allow and encourage departmental professional development activities in which they invite subject experts to visit and help their teachers in the schools. For instance, one of the principals said:

A day is normally set aside for all subjects to have their own facilitators on issues affecting them. Teachers get to have their concerns addressed by someone they trust to help them and then improve their teaching methods and approaches.

This indicates that teachers do participate in MCPD programs provided for them. It also indicates that teachers would be happy to get more opportunities to participate in MCPD programs. The formation and the commitment of teachers to form clusters and to participate in these clusters is an indication that teachers would be happier with more participation in MCPD activities. The fact that principals dedicate days for MCPD activities also indicate the value they attach to MCPD and their commitment to supporting it. The fact that teachers would be happier with more participation is in line with the assertion that professional development that is limited to a few in-service days a year is ineffective in enhancing teaching (Weiss and Pasley 2006). This may mean we have a challenge of looking for ways of decentralising MCPD activities to something like zonal regions or clusters in order to increase the frequency of meetings.

The meaning of MCPD as viewed by teachers is improving teachers' strategies of teaching the subject. Teachers seem to be looking at MCPD as a vehicle to help them keep improving their teaching strategy. For instance, when asked to define MCPD, one teacher said:

Equipping the teacher with more strategies that can help to deliver or handle the matters of the subjects in a simple and appropriate way, correction and misconception.

Though the teacher seems to be rooted in teacher centred approaches in which teachers' duties is to deliver information, the teacher sees a need for improving teaching strategies.

The data also indicates that the main purpose of MCPD activities was for career progression. Only three teachers out of eighteen teachers who responded on the question on the purpose for MCPD activities did not mention career progression as the purpose. However, the definition for career progression that was given by the only two teachers who were asked to define it was keeping abreast with current knowledge in your field of study.

On the influence of participating in MCPD activities on the teacher's practice, the study indicated that teachers were influenced in different ways. Some, for instance say they were equipped with techniques of constructing test items.

It helped in reminding the teacher to consider Bruner's taxonomies when setting questions for exams. Include all the levels like: recall, synthesis, application etc.

Though this teacher misplaces the Bloom's taxonomy to Bruner, the teacher seemed to have gained pedagogical knowledge from the MCPD activities. Another teacher said:

I am now able to set both standard tests and examinations hence improving my professional practice.

This shows one of the constructing tests items and administration of tests and examinations should be part of MCPD programs. Since assessment is an important part of teaching, it is important to enrich teachers with techniques of constructing test items.

Another area that was indicated by teachers as an area of concern is the mathematical content knowledge. For instance, one teacher said:

Further understanding of maths not only a theoretical subject but also as an applied science.

Teachers value workshops that enrich their mathematical content knowledge. Teachers also indicated that participating in MCPD programs helps them to change their beliefs about mathematics. This goes in line with the assertion that It is critical that teacher education programs attempt to understand and provoke change in prospective teachers' beliefs about mathematics, especially since many of them enter these programs with "misconceptions and negative atti-

tudes towards mathematics, a subject they will soon be expected to teach (Shilling-Traina and Stylianides 2013). The data indicates that teachers want a program that combines content and pedagogical knowledge. Ball et al. (2008) posit that the notion of mathematical knowledge for teaching required for high-quality mathematics instruction and has been linked to student achievement.

Though teachers seemed to be excited in participating in MCPD activities, sixteen teachers indicated not being happy that issues being discussed in these MCPD activities are somehow imposed on them. For instance, one teacher said:

While I'm excited about it, but I am nervous, mainly about change. We are so use to the way things are and it is difficult to change especially if you are not sure of the reason for it. I think all of us are not yet ready for new things now. I think the way these changes are brought to us in the workshops is not very good. If only we are also involved in planning the workshops.

This indicates that the effectiveness of MCPD activities can be improved by engaging teachers in planning for issues to be dealt with in these activities

CONCLUSION

The study shows there are MCPD activities in Swaziland. The Ministry of Education and Training provides MCPD for Primary school teachers as well as junior Secondary school teachers. The University of Swaziland provides MCPD activities for senior secondary schools. The study, however reveals that teachers would be happy if MCPD activities can be more often and given more time. This is in line with what literature on MCPD suggests. Teachers seem to want to participate in MCPD activities that will help them both in pedagogy and in mathematical content knowledge.

RECOMMENDATIONS

The researchers would like to recommend that the country increase the number of MCPD activities per year as suggested by mathematics teachers. It is also recommended that all schools should financially support teachers to attend MCPD activities. MCPD activities should be evaluated so that they may be improved. It is

recommended that MCPD providers for all levels of schooling should be considered for future studies.

LIMITATIONS OF THE STUDY

Few professionals participated in this study since data was collected at a season where there were few MCPD activities.

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