

Advances in the Provision of Mathematics Teacher Professional Development in Botswana

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ABSTRACT Advances have been made into mathematics teacher professional development to attempt to address the complexities of professional development provision in Botswana. This paper presents a pilot study that sought to investigate the provision of mathematics professional development in Botswana by focusing on the services of professional development providers, the teachers as participants of the programs, the process of professional development provision, and the outcome of professional development provision. Employing the qualitative method of grounded theory, data was collected through the solicitation of teachers' and providers' views with the use of questionnaires and document analysis of the programs. The findings suggest that professional development programs are in place but the major challenge in professional development provision is the participants' non-commitment and involvement in the implementation of the initiated objectives of the various programs proposed by the service providers.

INTRODUCTION

The last two decades has seen professional development of teachers taking centre stage in the education matters globally (Garet et al. 2001; Guskey 2002; Villegas-Reimer 2003; James et al. 2008; Koellner et al. 2011). The growing demand for raising the status of teaching as a profession has triggered interest and revisions of teacher professional development opportunities. Professional development (herein referred to as PD) opportunities for teachers have increased with little understanding of what makes for successful PD. Various educational reforms meant to address the challenges of teaching and learning have compelled that there be a need to examine the development of teachers to improve their skills, knowledge and pedagogical practices (Koellner et al. 2011; Villegas-Reimer 2003). Professional development, multifaceted as it is, requires an understanding and recognition of the needs of the teacher in implementing such reforms, suggesting that educational reforms and teacher PD are in a symbiotic liaison with teachers as objects of such reforms.

Ideally, the mathematics education community needs to introspectively reflect on what advances have developing and developed countries put in place to acknowledge the role of teacher PD in transforming educational achieve-

ment. Evaluations of PD programs are essential in determining and addressing the needs of the stakeholders of such professional development programs. The advances that Botswana has made in implementing mathematics professional development aiming at improving teacher learning and practices have not gone unnoticed. Presented in this paper is a pilot study that was conducted in Botswana as part of the mathematics teachers' professional development (MTPD) project. The MTPD project was initiated by the Department of Mathematics Education at the University of South Africa (UNISA) seeking to document mathematics professional development programs in developed and developing countries. These countries are South Africa, Botswana, Namibia, Singapore, Zimbabwe, Swaziland, Poland, South Korea, Ireland, Morocco, and Tanzania.

Context

The mathematics teachers' professional development (MTPD) project initiated by the Department of Mathematics Education at the University of South Africa (UNISA), is aimed at documenting mathematics professional development programs in developed and developing countries; namely, South Africa, Botswana,

Namibia, Singapore, Zimbabwe, Swaziland, Poland, South Korea, Ireland, Morocco, and Tanzania. This paper reports on a pilot study conducted in Botswana.

Botswana is a landlocked sparsely populated country in southern Africa with approximately 2 million people. The country has come a long way from lack of infrastructure at independence in 1966 with teachers outsourced from the countries such as United States of America, United Kingdom, Zimbabwe (formerly Rhodesia), and South Africa to complement the few qualified citizen teachers to an education system that has developed two-fold; adequate human resource and sufficient infrastructure. The school education system has three levels: seven-year of primary, three-year junior secondary and the two-year senior secondary level. Access to the ten-year basic education, as outlined in its 1st education policy of 1993, is considered a fundamental human right and a priority for all citizens Botswana. This vision is expounded in the country's national Vision 2016, of which one of its pillars is "Building an educated and informed nation". In 2008, the average teacher-learner ratio in Botswana stood at 1:35 after a slight adjustment from the class size at secondary school level of 43 students per classroom.

As noted by Ramatlapana (2009), the expansion of the Botswana education sector in the 1980s required teacher education to be responsive to these expansion demands and, as such, much hype was given to teacher education programs to prepared qualified teachers. However, the objective was successfully achieved as noted in a study by Motswiri et al. (2010), that revealed that 93% of secondary school teachers in a needs assessment study that involved all mathematics and science teachers in senior secondary schools, are qualified having attained a Bachelor of Education degree from the University of Botswana. This outcome is acknowledged by the Botswana Ministry of Education when the Minister of Education in her address on Teachers' Day in 2001 that

Teacher education in this country is set to change significantly in the near future. A number of forces are currently at work and these are likely to impact teacher education in no small ways. Examples of these forces are the new tertiary education policy and the apparent 'oversupply' of teachers. It is envisaged that

by 2014 Botswana would probably not need any more teachers in most subjects.

The role of teacher education is to support and sustain the school curriculum building on the supportive structures of mathematics teacher preparation and teacher continuous professional development programs.

Initial Mathematics Teacher Preparation

Teacher preparation in Botswana is offered by Colleges of Education and the University of Botswana. The colleges offer a three (3) years diploma in primary education for generalists and a three year diploma in education for specialists' junior secondary school teachers. Both these programs offer mathematics content and professional courses. The University of Botswana offers a four-year Bachelor of Education (primary), a four-year Bachelor of Education (Special Education), a four-year Bachelor of Education (science) and a one-year Post-Graduate Diploma in Education for graduates to teach at primary, junior and senior secondary school levels respectively. The University also offers Bachelor of Education (secondary), an in-service degree program for the college diploma holders. All these programs include discipline content matter, courses on pedagogy and teaching practicum. The Mathematics Education program is an integrated program with courses offered both in the Department of Mathematics and Science Education in the Faculty of Education and the Mathematics Department in the Faculty of Science. The University of Botswana teacher education programs have been critiqued for its emphasis is on content knowledge than pedagogy.

Mathematics Teacher Continuous Professional Development

Globally, mathematics and science are given prominence in the school curriculum, for roles as pre-requisites for the advancement of technology in various government sectors. The critical role of mathematics in the society is recognized globally and the demand for mathematics proficiency has resulted with realization of the need to better mathematics teacher preparation and continuing professional development (Adler et al. 2005). The views concerning teacher education, professional development of teachers, and the status of science and mathematics edu-

cation at secondary schools are on the agenda of Ministry of Education and Skills Development (MoESD), the University of Botswana (UB) through the Faculty of Education (FoE) and the Department of Mathematics and Science Education (DMSE). The high demand for the skills of mathematically qualified graduates at school and tertiary levels has led to an expansion of the education system and the professional development of mathematics teachers.

Theoretical Framework

For decades, studies of professional development evaluation consisted mainly of documenting teacher satisfaction, attitude change, or commitment to innovation rather than its results or the processes by which it worked (Guskey 2000; Desimone 2009). Professional development is an on-going process that requires the evaluation process to be embedded throughout its implementation. Evaluation practices are evident in externally funded projects that require accountability reports from program implementers. Evaluation that is designed for internal use in program development and improvement is largely insufficient. In the past decade the field has acknowledged a need for more empirically valid methods of studying professional development. Most literature is on studies that have adopted the experimentation design that examined the program outcome instead of the four components of content, input, process and outcome. Guskey (2000) has done comprehensive studies on professional development and has suggested a systematic model of evaluation of professional development which is globally employed by advocates of professional development.

The researcher employed the Guskey (2000) model of evaluation as a framework for understanding the PD provision in Botswana. The researcher deliberately conceptualized the investigation of PD in Botswana in this paper as an evaluation of PD since the researcher typically focused on the professional development programs' outcomes and their relationship with outputs of the PD provision. The framework provides a rationale for evaluating the necessary stakeholders in the PD program; the service providers, the teachers, the process of PD provision, and the outcome of PD provision. Evaluation of PD provision in this paper is not only

conceptualized as the provision of insights into professional development programs in Botswana, but also to provide data for understanding the implementation of the programs. Table 1 shows the critical levels through which the evaluation should be based (Guskey 2000: 79-81). Guskey's model is based on the belief that the characteristics of PD program content, the PD process variables, and PD context characteristics influence the quality of the PD program. Guskey (2000) suggests five critical level of PD evaluation of which the intention is to understand the reaction, learning, behavior and actions, and the results of the PD provision. These critical levels through which PD can be evaluated are:

Level 1: Participants' Reaction to PD Experience

The level evaluates the participants' reaction in terms of the program content, the types of program activities, resources and a sense of the worth of the program. Evaluation of this level is conducted through the use of questionnaires, interviews to solicit participants' satisfaction on experiencing the program. The purpose of the evaluation at this level is to improve the program design and delivery

Level 2: Participants' Learning Gained from Participation

Level 2 is concerned with finding out the knowledge and skills intended for the participants. The evaluation is done through the participants' reflections and demonstrations of acquired knowledge and skills. The purpose of the evaluation at this level is to improve program content, format, and organization.

Level 3: Organizational Attributes of the PD Program

Level 3 is concerned with the evaluation of how support and change were organized. It addresses how the implementation of the PD provision was advocated, facilitated, and supported. The level considers the evaluation of resources used and the problems encountered during implementation. The evaluation is measured through the use of minutes of meeting, questionnaires and interviews. The purpose of

evaluation at this level is to improve organizational support that put in constringency measures that will inform future program changes.

Level 4: Participants' Use of New Knowledge and Skills

The outcome of any PD program should transition into application of knowledge and skills acquired at the implementation level. Level 4 evaluation determines the effectiveness of the implementation of knowledge and skills acquired. Direct observations, questionnaires and participant reflection through the use of portfolio are tools that are utilized to evaluate how participants use the knowledge and skills attained from the program. The purpose of evaluation at this level is to document and improve the implementation of program content

Level 5: Student Learning Outcomes

Guskey (2000) purports that professional development should culminate to higher learning achievement, suggesting that an evaluation of the impact of the professional development programs are essential. Level 5 is concerned with how the program has affected learner achievement, learner attendance, and so forth. Information for the evaluation is conducted through the use of learner records, interviews, questionnaires and learning outcomes that address the cognitive, affective and psychomotor domains. The purpose of evaluation at this level is to inform on the program design, implementation and follow-up with all these transitioning into determining the overall impact of professional development.

The researcher employed the framework to gather evidence for the five critical levels as suggested by Guskey (2000). The framework informed in the development of the tools for data collection and a systematic approach towards data collection and analysis of evidence collected from the service providers and the participants. Each level is critical in that information gathered differs as per level. The information gathered at each level provides vital data for improving the quality of professional development programs.

Research Questions

Teacher professional development in Botswana has undergone tremendous shifts.

Observations made by Ramatlapana (2009) in her interaction with mathematics teachers through the DMSE-INSET program, are that INSET activities that are imposed on teachers fail due to lack of contextual understanding of the INSET strategy appropriate for the Botswana mathematics teacher. The main problem of this study was to understand the status of professional development of mathematics teachers in Botswana. In order to understand the PD provision the following questions guided the investigation:

1. What mathematics PD programs are in place?
2. Who are the participants of these programs?
3. What are the participants' experiences in the programs?
4. Who are the mathematics PD providers of these programs?

RESEARCH METHODS

This paper is a report of a pilot study of an on-going investigation on the provision of mathematics professional development programs in Botswana. A qualitative approach was considered appropriate for this investigation. A sample size (35) of mathematics primary and secondary teachers comprising of females (25) and males (10) was pooled from the central and southern regions of Botswana. The sample was strategically selected for the researcher's convenience from eighteen (18) in-service primary school teachers who were at a teacher training institute to upgrade their qualifications from a certificate to a Diploma in Primary Education and from seventeen (17) practicing secondary school teachers in two urban schools. The teachers are practicing teachers from the urban, semi-urban and rural schools. The sample was conveniently selected to pilot the instruments of the major study. Of the sample, 69% teachers had a teaching experience of less than 10 years, 70% are in the mathematics teacher position, 30% are senior teachers, and 66% have not attended PD programs in the last two years. The standards (grades) taught by primary teachers were fairly spread out from standard 2 to 7 whereas the secondary school teachers taught forms 1 to 4. All the secondary school teachers were holders of a Bachelor of Education degree in Mathematics Education. The major subjects of the primary school teachers were as follows: Maths: 10; Sci-

ence: 3; agriculture: 2; no response: 3. A ministry official and one service providers were consulted on issues related outside PD provision. Data was collected through the use of questionnaires and analysis of document from service providers.

RESULTS AND DISCUSSION

Gaining insights into PD provision dictated that I look for evidence from program contents, the PD provision process variables, and the PD context characteristics, all of which the theoretical framework for the investigation purports that they influence the quality of the PD program. The PD program contents are the activities and design of program. The PD provision process variables are participants, activities, service providers, teacher employers, and resources. The context characteristics refer to the context through which PD is provided. This evaluation study investigated Mathematics PD programs in Botswana by soliciting evidence from the PD service providers, the teachers, the programs' processes of PD provision, and the outcome of PD provision. The following are the findings of the investigation:

Teacher Responses

In completing the questionnaire various issues were raised about the design and the contents of the questionnaire. Teachers were not familiar with the terminology Mathematics Continuous Professional Development (MCPD). This was a constraint in that although teachers completed the questionnaire, they were second guessing what MCPD was. The researcher had anticipated the unfamiliarity of this terminology and strategically introduced the term "in-service" as a precursor to the term "MCPD" and it seems some of the teachers noted this. The questionnaire format was a hindrance to completion by teachers. The teachers emphasized that they preferred the Likert-type questions for ease of completion than the open-ended questions.

It was critical to understand teachers' reactions and learning in the PD programs as suggested by Guskey's Levels 1 and 2. Teachers are the key stakeholders as the PD program's effort should be directed towards teachers needs. The teachers' responses were directed

towards the program activities, their own learning and experiences. Teachers revealed that (i) there is lack of enthusiasm for participating in PD emanating from lack of reason to participate; (ii) only one or two teachers per school attend the workshops, it is difficult for the remainder to assume participation in PD programs. There is no structure in place that monitors senior secondary school teacher participation. On the one hand, PD at junior school is school-based for the Strengthening Mathematics and Science in Secondary Education (SMASSE) professional development project and as such involves all teachers in the department. This finding suggests a need to widen scope of the sample and the duration of data collection in main study. The timing of data collection was an inconvenience for schools as they were about to close, with teachers involved in end of term examinations.

The emerging patterns from the findings were identified as: (i) teacher beliefs on the need for their own professional development, (ii) suitable model of the programs, (iii) the suitable models of implementation of PD programs. Teachers suggested that PD should have intensified follow-up programs if teachers are to sustain the mastery of skills attained in the workshops. Teachers have lamented that time constraints tend to make school-based workshops difficult. Teacher workload also surfaced as a barrier to effective in-service training. The main reason for non-implementation of recommended approaches was that teachers did not gain enough applicable knowledge and skills from the workshops for application in the classroom and for addressing the challenges in their practice. A few teachers mentioned that they were unwilling to participate in some activities, which they deemed not to be dealing with issues relevant to teachers' daily work lives.

Service Providers' Responses

The researcher employed the critical level 3 to explore service providers' roles in the provision and implementation of professional development. These service providers are the Department of Mathematics and Science Education-In-service Education and Training, the Ministry of Education, Skills and Development and the Department of Teacher Training and Development (TT&D). Drawing from the work of Gareth et al. (2001), The researcher focused the evaluation

on the structural features and core features of the programs provided by the service providers.

Service Providers -DMSE-INSET

The University of Botswana (UB) through the Faculty of Education (FoE) and the Department of Mathematics and Science Education (DMSE) has an outreach program Department of Mathematics and Science Education-In-service Education and Training (DMSE-INSET) that support the professional development of in-service teachers at schools. Its activities are organized and delivered by DMSE lecturers employed by the University of Botswana. The content of the program is tailor-made to address specific needs for serving teachers, specifically to accommodate the promotion of pedagogical content knowledge. Its current structure is not comprehensive enough and is constrained by, among others, insufficient resources to support quality PD provision and the provision of continuous support to teachers, financial support is insufficient, particularly for doing research and scholarly work. A credit accumulation and transfer system (CATS) is not yet in place but desirable to enhance the rewards of INSET participation.

Service Providers -Ministry of Education, Skills and Development

The Ministry of Education, Skills and Development is committed to teacher education and development department. Botswana has (and continues to) participate in projects to improve competency in mathematics. For instance, Botswana has participated in the teacher capacity building initiatives, projects like Trends in Mathematics and Science Studies (TIMSS), Teacher Education and Development Study in Mathematics (TEDS-M), and SACMEQ studies: (although featuring at the bottom end of the chart), it is a reflection that Botswana is proactive as she reflects on this. Strategic quality assurance is in place to monitor teacher education programs. Models are borrowed from developed countries with successful teacher education and development models, for example, the Singapore models that put emphasis on change of mindset for teachers to acknowledge the need for professional development. It is the ministry's vision to emphasize that provision of PD because of its nature cannot be the role of a single entity hence the need for a joint effort/venture.

Service Providers -Department of Teacher Training and Development (TT&D)

The role of the Department of Teacher Training and Development (TT&D) is to provide a policy framework for teacher education and teacher professional development. Monitoring and evaluation of policy implementation is realized in regular forums for PD consultations with other stakeholders to ensure that programs are regulated. Its major agenda is the "coordination of pre and in-service training of teachers to equitably provide quality teacher education and training to produce competent and competitive teachers through relevant and responsive Pre-service and In-service training" as expounded in its mission statement. Through the primary and secondary education divisions, the TT&D department has committed staff to ensuring the development and implementation of teacher education and development programs. The provision of professional development of teachers is decentralized in various regions country-wide manned by TT&D personnel to provide support for primary and junior secondary school teacher education PD structures.

CONCLUSION

The objectives of this on-going study sort out to investigate mathematics Professional Development (PD) provision in Botswana. The major focus of the research was to be informed about the implementation, monitoring and processes of mathematics professional development programs that are in place. A crucial finding in the study was that although policies are in place that provide a clear structure and intentions of the PD programs, the policies are not operationalized and enforced. There are issues of organizational deficiencies. The participants' reactions to the PD program suggest that teacher participation in the programs is not systematic. It would be helpful for PD providers to provide programs that will enable teachers to value professional development and take ownership of their development. Main thrust of sustaining PD in Botswana is addressing (i) what model is appropriate for Botswana; (ii) how is PD modeled in contexts of teacher saturation? A way forward for the main study is the re-structuring of teacher questionnaire for ease of completion

and high return rate, to re-consider sampling procedures, widen the scope of investigation by including regional education officials and to focus on an investigating of lack of implementation of PD.

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