

Provision of in-service training of mathematics and science teachers in Botswana: teachers' perspectives

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Abstract Teaching is a field that is dynamic, with innovations necessitating upgrading of skills and education of teachers for the successful implementation of reforms. The behaviour and attitudes of teachers towards teaching and learning and their knowledge banks are the result of the impact of in-service training. This study investigated the perceptions of mathematics and science teachers in Botswana towards in-service provision by the Department of Mathematics and Science Education In-service Training unit (DMSE-INSET), whose mandate is to improve the quality of teaching by supporting teachers through training programmes that enable them to take ownership of their professional development. Data were collected from a sample of 42 senior Mathematics and Science secondary school teachers, using structured interviews with open-ended questions, which were analyzed qualitatively. The findings show that teachers' concerns included the lack of impact of current in-service training programmes on the education system, no regular follow-up activities to support the one-off workshops and insufficient skills acquired to sustain the implementation of the strategies solicited by the workshops.

Keywords In-service training · Mathematic education · Professional development

Introduction

Teaching is a complex activity that requires continuous development of teachers, with emphasis on both content knowledge and pedagogical content knowledge. Shulman (1986) analyzed teacher knowledge as (a) content knowledge, which are the facts, concepts, generalization and structure of the discipline; (b) content pedagogical knowledge, which are the explanation, demonstration, and presentation of instructional strategies with clarity and efficiency; and, (c) curricular knowledge which are the array of instructional materials, reinforcement devices, and teaching aids. The continuous renewal and development of pedagogical content knowledge, together with general content knowledge and the changes

in the education system do not equip prospective teachers with all the knowledge and skills to sustain their whole professional life (UNESCO 1996). In-service education and training (INSET) is intended to raise the quality of education. In-service training in the context of this article is defined according to Henderson (1978) as:

structured activities designed exclusively or primarily to improve professional performance... It may lead to the acquisition of some professional qualification, securing a particular type of appointment or there maybe no expectation of financial or academic reward. (p. 11)

The role of in-service training can also be viewed as ensuring that teachers are connected to their emerging knowledge base. The research literature on training has shown that with appropriate conditions, training has the potential to significantly change teachers' beliefs, knowledge, behaviour and the performance of their students. Studies have emphasized the role and significance of in-service training in the professional development of teachers (Cooney and Krainer 1996; Sparks 2002). Staff development programmes have been found to be effective for the improvement of classroom practice and student performance (Wade 1985; Good and Grouws, 1987). Training programmes delivered by INSET providers in Botswana are workshop-type sessions in which the presenter is the expert who establishes the content and the flow of activities. Typically, training sessions are conducted with a clear set of objectives or learner outcomes, which, according to Wood et al. (1982), should be determined by the trainer and participants together. It has been argued that the model or the type of professional development that promotes active learning increases teachers' use of desired strategies in mathematics and science classrooms (US Department of Education 2000). Joyce and Showers (1988) recommend that in-service training should include exploration of theory, demonstration, practice, feedback about performance and coaching in the workplace. This training needs to be sustained, since studies have shown that one-off training is ineffective (Loucks-Horsley et al. 1987; Sparks 2002).

Research context

Botswana is a sparsely populated country with 1.2 million people (about 2.2 persons per square kilometre). The education system comprises three school levels: seven-year primary level, three-year junior secondary level and two-year senior secondary level. Access to the ten-year basic education is considered a fundamental human right for all Batswana. The government's effort to afford Batswana education to the senior school level has seen the transition rate from junior to senior schools reach 51% in 2004, and this is expected to increase. Schools are well spread throughout the country and well placed to admit students who are within the region. In 2008, the average class size at secondary school level stood at 43 mixed ability students. The role of teacher education is to support and sustain the school curriculum building on the supportive structures of mathematics teacher preparation and development programmes.

The expansion of the Botswana education sector in the 1980s required teacher education to be responsive to these demands and, as such, teacher education programmes prepared teachers as professionals instead of as "gatekeepers".

Mathematics teacher preparation is offered in the two colleges of education and the University of Botswana. The colleges educate teachers for junior secondary schools and offer diploma programmes, whereas the University offers degree programmes and its

graduates teach at both junior and senior secondary school level. The University also offers an in-service degree programme for the college diploma. All these programmes include discipline content matter, courses on pedagogy and practicum. There is currently a shortage of mathematics teachers in Botswana.

The salaries of teachers are on a par with those of other professions. Incentives for mathematics and science teachers are offered to encourage and attract a good number of mathematics and science students at tertiary level. Sponsorship for in-service education and training is offered to practising teachers by their employer, the Ministry of Education and Skills Development. Teachers who engage in self-development through distance education and part-time studies are reimbursed any expenses.

In-service training in Botswana

Botswana recognizes the need for in-service training of teachers to address curriculum changes at all levels of the education system, especially with the paradigm shift from teacher-centred to learner-centred approaches in teaching, to relating the curriculum to real-life situations, and to contemporary models of assessment.

Up-grading the skills of teachers in Botswana can be traced back to the recommendations of the 1994 *Revised National Policy on Education* which emphasized developing in-service training programmes to improve teacher productivity. It recommended that INSET programmes be developed to help teachers articulate and meaningfully implement changes advocated by the school curriculum (Chakalisa et al. 2007). The Department of Mathematics and Science Education (DMSE), whose commitment is to both pre-service and in-service training of mathematics, science and computer studies teachers, aims to provide opportunities for professional development of serving teachers and to alleviate inequities in education in the sciences and mathematics through appropriate intervention at both pre-service and in-service level of teacher preparation (UB-INSET 1997).

The department acknowledges that content knowledge and pedagogical knowledge are acquired at pre-service levels and that pedagogical content knowledge can be further developed during the induction and in-service phases.

The University of Botswana In-service Training (UB-INSET), a Dutch-funded project started in 1988, was geared towards the improvement of the quality of Botswana mathematics and science teachers in senior secondary schools. This tri-partite partnership, based at the University of Botswana, was between the University of Botswana, the Dutch Vrije Universiteit of Amsterdam and the Botswana Ministry of Education (MoE). The Department of Mathematics and Science Education institutionalized the project in 1997 and it became the Department of Mathematics and Science Education-In-service Education and Training (DMSE-INSET) program, whose terms of reference are the provision of in-service training for senior secondary school mathematics and science teachers (UB-INSET 1997). The rationale for an 'African answer to western paradigms of teaching and learning' (UB-INSET 1997, p. 4) gave as its objective:

[to] improve the quality of science and mathematics teachers by training and supporting teachers through workshops, study groups and magazines, and by establishing a permanent in-service network through which teachers will be enabled to take ownership of their professional development.

The Department of Teacher Training and Development (TT&D), under which INSET activities fall, facilitates all in-service activities, including those carried out by DMSE-

INSET. TT&D is responsible for transporting teachers to attend workshops. The training workshops consider issues such as curricular changes and implementation, as well as classroom best practice. Workshops are a part of a wider program of INSET training that involves implementation at classroom level and reflection on practice. The model preferred by DMSE-INSET is the Department Oriented In-service Training (DO IT) programme which includes presentation, demonstration, practice, feedback and coaching. This approach involves the provision of national workshops in which the theory is presented with demonstration and feedback. The workshop outcomes and decisions provide guidance for mathematics and science departments in schools and coaching takes place in classrooms. Follow-up workshops are based on the outcomes and experiences in the coaching sessions.

Provision of in-service education is a challenge to both teachers and teacher-educators. In-service education should not only be viewed as a way to increase teachers' knowledge but also should have a reflective component in which teachers reflect on the implications of their own learning experiences in their teaching (Cooney and Krainer 1996). The delivery and interpretation of INSET is influenced by the fact that education in itself is dynamic. The challenges mentioned by Koosimile (2006, p. 2), that 'in-service work in the DMSE has outlived its original mandate and is now misdirected and lacking in focus, direction and vision', require evaluation in order to address issues such as the current concerns of teachers regarding their teaching and learning as well as their perceptions towards in-service training.

There needs to be consideration when designing professional development programmes, to ensure that such programmes relate to factors that could influence their effective implementation. These factors include the perceptions of teachers towards in-service training. Effective in-service training should identify and emphasize designing programmes that address the specific needs of teachers so that appropriate activities can be planned to support teachers in applying the knowledge and teaching methodology creatively and confidently (Bredeson 2003).

The challenges that in-service providers face include ensuring collaboration among the stakeholders, to avoid duplication of issues for training. The coaching exercise, which is a crucial stage that determines the success or failure of training programmes, is sometimes abandoned. Limited resources, time management and planning for implementation are challenges that continue to confront teachers. The training workshops are conducted during school vacations which coincide with teachers' leave. Monitoring of the programmes is a challenge as in-service staffs are limited.

The significance of the study that is reported below is that needs assessment is an essential component in the development of a training programme. Needs assessment solicits information to determine priorities when planning for training, which will consider the expectations of teachers and address their concerns. The purpose of the study was to investigate the views of teachers on in-service training provided by DMSE-INSET. The study also sought to describe the teachers' concerns and expectations. This article presents the findings of the study on the perceptions of Botswana mathematics and science teachers towards in-service provision.

Methodology

The purpose of this study was to investigate teachers' perceptions on the provision of in-service training. A qualitative approach was considered suitable for this study because it

allowed the researcher to accord the participants an opportunity to define their own perceptions and concerns. According to Best and Kahn (1998) and Leedy (1989), a descriptive survey gathers detailed information that can be observed with scrutiny. This design enabled the researcher to gather data through face-to-face interviews.

The data pool consisted of forty-two (42) mathematics and science Senior teachers from fourteen (14) senior secondary schools in the northern region of Botswana. Of the sample, nineteen (19) were mathematics teachers and twenty-three (23) were science teachers. The science teachers were specialists in one or more of the sciences (biology, physics, chemistry) offered by all schools. These schools, strategically selected for the researcher's convenience, are located in the urban, semi-urban and rural areas. The study targeted the senior teachers since it is their responsibility to structure the school-based professional development for teachers and to create a facilitative and supportive departmental environment.

Findings

The respondents revealed factors that impinge on the impact, successful delivery and implementation of in-service provision, and included items such as support from and involvement with the Regional Education office, TT&D and DMSE-INSET, as well as time constraints and resources allocated at the school level to support change and leadership issues. Interviewed teachers felt that these should be given consideration when planning and designing INSET activities. Teachers suggested that the Regional Education Office, TT&D and DMSE-INSET do not have the same agenda for the schools. Another concern was that pre-service training does not prepare teachers for teaching the content and yet this is the express role of secondary teaching.

For in-service delivery to be successful, recipients should be willing participants with positive attitudes towards learning. Teachers noted that professional development is unlikely to impact on their work unless they are able to re-examine their beliefs about teaching and learning and develop consistent strategies. It would be helpful for in-service providers such as DMSE-INSET to roll out programmes that will enable teachers to value professional development and take ownership of their development. Comments suggested that there are various constraints that may hinder the successful implementation of in-service training programmes if in-service providers do not consider the concerns and expectations of teachers. Issues were raised related to the INSET packages, implementation, reforms on teaching practices, and the agenda of in-service providers.

The results suggested that teachers were concerned by the lack of impact of INSET on the education system. Reasons for this included the inability to involve teachers when designing and planning training. Teachers concurred that inadequate planning sometimes limits the success of in-service training. This leads to providers imposing their agenda on teachers who, in turn, resorted to criticising the training content, and sometimes even considering it to be too theoretical rather than practical. Teachers raised the issue of the links between theory and practice. The teachers lamented that they encountered difficulty in implementation due to lack of time and scheduling constraints. As with content, supporting teachers during implementation was one of the dimensions of professional development that posed a challenge. The time spent at DMSE-INSET workshops was considered too short with substantial material covered and issues condensed into one workshop. DMSE-INSET must assess the situation in schools to avoid training teachers on topics that cannot be successfully implemented. A typical example mentioned was that

with a lack of computers in schools, the training on integrating computers less useful. Teachers may gain computer skills but will not succeed in implementing the skills in the classroom.

Teachers suggested that DMSE-INSET should intensify follow-up programmes if teachers are to sustain the mastery of skills attained in the workshops. Teachers have lamented the time constraints tend to make school-based workshops difficult. 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. Teacher workload also surfaced as a barrier to effective in-service training. 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.

Conclusion

This study revealed that DMSE-INSET could re-structure its programmes to align with the current and immediate needs of users. Teachers suggested that programmes can be beneficial and have an impact if carefully designed with built-in monitoring and sustainable components that meet the contextual needs of teachers (Wheeler 2001; Lessing 2007). It is hoped that this study will reveal more perceptions and provide a basis for re-structuring the current in-service programme offered by DMSE-INSET.

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