

Trends in Mathematics Professional Development Programmes in Post-Apartheid South Africa

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ABSTRACT This paper reports on a pilot study on Mathematics Continuous Professional Development (MCPD) programmes in the post-apartheid era South Africa. The study examined current practices in mathematics professional development programmes and the challenges practitioners experience in the implementation of such programmes. The study involved five of the nine provinces in South Africa and the population of the study was 55 that consisted of teachers, principals, subject advisors, district officials, ministry of education and service providers. Data were collected by means of a questionnaire and interviews which were analysed using qualitative methods. The study found that the implementation of MCPD programmes was characterized by different factors such as relations between labour unions and the employer, the political legacy of the country and others. The study also established that different participating groups experienced different challenges regarding the implementation of MCPD programmes. The findings from this pilot study were also useful in the modification of some of the research instruments for main data collection.

INTRODUCTION

Teacher education in South Africa has been characterised by segregation of teacher education programs that generated a set of teachers with non-matching school subject knowledge and contrasting models of classroom practices. According to a report by the Departments of Basic Education and Higher Education and Training [DBEHET] (2011), some controversies in teacher training in the South African education system are mainly due to the previous political incorporation of language and race issues in education. The apartheid-conscious architectural model in clearly necessitated different training programs for teachers, with consequences of different teaching qualifications and uneven quality of inputs for teachers of different races (for details see Macrae 1994: 272). According to the DBEHET (2011) report, many colleges meant for the training of black teachers were built with little national planning, quality assurance or accountability. These colleges focussed mainly on primary school teachers despite a huge demand

for secondary teachers such as those of mathematics and science (Parker 2003).

In the 1990s, the training of white teachers in the colleges was being phased out in favour of a more structured and progressive university teaching qualification, while colleges for black teacher education continued to mushroom all over South Africa (Parker 2003). For instance, in 1981 there were 37 training colleges for black teachers in South Africa and they reached a peak of 120 with about 80000 student teachers by 1994 (Parker 2002). Despite many colleges that existed to train black teachers and a relatively high volume of teachers that emerged from these establishments, the schools under the Department of Education and Training (DET) persistently performed poorly when compared to schools served by the Department of Education and Culture (DEC). However, it is not known whether the emphasis was to train more mathematics or science teachers and whether the issue of quality rather than quantity of teachers was addressed.

The democratic government of national unity in 1994 undertook to resolve persisting problems in the teacher training system by addressing undesirable societal inequalities. In particular, the culture of poor performance in black township schools mirrored the inferior quality standards of teacher training programs associated with 120 colleges that existed at that time. Chang-

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es to the education system that took place have since contributed to setting up a framework and philosophy for the current education system. Underpinning any educational reform that is introduced are the concomitant changes regarding what is viewed as being important to teach, how it should be taught and consequently the way the pre-service training and professional development of serving teachers is approached.

Curriculum 2005 (C2005) was introduced in 1998 and provided the shift from a content-based curriculum to an outcomes-based curriculum as was alluded to in the 1994 statements (Mda and Mothata 2000). This system was the first, and probably one of the most significant changes to take place in the new democrateducation system. The implementation of Curriculum 2005 took place in an environment characterised by enormous infrastructural backlogs, resource limitations, and the absence of common national standards for learning and assessment. One of the basic principles of Outcomes Based Education (OBE) is that learners should become active participants in the classroom. The learners should take ownership of their learning. The shift in methodology from a teacher-centred to a learner-centred approach was one of the main propositions. In an OBE classroom the learners had to be allowed to apply their knowledge in real-life situations (Van der Horst and McDonald 2008).

Assessment strategies also changed drastically from mainly summative assessment to a more formative assessment approach. The teacher was to take on the role of facilitator, while the learners emerged as the creators of learning. Learning was to replace teaching, and the construction of meaning took priority over classroom instruction. Jansen and Christie (1999: 213) indicated that this “disappearing” of teachers under C2005 was “completely naïve about the working conditions and proficiency profiles of most South African teachers”. The implementation of C2005 was not without its problems and OBE came under heavy criticism from teachers, parents, the media and academics (Spady 2008; Jansen 1998). Jansen (1998) provided reasons why he thought OBE would not work in South Africa. He made recommendations regarding what he perceived should be done to overcome the challenges posed by C2005 if it were to be implemented. One issue that stands out from what Jansen’s concerns were, was about the

quality of in-service teacher development that he considered would be (and was) superficial.

Despite the critique, the consequence was that C2005 was then modified into the National Curriculum Statement (NCS) in 2002. Kadar Asmal (Minister of Education) was adamant that “OBE is here to stay” (Asmal 2000). Thus, the NCS was still underpinned by the philosophy of OBE. Despite the introduction of the NCS in 2002, the education dilemma continued and mathematics teaching and learning continued to be fraught with problems. On the 5th November 2009, Minister Angie Motshekga declared the “death” of Outcomes Based Education in Parliament.

The deliberations in the previous paragraph gave rise to yet another change in South Africa’s Educational System. In 2012, the Curriculum and Assessment Policy Statement (CAPS) became part of the National Curriculum Statement (Department of Basic Education 2011). The Department of Basic Education gave the reasons to the changes made to the NSC as:

Complaints about the implementation of the NCS;

Teachers who were overburdened with administration;

Different interpretations of the curriculum requirements and

Underperformance of learners (Pinnock 2011).

In the CAPS document, the National Curriculum Statement was repackaged so that it could be more accessible to teachers. Every subject in each grade now had a single, comprehensive and concise Curriculum and Assessment Policy Statement (CAPS) to provide details on what content teachers ought to teach and assess on a grade-by-grade and subject-by-subject basis. There were clearly delineated topics for each subject and a recommended number and type of assessments per term. The terms Learning Outcomes and Assessment Standards were no longer used, and Learning Areas became known as subjects, as before.

In reference to the South African education system, Section B of DoE (2005) begins with the statement that “the education system requires a steady flow of newly qualified teachers” (p. 10). This statement clearly conjured the new government’s intentions of finding new possible ways to produce a competent generation of teachers for the 21st century. As a departing point the government embarked on a merging project

that saw different ministries of education becoming one National Department of Education. The resulting merging of the Departments of Education also meant that the issue of teacher training and education needed serious and immediate intervention. Because colleges offered a teaching diploma for training teachers, it was soon proposed that teaching must be a graduate profession. With this proposal came an idea that initial teacher education programs be moved from Colleges of Education to Higher Education Institutions. Between 1994 and 2000, many Colleges of Education ceased to exist, making universities major providers of teacher training. As a consequence, most of the colleges were either merged or incorporated into larger entities as part of provincial rationalization processes aimed at overcoming the educational inequalities of apartheid and reducing an identified oversupply of primary school teachers (DBEHET 2011).

While the current government is making efforts to produce highly qualified mathematics teachers, the challenge is that there still exists a knowledge gap in terms of professional development of teachers. Teacher education is a form of professional education that has a purpose to improve the professional classroom practice of teachers (DOE 2005). Mathematics education in particular in South Africa has suffered a multitude of well-publicised problems namely:

- Shortage of mathematics teachers
- Under qualified teachers
- Teachers struggling with subject content
- Little or absence of pedagogical content knowledge and
- Poor teacher performance in mathematics in general
- Mathematics taught in English, a second language for the majority of both teachers and learners. There are 11 official languages used to teach all subjects from grade R to grade 3.

From grade 4 up, instruction is given in English, a language that is used in school classrooms only, and they switch back to their home language outside the class.

In addition the frequent changes in both mathematics curricula and syllabi (OBE, curriculum 2005, NCS and CAPS) have resulted in challenges at classroom and governmental level.

In the classroom:

- ♦ Poor learner performance standards and results

- ♦ A lack of classroom discipline
- ♦ Insufficient resources (modern technology not an option in most rural situated schools)
- ♦ Inadequate infrastructure
 - On a governmental level:
- ♦ Failure of appropriate teachers' work support, inspection, and monitoring,
- ♦ Lack of continuous training of teachers in service
- ♦ Changing curricula without proper training and communication
- ♦ No continuity for teachers as well as learners
- ♦ Demoralisation and disillusionment among teachers and
 - Negative and worsening perception of the teaching profession as a whole.

International Comparisons

The most recent report on Mathematics outcomes in South African schools was published by the Centre for Development and Enterprise in year 2013. This report summarises two specially commissioned research papers by Professor Charles Simkins and Dr Nic Spaull. The 2011 TIMSS showed that South Africa performed worse than any other middle-income country. The average South African Grade 9 learner is 2 years' learning behind the average Grade 8 learner from 21 other middle income countries in mathematics (CDE 2013).

Dr Nick Taylor, in his most recent report as Head of the Department of Basic Education's National Education Evaluation and Development Unit (NEEDU), argues that poor learner performance in most schools is largely due to the poor subject knowledge of teachers, especially in mathematics. He also emphasised the role of patronage in teacher appointments in his input paper for the National Development Plan.

More broadly there is a major problem with teacher complacency, and this is linked to the ways in which many teachers are appointed – often not on merit. One aspect of this lack of attention to merit is how teachers evaluate themselves.

Spaull (2013) reports that:

"In the recent TIMSS 2011, 89 per cent of South African Grade 9 teachers felt 'very confident' in teaching mathematics, in stark contrast to teachers in Finland (69 per cent very confident), Singapore (59 per cent very confident) and Japan (36 per cent very confident),

the best performing countries. This is particularly at odds with Grade 9 student performance, where 32 per cent of South African students perform worse than random guessing on the multiple choice questions.”

The report further indicates that in reforming mathematics teaching, it is likely that resistance from teachers will be encountered. Why should they want to improve and undertake re-training, for example, if they believe they are already doing a good job? Interventions will thus have to bear in mind that teachers will be faced with a change in attitude.

Based on this evidence, CDE has developed four points that must be borne in mind in addressing South Africa’s numeracy and mathematics schooling challenge:

- ♦ Improving mathematics teaching and learning in public schools will not happen fast, but must begin in earnest as a matter of urgency;
- ♦ Poor mathematics and numeracy in public schools is likely to accelerate private schooling growth and enrolment in private extra mathematics lessons;
- ♦ If South Africa is to be realistic about having a knowledge economy and creating more and better jobs, it will require a sustained focus on teacher and teacher-training enhancement, particularly in mathematics teaching, which – given its scale and current attitudes – will likely take a decade or more to achieve significant results;
- ♦ In the interim, it is likely that we will have growing numbers of innumerate young people, and a majority of young South Africans could be unqualified for many types of white collar work (assuming less than 30 per cent in mathematics in Grade 9 roughly translates into such a status) (CDE 2013).

Objectives of the Study

The general objectives of the pilot study were to:

- ♦ Examine existing practices in Mathematics Continuous Professional Development (MCPD) programmes in South Africa
- ♦ Pilot the instruments designed for examining the existing practices in (MCPD) programmes in South Africa

The specific objectives of this study were to:

- ♦ Determine the nature of the MCPD activities conducted by practitioners¹
- ♦ Explore the practitioners’ views on MCPD
- ♦ Investigate the roles and contribution of the stake holders² in MPCD
- ♦ Explore the challenges the practitioners experience in the implementation of MPCD-programmes.

The Research Questions

The two research questions for this study were:

- ♦ What is the nature of mathematics teacher professional development programmes that exist in South Africa?
- ♦ What are the challenges experienced in implementing current initiatives in mathematics teacher professional development programmes?

METHODOLOGY

Research Design

This pilot study was exploratory in design in which data were obtained by means of a teacher questionnaire and interviews for the other participants. The exploratory design was used to determine the nature of mathematics teacher professional development programmes that exist in South Africa. The study also explored the views and roles of the practitioners, contribution of stakeholders and the challenges experienced by the practitioners in the implementation of the mathematics professional development programmes.

Population and Sample

The population of the pilot study consisted of a convenience sample (N = 55). 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 population consisted of mathematics teachers (n = 17), school principals (n = 11), subject advisors for secondary schools (n = 14), district officials (n = 9), provincial officials (n = 3) and

service providers (n = 1). The rationale for including all these participating groups was to explore the nature of Mathematics Continuous Professional Development Programmes (MCPD) at various levels of implementation, and to triangulate data from these sources. Triangulation essentially involves cross-checking for internal consistency and reliability (Gall and Borg 2006).

The study was piloted in five of the nine provinces of South Africa selected at random. 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 = 55) in terms of provinces

	<i>Eastern Cape</i>	<i>North West</i>	<i>Gauteng</i>	<i>Mpuma-Lim-langa</i>	<i>Limpopo</i>
Teachers	8	4	0	5	0
Principals	3	1	1	3	2
Subject advisors	6	3	0	0	0
District officials	5	1	0	1	2
Service providers	1	-	-	-	-

Instruments

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. These different instruments were used to elicit and acquire more information and in some cases to compare views of participants on MCPD. The items in each of the instruments were mainly constructed and modified by the researchers to collect cross-sectional data on participants’ experiences, views, needs, and expectations regarding MCPD’s.

Teacher Questionnaire

The questionnaire probed teachers on the influence of MCPD on their abilities to perform effectively at classroom level. In this section participants were not given responses to choose from, they provided individualized responses that were largely influenced by their practice. Essentially, items sought teachers’ views on the MCPD they had experienced. This included

specifically the MCPD 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 MCPD in your practice as a teacher?; What challenges do you face in implementing MCPD initiatives after attending?;* etc. A sample of teachers’ responses to these items is documented in the analysis section of this paper.

The Interview Guides for Other Participants

Except for teachers who responded to a questionnaire, all other participants were interviewed. Different items were constructed for each group of respondents, and were posed to address issues pertained to each category of participation. For example:

Principals

What kind of support do you have for the facilitation of the MCPD programme in the school?

What kind of professional assistance do your mathematics teachers need?

Providers

How do you develop the MCPD programmes? Please explain.

How are the programmes conducted? (for example face to face; online, etc)

Subject Advisors/ District Officials

What kind of professional development support do you as a subject advisor provide to the mathematics teachers in your district?

What suggestions do you have on the improvement of the MCPD programmes?

Ministry

What type of professional development programmes exist in the country? (short courses, lesson study, progression related type, continuous development, once off intervention type, etc.

What kind of professional development programmes do you provide for mathematics teachers in your province?

Reliability and Validity of the Instruments

Reliability

The results of the pilot study were used to refine the instruments. Some of the items were redesigned and other discarded during the discussion of the original instrument. This paper deals with the responses of the pilot study.

Validity

The validity of a qualitative design is the degree to which the interpretations and concepts have meaning for both the participants and the researcher (Creswell 2002). In this study, multiple instruments, multiple informants and more than one data-gathering method were used, which greatly strengthened the study's usefulness in other settings.

Data Collection

The team of researchers from the Department of Mathematics Education (DME), at the University of South Africa, participated in all data collection activities. The actual field work of the pilot study lasted for approximately three months. In each case two researchers were assigned to visit provinces and districts to administer the questionnaires and conduct interviews. The administrative staff from the DME assisted in securing appointments with district managers to access schools. In addition, district managers were requested to assemble school principals to the district offices to facilitate the interviewing process. School principals, subject advisers and district officials were interviewed separately. Researchers divided themselves in terms of different participating groups in each district. All interviews lasted for almost 30 minutes and were audio recorded.

The next session entailed the administration of a questionnaire to mathematics teachers. Arrangements were made with schools to access and interact with teachers. Given that the data collection process took place during the normal school day, all teachers were visited during this time. It would not have been possible to assemble teachers at the district since this would disturb the normal running of the school. Upon arrival in each school mathematics teachers were

requested to complete both sections of the questionnaire. In each case arrangements were made that teachers complete the questionnaire at a time when they were not engaged in teaching activities. Teachers asked questions in items which seemed not to be clear to them. Averagely, the data collection process for the questionnaire lasted for almost 30min. Given that all questionnaires were completed in the presence of researchers the return rate was 100%.

OBSERVATIONS

Modification of Research Instruments

Basically, the pilot study intended to modify the research materials/instruments of the study before the main data collection exercise was conducted. A thematic analysis of the interview and questionnaire data revealed categories of existing Mathematics Continuous Professional Development (MCPD) activities in the provinces. After the data collection phase, all researchers convened to do the analysis. The interview questions for subject advisors and ministry were adopted because they were valid and reliable. The rest of the instruments were modified as follows:

District Officials- Item 2-which read, 'What kind of professional development programmes do you provide for mathematics teachers in the district' to 'What kind of mathematics professional development programmes do you provide for mathematics teachers in the district? (for example content knowledge, instructional skill and strategy, methods, etc.).'

Teachers- initially the categories that represented teachers' years of teaching were given as <3; 4-5; 6-10; 11-15; 16-20 and >20. They were then modified to 0-3; 4-6; 7- 12, then more than 12 years and leave out the other options. The modification was to align the instrument with the purpose of the study which contextualized the study within the post-apartheid era. Some of the responses necessitated the addition of new items to the instrument to capture the relevance of the effect of MCPD's to their practice. For example, one of the items added was, 'What are the benefits of CPD in your practice as a teacher? The process of reviewing the instruments also entailed the rephrasing, and removal. In addition, there was also an agreement to pose certain items in an open-ended format in order to give ground for teachers to talk.

DISCUSSION

Teachers' Responses

Although the term Continuous Professional Development (CPD) was unknown to some of the respondents in the pilot phase of the study, the majority of the teachers described it in terms of a definition or what it does or will do to/for them on a personal basis. In terms of a definition, it was described as a guiding, empowerment, enrichment, enhancement and development tool of content knowledge and teaching. It was also described as tool to close any existing gap in the content knowledge and teaching practices. As a description in terms of what CPD would do to/for them, teachers identified collaboration with other professionals as reflective of CPD. CPD was also described by teachers as the means by which they acquire resources, teaching skill and content knowledge for their own development or use. Responding to the question of whether they had ever participated in any kind of MCPD activities, some teachers indicated that they had not while others responded in the positive, listing Dinaledi, NCS and CAPS training, district, sub-district or school-based workshops and in-service or ETDP seta (skills development) training as some of the programmes they had been involved in.

Teachers mentioned the provision of learning support materials and the unpacking of challenging topics as some of the benefits of having been involved in the MCPD programmes. They also indicated the acquisition of content knowledge, pedagogical content knowledge and skills to present (interpret and/or implement) the curriculum as beneficial to them. According to these teachers, their participation in MCPD 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 MCPD programmes in terms of "easy", "understandable" and "effective".

The majority of the teachers identified the Department of Education as the source of financial support for their professional development

while others mentioned the school, non-governmental organisations and individuals. Apart from financial support to participate in MCPD programmes, teachers identified other kinds of support such as professional, motivational and the provision of transport, facilities and/or resources. The adequacy of the support provided for the teachers to participate in MCPD programmes was seen as positive by the majority of the teachers in the pilot study albeit others felt it 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 MCPD 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. The shortage or lack of resources was cited as the weakness of the implementation of MCPD programmes. Improvement of teaching skills and learners' performance were highlighted by teachers as successes in their classroom practice after attendance of or involvement in MCPD programmes. Overcrowding and shortage or lack of resources was identified by teachers as impediments for the successful implementation of MCPD initiatives.

The views above, indicated the need by teachers to improve their knowledge due to the changes made in the school curriculum where for example in 2012 the Curriculum and Assessment Policy Statement (CAPS) became part of the National Curriculum Statement (Department of Basic Education 2011) which introduced some new knowledge that teachers were not trained to handle at school level.

Subject Advisors' Responses

The subject advisors indicated that a variety of MCPD programs existed in the country, and these were done based on teachers' needs. These needs were identified through cluster meetings between subject advisors and teachers to address gaps in terms of content and methods in mathematics teaching. If it was noted that teachers continued to manifest weaknesses in the areas of content and pedagogical knowledge workshop, then a follow up workshop would be arranged. The subject advisors were aware of

the poor performance of students in schools (Pinnock 2011) and MCPD activities were part of the program to remedy the situation. Although some of the workshops were conducted by higher institution of learning they also reported challenges with regard to the shortage of facilitators, hence they often opted for the services of expert teachers. Basically these MCPD programs were targeted at capacitating novice teachers and under-qualified teachers to proficiency. They also registered concern around the availability of time to train teachers and absence of the evaluative mechanisms to measure the effectiveness of the MCPD programs offered.

Principals' Responses

The principals gave the impression that most of the MCPD initiatives were coming from the DoE. This was observed as most of their responses revolved around the government initiated evaluative system called Integrated Quality Management System (IQMS). Some principals use the IQMS as a tool to assess professional development of their teachers, but they have doubts about the effectiveness of the instrument, as they argued that it is used as a monetary incentive. They also mentioned that there was no follow up on issues such as attending workshops to determine the impact the training had on the classroom performance.

Ministry Officials' Responses

Of the five provinces that participated in the study, the ministries from two provinces expressed similar challenges with regard to teachers' attendance of MCPD workshops. In this regard the role of the unions in deciding whether or not teachers should attend a workshop was mentioned. For examples unions discouraged teachers from attending workshops conducted during school holidays. The researchers observed that the criteria used by the ministries to select MCPD service providers was almost similar in the two provinces since they looked at the experience of experts who would be conducting the workshops. The Ministry officials were aware of TIMSS's 2011 results that showed South Africa performed as worse than any other middle-income country (CDE 2013) and the significance of MCPD programs was recognized.

The ministry was also keen to address some controversies in teacher training in the South African education system that were mainly due to the previous political incorporation of language and race issues in education (DBEHET 2011). Thus, MCPD programs were one of the avenues to bring the teachers together and address common issues pertaining to teaching of mathematics in schools. There was a shortage of qualified mathematics teachers in schools and the few who attended MCPD activities were likely to transfer their knowledge acquired to colleagues in schools. Previously, the colleges of education focussed mainly on training primary school teachers despite a huge demand for secondary teachers in mathematics and science to date (DBEHET 2011; Pinnock 2011; CDE 2013).

Challenges in the Pilot Study

The following were challenges encountered during the pilot study:

- ♦ Timing for data collection

Some of the teachers were visited while their lessons were in sessions and this hindered the data collection process. In some instances some of the district officials were unavailable even though appointments had been arranged. Initially the researchers had planned to include observation schedules for data collection with the providers which did not materialise. This is because there was no MCPD activity that was being implemented at the time of field work.

- ♦ Distance from one districts to the other
- ♦ Some of the participants used the researchers' visits as opportunities to voice complaints with expectations from DBE, which researchers could not give solutions to.

CONCLUSION

Mainly, the pilot study aimed to collect MCPD data with the view to ascertain the reliability and validity of the teacher questionnaire and the interview schedules which were administered to the participants. Using data collected, all instruments were corrected and modified accordingly. Apart from corrections and modifications of the instruments, more information generated from the pilot study, led the authors to make preliminary conclusion that; (i) MCPD programmes required proper monitoring, (ii) MCPD programmes be designed to accommodate the

distance learning mode of presentation, (iii) MCPD programmes be specifically designed to address the needs of the teachers, especially those that affect the teachers' classroom practice and learners' performance and (iv) the period of CPD training/workshops should be long enough to benefit teachers qualitatively. Such conclusion is not popular in particular when a pilot study is conducted with the aim of sharpening the instruments. However, with a relatively large number of participants in the pilot study from 5 provinces, this conclusion should be viewed as a premise to the main data findings.

RECOMMENDATIONS

All the instruments that were discussed in this paper were recommended for data collection in the main study. It was also recommended that the administration of the observation schedule for the facilitation of the MCPD workshops and seminars should be timed accordingly, that is, should be administered when these workshops or seminars are being conducted. The latter, will help to capture, verify and triangulate data from other collection sources.

NOTES

- 1 Practitioners in this study refers to teachers, principals, subject advisors, district officials, provincial officials and service providers
- 2 Stake holders in this in this study refers to, government, ministry of education, district and provincial officials

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