IMPLEMENTING THE NATIONAL CURRICULUM STATEMENT: MATHEMATICS EDUCATORS' EXPERIENCES

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This study aimed to examine the experiences of mathematics educators when implementing the National Curriculum Statement (NCS) to teach mathematics in Grades 10 – 12. The study is contained in five different, but educationally related constructs. These are solutions to problems regarding the training of Further Education and Training (FET) mathematics educators; problem areas which challenge and appeal to mathematics educators; guidelines to assist educators with lesson planning; guidelines to assist educators with appropriate assessment strategies; and lastly, guidelines for the effective integration of Outcomes-Based Education (OBE) in the teaching of mathematics. A mixed method design was used, with data being collected and collated using questionnaires and semi-structured interviews. The study revealed that educators differed in terms of the problems they encountered in implementing the NCS in mathematics. It highlighted problems such as educators receiving inadequate training in implementing the NCS and a lack of support by departmental officials. However, despite the challenges, participants agreed that the implementation process was successful and that it contributed to the betterment of their teaching.

INTRODUCTION

Globally, education systems are dynamic, fluid and ever changing. According to Rambuda & Fraser (2004: 10), one such change is a shift from a philosophy that focuses mainly on the transmission of information to one based on a constructivist approach to teaching and learning. In South Africa this shift was evident in the Outcomes-Based Education (OBE) approach that was introduced two years after the country's first democratic elections in 1994. The introduction of a new curriculum replaced the traditional pedagogical style of rote learning with more learner-centred pedagogical approaches and engendered critical thought. Mason (1999: 137) argued that in South Africa OBE aimed to address the legacy of apartheid by promoting the development of skills to prepare all learners for participation in an increasingly competitive global economy. The transformation that took place in mathematics education in South Africa over the past 10 years, and the eventual launch of the National Curriculum Statement (NCS) for use in South African schools, served as motivation for the study reported on in this paper.

The process of curriculum change in South Africa gained momentum with the phasing in of the NCS for the Further Education and Training (FET) band, in the year 2006. The NCS attempted to provide more structure and support to educators than its forerunner, Curriculum 2005 (C2005). The critical factor in successfully translating

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C2005 into practice was to ensure that the three pillars of curriculum transformation were in place and in alignment. These pillars were curriculum development, teacher development and the development, selection and supply of learning materials. However, as the implementation of C2005 began, there were apparently no clear strategies put in place by the Department of Education in any of the nine provinces (Jansen & Christie 1999: 231).

The implementation of C2005 was not successful, and in 2006 it was replaced by the Revised National Curriculum Statement (RNCS) for Grades R – 9. While the RNCS was an improvement on its forerunner, it still had weaknesses. One of the central aims of the RNCS was to clearly define the assessment standards per grade against which learners were to be assessed. The RNCS streamlined and strengthened C2005. It was part of the process of transforming education and training to realize the aims of the South African democratic society and of the constitution. The RNCS had three curriculum design features, namely critical and development outcomes, learning outcomes and assessment standards.

The implementation of the NCS for Grades 10 – 12 was an improvement as educators were provided with guidelines on the context and content, as described in the Assessment Standards (ASs), through which the learning outcomes could be achieved. According to the NCS Grades 10 – 12 (DoE 2003: 7) assessment standards are "criteria that collectively provide evidence of what a learner should know and demonstrate at a specific grade. They embodied the knowledge, skills and values per grade required to achieve the learning outcomes". However, for the learning outcomes to be achieved, educators had to know how to interpret and teach in line with the set Assessment Standards.

Mathematics education in South Africa arguably has a tradition of narrowly defined teaching strategies, derived from the content that mathematics educators are expected to teach. If the policy intends a 'transformational' curriculum that moves away from a 'traditional' curriculum, how will it counter the teaching of mathematical techniques and procedures in ways that educators have been doing all along? School teachers would determine whether the newly implemented NCS succeeded or not, simply by the way they executed their teaching duties. Therefore, the newly implemented NCS would have teacher/educator involvement and development as an integral part thereof.

The fundamental objective of the study on which we are reporting was therefore the need to determine and highlight the teaching experiences encountered by mathematics educators regarding the implementation of the NCS in Grades 10 – 12. There was also a need to determine how educators understood the influence of OBE on the curriculum and whether or not OBE contributed to the problems encountered by educators while teaching mathematics in Grades 10 – 12. Our argument is that direct, clear and appropriate guidance from the Department of Education on the implementation of the NCS in mathematics in Grades 10 – 12, can

contribute to educators coping with implementation difficulties in an effective manner.

In an attempt to realize the aim of the study, we addressed the following five constructs. First, recommendations regarding the training of FET mathematics educators were investigated. Second, problem areas in the NCS that challenged mathematics educators teaching in the FET band and areas which appealed to these educators were identified. Third, we asked which guidelines existed to assist educators with lesson planning in mathematics and fourth the question regarding guidelines that existed to assist educators with appropriate assessment strategies in mathematics, were answered. Fifth, guidelines for the effective integration of OBE in the teaching of mathematics were determined.

In the following sections, the situational context of the study is described and underpinned by related literature. A rationale for the choice of a mixed methods research approach used in the study, is provided, and a discussion of study results follows. The paper concludes with recommendations for curriculum implementation and suggestions for further research.

SITUATIONAL CONTEXT

It is indisputable that teachers/educators are key to the success of curriculum reform and implementation (Smith & Desimone 2003; Spillane & Callahan 2000). Their knowledge, beliefs and perceptions play a fundamental role in understanding the reforms (Blignaut 2007; Haney *et al*., 2002). Thus it would be irrational and naïve to expect educators to accept educational reforms easily or without any objections. Some reforms have been triggered by the evaluation results of the Trends in International Mathematics and Science Study (TIMSS). Other reforms resulted from a lack of satisfaction with student performance.

Curriculum reform may be introduced with the goal of producing scientifically literate citizens capable of competing nationally and internationally. However, developing and launching a new curriculum does not guarantee that educational challenges and problems will be overcome (Gitlin & Margonis 1995). A range of factors, including educators' understanding and acceptance of the new curriculum, are likely to impact on implementation. In South Africa, for example, Jansen (1998) and Chisholm (2005) noted that since democracy in 1994, there has been a series of educational changes, all intended to redress past educational injustices. However, contrary to expectations, these changes have not been unconditionally welcomed (Lessing & De Witt 2007).

Currently, in South Africa, one often hears the words transformation, change, reform, development and growth. In-service training (INSET) programmes are professional development programmes focusing on transformation, change and reform in the education system. INSET programmes are organized in the form of workshops. These workshops are meant to develop educators and improve their classroom practice. Changes in classroom practices may be attributed to many factors, namely,

the introduction of technology in education, changes in curriculum, reform in instructional methods and new assessment practices and techniques (Adler 2002: 160). Along with learning and teaching study materials (LTSMs) and especially textbooks, effective educator training is crucial to the successful implementation of the intended curriculum.

Submissions from the review team of the panel appointed by the Minister of Basic Education, reported that many newly qualified educators have deficiencies in respect of their subject knowledge and methodologies (DoE 2000). It would appear that newly qualified educators have not been adequately prepared in respect of appropriate methodologies related to the reformed curriculum. A more general observation by the authors is that especially new educators (but also more experienced educators) are not confident with assessment. If new entrants to the profession are equipped with the necessary knowledge and skills with regard to the curriculum, the need for on-going training would be reduced over time.

Jansen (1998) and Chisholm (2005) noted that curriculum revision in South Africa proceeded in three main waves. The first involved cleansing syllabi from racist language and controversial and out-dated content. This process also aimed at laying a foundation for a single national core syllabus with curriculum decisions made in a participatory and representative manner. The second wave included the launch of C2005 in March 1997. C2005 was driven by the principles of OBE used in countries such as Australia, Canada and parts of the United States of America. C2005 also mirrored the South African constitutional emphasis on equity and human rights. It was seen as important for its content to be non-authoritarian and to be shaped in a participatory manner (Fiske & Ladd 2004). OBE thus formed the foundation of the revised South African school curriculum.

The origins and nature of OBE have been traced by various authors. Fiske and Ladd (2004) simply describe it as an instructional method in which curriculum planners define the general knowledge, skills, and values that learners should acquire. It thus differs from traditional instruction in which curriculum planners define specific kinds of knowledge and skills that are to be transferred from educator to learner, leaving educators to enjoy less freedom of operation (Fiske & Ladd 2004).

Due to challenges experienced in the implementation of C2005 in classrooms, the Ministry of Education appointed a task team led by Professor Chisholm to review C2005 in the year 2000. The Review Committee recommended that the curriculum be strengthened by streamlining its design features, simplifying its language and aligning curriculum and assessment. It also recommended improving educator orientation and training, learner support materials and provincial support (DoE 2000). This process marked the start of the third wave of curriculum reform.

The NCS (Grades 10 – 12) was introduced in 2002. The curriculum laid the foundation for the achievement of the goals of the South African constitution, stipulating that everyone has the right to education which the state, through

reasonable measures, must make progressively available and accessible. The NCS furthermore stipulated Learning Outcomes and Assessment Standards and spelt out the key principles and values that underpin the curriculum.

Recommendations by the task team for the review of the implementation of the NCS included the following. In the first place, a coherent, clear, simple five-year plan to improve teaching and learning across the schooling system needed to be developed and adhered to. The offering of support to educators and the improvement of learner performance must be its central themes. Mechanisms to monitor the implementation of the plan, through regular external monitoring in order to assess whether it had the desired effect on learner and educator performance, needed to be built into the plan. There was a plethora of policies and guidelines at all levels of the education system. Complicating the implementation stage, however, was the reality that educators, as well as some DoE staff, had not made the shift from C2005 to implementing the revised NCS. This had resulted in widespread confusion about the status of the new curriculum and assessment policies.

Contemporary curriculum changes posed a number of problems to the educators. Central to the problem was the implementation of the NCS in the FET band in South Africa. An observable problem for educators included understanding the critical outcomes and teaching mathematics in the FET band in such a way that the critical outcomes were reached by the end of a learner's Grade 12-year. Successful and accurate assessment strategies were implicit in determining whether or not critical outcomes had been reached. Assessment in mathematics still focuses on collecting reliable information regarding learners' mathematical growth and competence. NCS assessment formats included informal assessments, formal internal assessments and external assessments. Informal or daily assessments informed the educator about how learners were progressing towards achieving assessment standards with the purpose of enhancing teaching and learning. Formal internal assessment tools provided the educator with the means to differentiate between learners on a given scale. External assessments occurred in the form of the Grade 12 National Senior Certificate examinations, as is still the case.

A new approach to the implementation of the NCS was the introduction and the use of rubrics in mathematics assessment in the FET band. "These rubrics can be self-assessment rubrics, peer-assessment rubrics, group assessment rubrics or rubrics designed to help the educator assess whatever is being looked for. A rubric is a set of criteria that will be applied in the learning process" (Govender et al. 2006: viii). Mathematics educators specifically were previously not exposed to the use of rubrics for assessment purposes, as tests and examinations were always accepted as the norm.

Implementing the NCS in the FET band clearly challenged educators, particularly mathematics educators. The following section describes the methodology that was followed in an attempt to determine how the NCS could have been introduced more

appropriately to enable educators to cope with the challenges in a more effective manner.

RESEARCH DESIGN AND METHODOLOGY

This study employed a mixed methods research design, therefore qualitative and quantitative research methods were used in collecting and collating the data. The rationale for using a qualitative methodology on the one hand was that the researchers recognised the multi-layered nature of the issues under study, and they tried to portray the issues in their multifaceted form (Leedy & Ormrod 2001: 147). The qualitative data could furthermore support the outcomes of the quantitative component of the study. The researchers remained neutral and subjective about the multiplicity of the realities under investigation, however. Semi-structured interviews were conducted with a blend of flexible and open-ended questions, directly derived from literature and the personal teaching experience of the authors. One educator from each of the 15 randomly selected public schools in the Motheo district was anticipated to participate in this interview process. However, due to personal reasons, only 10 educators from the 15 schools eventually participated in the process. The use of interviews was indispensable, however, as teachers' heartfelt opinions regarding the topics under investigation needed to be obtained. This could be done most successfully by using informal and relaxed semi-structured interviews.

To collect quantitative data a questionnaire was employed. There was a clear structure, sequence and focus to the questionnaire, but the format remained open-ended, enabling the respondents to respond freely. The five constructs that were addressed included aspects regarding training, problematic aspects that either challenged or appealed to educators, guidelines for lesson planning, guidelines for assessment strategies, and guidelines for effective OBE-integration. Once again, guidelines for choosing the questions were obtained from literature and the personal teaching experiences of the authors. The questionnaire was distributed to fifty-two mathematics educators in the Motheo district. The sample consisted of three to four Grades 10 – 12 mathematics educators per school who participated on a basis of availability. In accordance with research ethics, participation furthermore had to be voluntary and the participants were free to withdraw at any stage if they chose to. The data that was obtained can be seen as reliable as it was sourced from participants actually involved in teaching mathematics at the levels under investigation. Its validity stems from the fact that both the interviews and the questionnaire that was presented to the participants, only addressed aspects which were directly linked to the study.

An analysis of the qualitative data was made by identifying similarities and differences in the respondents' answers from the interviews. For the quantitative data the researcher first analysed the responses according to the respondent's biographical information contained in section A of the questionnaire. A descriptive analysis of the main sample data from section B of the questionnaire was then done, using

respondent counting, percentages and the average (mean) of the responses to each statement. Respondent counting involved counting the number of respondents who marked SA (strongly agree), A (agree), D (disagree) or SD (strongly disagree) on the questionnaire. Points were allocated on a scale of 1 – 4 with 1 allocated to SD and 4 to SA. It provided a summary of the frequency of responses for each question per category. The frequency data was converted to percentages, indicating the percentage of respondents who marked a particular category in relation to the total number of respondents. These percentages per category were then allocated to one of the four nominal categories, namely "strongly agree", "agree", "disagree" or "strongly disagree".

Although the main study included both quantitative and qualitative methods, the bulk of data on which the researchers are reporting in this paper was obtained from quantitative methods. Some qualitative findings which support the quantitative findings are mentioned, however.

RESULTS AND DISCUSSION

The findings revealed that educators differ in terms of the problems that they encountered in implementing the NCS in the teaching of mathematics in the FET band. However, average responses from the interviews and questionnaire corresponded and leaned over to the positive side, averaging at around 60% in favour of the NCS implementation. Six out of the 10 educators who were interviewed reported a positive overall attitude with regard to the problems encountered with the implementation of the NCS in the teaching of mathematics in secondary schools. The implication of these findings is that despite the problems, the majority of educators were comfortable with implementing the NCS in the teaching of mathematics on FET level. A possible reason for the positive attitude of the majority of educators may have been the streamlining of C2005 in the form of the RNCS in Grades 8 and 9, followed up by the NCS in Grades 10 – 12.

A summary of the information pertaining to the problems encountered by mathematics FET educators in the Motheo district regarding the implementation of the NCS in mathematics indicated that 9.6% of the participants strongly agreed and 42.3% agreed that the timeframes for implementing the NCS in mathematics were realistic. Only 34.6% disagreed and 13.5% strongly disagreed with the statement. The mean score obtained by the participants for this statement is 2.48 out of a possible four. When converted back to the nominal categories of the implemented scale, it falls within the "Agree" category, which means that on average, the educators agreed that the timeframe for implementing the NCS in mathematics was realistic. On average, educators in the sample agreed that they received adequate training in implementing the NCS in mathematics teaching. The abovementioned data addressed the construct on problems regarding the training of FET mathematics educators with respect to the implementation of the NCS.

Educators agreed: that the timeframe for implementing the NCS in mathematics was, on average, realistic (a mean of 2.48 out of a possible 4); that educators received support from the departmental officials through attending workshops in order to assist them with the implementation of the NCS in mathematics (2.83 out of 4); that the materials received from the DoE was useful for implementing the NCS in the teaching of mathematics (2.42 out of 4); and that educators found the simplified terminology of the NCS in mathematics easily understandable (2.56 out of 4). These observations addressed the construct on the problematic aspects in the NCS that either frustrated or appealed to mathematics educators teaching in the FET band. Once again the average of responses fell within the "Agree" category.

Regarding the guidelines for appropriate assessment and the level on which educators received assistance with lesson planning in mathematics, the results revealed that 50% of the educators disagreed that the NCS had a negative impact on their record keeping of learners' performance. 70% of the educators further disagreed that the NCS had a negative impact on their assessment of learners' performance in mathematics. They furthermore agreed that the NCS had a positive impact on their lesson planning in mathematics (56%). Disagreement on the first two negatively worded statements and agreement on the third positively worded statement in the questionnaire resulted in overall agreement to the existence of guidelines for lesson planning and appropriate assessment strategies in mathematics in the FET band. These responses therefore once again delivered means which fell within the "Agree" category.

On average, educators agreed: that they found the simplified terminology of the NCS in mathematics more easily understandable compared to that in the preceding curriculum documents (a mean of 2.56 out of a possible 4); that the educators used the NCS in mathematics in their day-to-day planning and teaching (a mean of 2.94 out of 4); and that 41% of the participants either disagreed or strongly disagreed about taking long to feel confident with implementing the NCS in mathematics. 75% of the participants either disagreed or strongly disagreed that the NCS had a negative impact on their teaching methodology in mathematics. It was furthermore found that 69% of the participants either disagreed or strongly disagreed that they had difficulty in using the learning outcomes in implementing the NCS in mathematics; that 50% of the participants disagreed to having difficulty in integrating knowledge and skills from different learning areas when they implemented the NCS in mathematics and that 65% of the participants either disagreed or strongly disagreed on having difficulty differentiating between learning outcomes and assessment standards in the NCS for mathematics. These results addressed the construct on the existence of guidelines for the effective implementation of mathematics didactics and OBE principles in the FET band. According to the participants, they agreed that these aspects were in place.

Although, on average, participants agreed that the implementation of the NCS in mathematics at FET level was successful, there is always opportunity for

improvement. In the interviews recommendations were raised regarding various aspects of the curriculum implementation. On district level it was recommended that a plan should be put in place to provide on-going support to educators after the initial implementation. This should be provided by the departmental officials in the form of in-service training and the provision of materials for teaching and learning. Linked to the support, is monitoring. Through monitoring, areas which need support and development can be identified. A suggestion by a participant was that the roll-out of the NCS be piloted before the actual full-scale implementation.

The professional development of educators is vital to the successful implementation of a curriculum. It is therefore imperative that educators receive adequate and on-going training to prepare them for the initial and continuous presentation of the new curriculum. Subject advisors could also be included in this process of training and these teams could work collaboratively with NGOs. Aspects that could be addressed include training in assessment, record keeping, promotions, the use of team teaching, the development of supplementary materials and policy interpretation in Mathematics. The training teams should be deployed to work directly with school clusters providing on-site support to educators and to serve as mentors. All trainers should be accredited through an appropriate process, however.

This study is not free from limitations. Acknowledgement and recognition of these limitations are particularly crucial for the way in which the findings of the study are interpreted. The sample of this study was drawn from educators in the Motheo-district of the Free State province only. It is therefore not representative of the entire population of educators in the Free State province. Further studies could be conducted in other districts of the province to corroborate the findings of this study. Furthermore, only educators from public schools participated in the study. Possibly, research focusing on educators from private schools may add another perspective to the results obtained in this study.

This study focused on the implementation of the NCS in the Further Education and Training band. Similar studies on the implementation of new curricula in the Foundation, Intermediate and Senior Education and Training bands could also be conducted. More research, with a bigger sample, preferably nation-wide, is essential to generalize results nationally with greater confidence.

CONCLUSION

This paper examined the experiences of mathematics educators when implementing the NCS to teach mathematics in Grades 10 – 12. The researchers found that educators encountered problems when implementing the NCS, and that these problems occurred on different levels. However, on average, educators acknowledged that the implementation of the NCS in the teaching of mathematics in the FET band was successful, and that it contributed positively to their teaching. Direct, clear and appropriate guidance from the Department of Education on the implementation of the

NCS in mathematics in Grades 10 – 12, may contribute to educators coping effectively with difficulties associated with the implementation of the NCS.

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