Int J Edu Sci, 15(3): 433-443 (2016)
PRINT: ISSN 0975-1122 ONLINE: 2456-6322
DOI: 10.31901/24566322.2016/15.03.15

Impact of Teacher Self-efficacy on Learner Performance within a Changing Mathematics Curriculum: A Case for Previously Disadvantaged Schools

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KEYWORDS Achievement. Numeracy. Outcomes. Self-efficacy. Understanding

ABSTRACT The performance of learners in the so-called 'critical subjects' such as mathematics in South Africa has been a cause for concern for a number of years especially when test scores of learners are compared against international standards and practices. It is well documented that South African learners underperform in national and international assessment instruments (ANA, PIRLS,TIMSS etc.) when numeracy and mathematical skills are assessed. This paper examines the impact of mathematics teachers' self-efficacy in teaching mathematics in previously disadvantaged schools has on academic performance of leaners within a changing curriculum. A mixed method approach was adopted using one questionnaire (n=16), interviews (n=6) and a mathematics test (n=100) to generate data on the topic suggesting that teachers' self-efficacy in mathematics teaching impacts on the conceptual understanding of mathematics and consequently on academic achievement.

INTRODUCTION

The introduction of curriculum changes in the South African context post-1994 brings along some unique challenges. The poor performance of South African grade 8 learners in mathematics and science as compared to international benchmarks is well documented (TIMSS 2003: 56). The fact that even South African grade 12 learners performed so poorly in the Third International Mathematics and Science Study (TIMSS), suggests that their general mathematics and science skills are limited, and fall short of the literacy levels necessary for effective functioning in global society (Moodaley et al. 2006: 635). The then National Minister of Education, Naledi Pandor MP (DOE 2007a: 2) referred to the release of the 2007 senior certificate examination results, when she stated with some alarm the inadequate progress in the higher grade passes in mathematics and science. Pandor (DOE 2007a: 2) also mentioned that the Dinaledi (under-performing) schools must be given focused attention and support by every province, as must be the priority of ensuring that every child studying mathematics and science has a qualified and competent teacher in their respective classrooms.

The introduction of the Annual National Assessment (ANA) in 2011, is to continuously measure, initially at primary school level, the performance of individual learners and that of classes, schools, districts, provinces and the country as a whole (Motshekga 2011). The results of the tests written in February 2011, according to Motshekga (2011), show that the national average performance for Grade 3 in Literacy stands at 35percent and for Numeracy learners are performing at an average of 28 percent. The report also states that the provincial performance in Literacy and Numeracy is between 19 percent in Mpumalanga, the lowest and 43 percent in the Western Cape, the highest. In the case of the different levels of performance, according to Motshekga (2011: 2), in Grade 3, 47 percent of learners achieved above 35 percent in Literacy, and 34 percent of learners achieved above 35 percent in numeracy.

In Grade 6, according to the national average, performance in Languages is 28 percent and for Mathematics the average performance is 30 percent (Motshekga 2011). The Provincial performance in Languages and Mathematics ranges between 20 percent in Mpumalanga, the lowest and 41 percent in the Western Cape, the highest. In terms of the different levels for Grade 6, 30 percent of learners achieved above 35 percent in Languages, and 31 percent of learners achieved above 35 percent in Mathematics.The

Curriculum Assessment Policy Statement (CAPS) stipulates that a mark of 50percentor higher is regarded as an acceptable level of competency (Department of Basic Education 2014). In the 2012, 2013 and 2014 assessments for the grade 9 learners were unable to achieve an acceptable level of competency (Department of Basic Education 2014). Grade 9 is an important link for mathematics between the Senior Phase and Further Education and Training (FET) phase.

The comparison of a mathematics and science curriculum being taught in developed countries such as Britain and Australia measured against developing countries such as South Africa, contextualizes the challenges that exist in the South African education system. The curriculum changes, according to Asmal (DOE 2003), will be differently interpreted and enacted in diverse contexts, which therefore makes the availability of resources for teaching and learning an asset in any educational setting.

It is within the context of the *unavailability* of these resources in previously disadvantaged schools, that the introduction of curriculum changes is researched. The lack of well-equipped laboratories and/or libraries (without computer and multi-media facilities), physical constraints (heavy teaching workloads, overcrowded classrooms, lack of teacher and learner support material) and psychological constraints (low morale, a negative stigmatizing of the teaching profession, disempowerment of teacher control by a human rights and democratic learning culture) are major challenges for teachers and learners in previously disadvantaged schools and who are faced with new reforms in the mathematics curriculum.

Several further curriculum changes occurred in South Africa since 1994, notably *Curriculum 2005* (C2005), the *Revised National Curriculum Statement (RNCS)* and the *National Curriculum (NCS)*.The latter was followed by another revised curriculum, namely the current *Curriculum and Policy Statement (CAPS)*. These curriculum changes demanded a high level of commitment and competence from those who were responsible for its implementation, particularly from the teacher in the classroom. Some of the new approaches and strategies teachers had to contend with include the following:

- In C2005, learner-centred outcomes were set that have an activity-based approach to education (DOE 2002: 1). The teacher is regarded, not as a transmitter of knowledge, but rather as a facilitator and provider of experiences from which learners will learn. It also requires teaching methods that are learner-centred, an approach that requires learners to participate in classroom activities, become more involved in the learning process and take responsibility for their own learning (Sebela 2009). New teaching practices, in terms of learner-centeredness, require from teachers to give learners the opportunity to work at their own pace according to individual abilities and levels of cognitive development. The C2005 curriculum also advocates teaching practices that are of a reflective nature, by letting both teachers and learners reflect on predetermined outcomes that should be achieved during or at the end of each learning process.
- The RNCS identifies goals, expectations and outcomes to be achieved through related learning outcomes and assessment standards. The learning outcomes for each learning area indicate the broad framework a learner should achieve at the end of a learning process, whereby the assessment standards provide detailed skills, knowledge and attitudes requirements to be achieved in terms of the broader learning outcome. The learning outcomes and assessment standards are cognitive and supportive of each other (DOE 2002: 6).
- The NCS continued with the outcomes-based approach to teaching and learning with specified Learning Outcomes (LOs) for teaching and learning, and Assessment Standards (ASs) for different cognitive levels in the assessment process.
- The current revised NCS, known as CAPS requires new approaches to teaching and learning which has to be implemented by the teacher in the classroom. CAPS provide content on a grade-by-grade and subject-subject basis, indicating the number and type of assessments per term. Learning outcomes (LOs) and assessment standards change to topics and themes and learning areas change to subjects (DOE 2002: 6).

In some documents (DOE 2003a, b) it is assumed that the terms *learner-centred* and *activity-based* were well understood by teachers, which was not the case (Parker 2006: 62). These points to the pivotal fact that it is the *people* along with the *learning process* that ensure that quality teaching and learning materialise (Crick et al. 2007: 272). Effective curriculum implementation is therefore dependent on adequate and appropriate teacher support and development, thus ensuring well-equipped and competent curriculum implementers in the classroom. In the case of the so-called 'critical subjects' such as mathematics is effective curriculum important in all types of schools, but it is even much more important in schools that are situated in challenging economic and social contexts.

Objective of the Study

The paper investigated the impact of teacher self-efficacy on learner performance within a changing mathematics curriculum: a case for previously disadvantaged schools.

Review of Literature

Teacher Self-efficacy and the Mathematics Curriculum

Teacher efficacy was derived from Bandura's (1977) conceptualization of self-efficacy, which is defined as individuals' judgments of their capabilities to accomplish certain levels of performance, it deals with assertion that self-efficacy beliefs govern most human functioning and mediates on how individuals think, feel, motivate themselves and behave. Teacher efficacy is a significant predictor of mathematics instructional strategies, and highly efficacious teachers are more effective mathematics teachers than teachers with a lower sense of efficacy (Swars 2005: 139).

Although there are many studies concerning teacher efficacy, there is limited research on mathematics teacher efficacy in mathematics (Swars 2005: 140). In the few studies on mathematics teacher efficacy (Cakiroglu 2000; Wenta 2000), according to Swars (2005:140) it was found that pre-service teachers' participation in a mathematics method course correspond to significant increases in mathematics teacher efficacy. Pre-service teachers also reported (Cakiroglu 2000) that having exposure to reform approaches in a mathematics course, influenced their levels of mathematics teacher efficacy positively (Swars 2005: 140).

It is within the context of limited research in the area of mathematics teacher efficacy, together with teacher self-efficacy regarding instructional practices and a willingness to embrace reform within a changing curriculum, that this study was undertaken. In order to facilitate the development of highly efficacious mathematics teachers, the perceptions regarding mathematics teacher efficacy, within the context of a changing curriculum in mathematics are investigated.

New Teaching Practices for Curriculum Change

A worldwide paradigm shift is taking place by which educational institutions are gradually changing from places where teaching is provided to places where learning is facilitated (Van der Walt et al. 2008: 206).

C2005 advocates a constructivist theory of learning which acknowledges that the teacher is not a transmitter of knowledge, but rather a facilitator and provider of experiences from which learners will learn. The constructivist theory claims that knowledge is a social construct that is gained through inter-action with other people, hence advocates the use of teaching methods that ensure a more learner-centered approach in social constructivist classrooms in South Africa (Sebela 2009: 2).

The notion of constructivism is one of main pillars of Curriculum 2005 which is used as a reference to provide information around teaching practice regarding teaching styles and efforts to transform the classroom. TheC2005 curriculum has an outcomes-based approach to education, which requires teaching methods that are learner-centred, an approach that requires learners to participate in classroom activities, become more involved in the learning process and take responsibility for their own learning (Sebela 2009: 2). The RNCS and NCS also continue with a constructivist approach to teaching and learning by providing specifics in terms of LO's for teaching and learning, and Assessment Standards for assessment.

The current CAPS do acknowledges a constructivism approach as a continuation of the NCS, but also focuses on the role of the teacher as the primary curriculum implementer. Outcomes-based education is no longer used in CAPS, but emphasise that 'children acquire and apply knowledge and skills in ways that are meaningful to their own lives' (Department of Basic Education 2011: 4)

The view of learner-centeredness is a transformational, research-validated perspective needed in building professional learning communities and improving schools (Crick et al. 2007: 272). A learner-centered approach to educational reform implies, according to Crick et al. (2007: 267) that the focus is on the psychological, emotional and social needs of the learners, and could promote motivation, learning and achievement for all learners. Crick et al. (2007: 268) states that the creation of learner-centered classrooms may be supported by the development of learners' ownership of their own learning power, hence making teacher learner-centered practices respectable in that they create a voice for learners through an emotionally literate school climate.

Teaching practices as prescribed by all the curriculums (C2005, RNCS, NCS and CAPS) implemented post 1994 in South Africa requires from teachers to give learners the opportunity to work at their own pace according to individual abilities and levels of cognitive development.

The Views of Mathematics Teachers on a Changing Curriculum

Olivier (2013: 15) mentions numerous views by teachers about the previous NCS and includes issues such as overburdening of teachers with administrative tasks that has led to teacher overload; different interpretations of curriculum requirements across the country and in different schools and growing levels of learner underperformance in literacy and numeracy. These complaints according to Olivier (2013: 16) that were raised by teachers were instrumental in revising the NCS to the current CAPS by providing single, comprehensive and concise CAPS, provide content on a grade-by-grade and subject-subject basis, indicating the number and type of assessments per term, and changing learning outcomes (LO's) and assessment standards to topics and themes and changing learning areas to subjects.

This research by Olivier (2013) suggests that teachers view fundamental differences between learners who were taught the previous NCS and those learners who were taught the current CAPS, in terms of curriculum policy and content alignment. The constructivist approach to teaching and learning is upheld in CAPS (Department of Basic Education, 2011: 8).

Mathematics Learners Adjusting to the New Curriculum

Despite the fact that mathematics is the cornerstone of scientific literacy, many South African learners do not perform adequately in the subject (Maree and Louw 2007: 279). Learners throughout the country find themselves in situations where high demands are made on them in order to process loads of information to master contents and to apply their knowledge and skills in everyday situations (Maree and Erasmus 2006: 1).

Research by Vithal and Gopal (2005: 45) reports on the views of Grade 8 learners about new curriculum reforms in South Africa, namely Outcomes-based Education (OBE) and Curriculum 2005 (C2005) that were introduced into the mathematics classrooms. The research focused on some important design features of curriculum reform, namely: *group work, mathematics and context, learning and teaching materials, assessment strategies and the discourse of curriculum reform.* The learners' views on the main features of the C2005 curriculum seemed to linked to their teachers' explicit engagement or non-engagement with the C2005curriculum, and they appear to be aware of the tensions and trade-offs for themselves in the enactment of the new curriculum (Vithal and Gopal 2005: 45). Whether this is the case for CAPS is still premature, as this curriculum is now only in existence for two years for Grade 12 and no research has yet been done on learners' views of CAPS.

METHODOLOGY

Research Design

An mixed method with a sequential design was selected to achieve a more comprehensive, elaborated and nuanced view (Creswell et al. 2003) of the link between self-efficacy of mathematics teachers and learner performance in mathematics. The quantitative component provided estimates of self-efficacy scores of mathematics teachers and the impact it has on learner performance in mathematics. The qualitative component, with its inductive theoretical drive (Morse 2003), generated insights on the perceptions and perspectives of only mathematics teachers in relation to effective curriculum implementation and consequently academic achievement of mathematics learners. The mathematics test for learners is also a quantitative (multiple-choice test) instrument which is used as a measure to triangulate the qualitative data by supplementing transcripts of structured interviews with mathematics teachers in the sample schools.

Sample and Sampling Technique

Purposive random sampling technique is used for this study, because the researcher is selecting the sample on the basis of knowledge of the population, its elements and the purpose of the study (Babbie 2004: 183). The sample for this study includes 6 mathematics teachers who have already dealt with instruction through new curriculum content as the curriculum was changing. These six teachers and 100 learners were drawn from three secondary schools situated in historically disadvantaged communities in East London, Eastern Cape, South Africa. These schools are referred to as School A, School B and School C for ethical considerations. The schools that have been selected have all quintile ratings below five, which require substantial financial and resource support from the Department of Basic Education due to socio-economic constraints. The socio-economic surroundings of these schools are important considerations for this study, because of the insight these teachers and the learners provide in terms of the conduciveness regarding effective teaching, learning and assessment practices in these schools.

Ethical Issues

The research was given ethical clearance by the NMMU ethics committee (ethical clearance number H11-EDU-ERE-032). The principles and guidelines of the Belmont Report (1979) were adhered to throughout the research.

Data Gathering Instruments

The data gathering instruments for this study include three tools namely one questionnaire and six interviews with teachers, and a mathematics test for grade twelve learners who have completed all the prescribed mathematical content in grade eleven.

Questionnaires

The questionnaire for all the mathematics teachers in the sample schools focuses on the self-efficacy of mathematics teachers in terms of instructional strategies and classroom management practices in the schools where they teach. The questionnaire comprises 25 items of which the participants indicated their choice of preference between two statements. Numerical values (external control = 0 and internal control = 1) are allocated to different statements of choice, and the questionnaire is analyzed in relation to the attitudes, perceptions and perspectives of the mathematics teachers in the classroom. Durrheim (2002: 93) claims that most measures in behavioural sciences (for example, IQ scores, scores on attitude scales and knowledge tests) are considered interval scores, and in addition to performing mathematical relations (<,>), mathematical operations of addition and subtraction (+,) may be legitimately operated.

Semi-structured Interviews

The purpose of the interviews for this study is to illicit responses from mathematics teachers who teach in schools situated in previously disadvantaged communities, in order to gauge the level of their mathematics efficacy beliefs to bring about effective teaching, learning and assessment strategies in the new curriculum. The questions for the interviews focus on three themes in terms of effective teaching and learning methodologies, namely: *Theme 1: Teachers' understanding of the concept of outcomes-based education, Theme2: Teachers' understanding of a new curriculum statement in mathematics and Theme 3: Teachers' expositions in the schools where they teach.*

Mathematics Test

A mathematics test was also written by grade twelve mathematics learners (n = 100) to give insight of their conceptual understanding of the grade eleven mathematics curriculum in terms of content and taxonomy. This mathematics test included certain disciplines as set out for the core mathematics curriculum for grade eleven which included categories for Algebra (Alg), Trigonometry (Trig), Analytical Geometry (AnGeo), Transformation Geometry (TrGeo), Data Handling (Data) and Surface Area and Volume (SAV). The inclusion of Transformation Geometry is strategic in the test, because the transformation rules used in Transformation Geometry are applied in Algebra for CAPS when finding equations when graphs are shifted to new positions. The test consisted of thirty five statements whereby four multiple answer options were given and was informed by some of the content of the grade eleven mathematics core curriculum.

The mathematics test was quality assured by the Eastern Cape Department of Education. The degree of difficulty of the questions ranges from questions that require basic mathematical knowledge, routine procedures, complex procedures and problem solving techniques, which guides taxonomical differentiation of questions on National Grade Twelve question papers for the National Senior Certificate Examination. The mathematics test for the grade twelve learners that assesses grade eleven work is important, because the grade eleven content does not only form the basis for conceptual understanding of the core assessment standards in grade twelve, but the grade twelve final question paper also consists of between 35 percent to 40 percent of grade eleven content. The National Senior Certification process, according to the Subject Assessment Guidelines for Mathematics, Gr10-12 (DOE 2005: 11) includes a formal assessment at the end of grade twelve, whereby the external mathematics assessment assesses the Assessment Standards of grades eleven and twelve, assuming that learners have achieved the grade ten Assessment Standards.

Data Analysis

The data analysis process, because of the mixed method approach adopted by this study, required methods which included both quantitative and qualitative data analysis. Descriptive statistics were independently analysed by the Unit for Statistical Consultation at the Nelson Mandela Metropolitan University. The qualitative data in the form of interviews were analysed by using theme analysis as it presented itself in the three themes.

RESULTS AND DISCUSSION

Teacher Self-efficacy (TSE)

The data were collected from all the mathematics teachers of the sample schools in the form of a questionnaire where the teachers had to indicate their preference between two options. The data collected amongst all the mathematics teachers of the sample schools show a Cronbach's alpha Reliability (Internal Consistency) score of 0.68 very close to 0.7, which according to Cohen et al. (2007:506) is Cronbach's alpha benchmark for internal consistency. The 0.68 score could be argued to show marginal consistency, according to Cohen et al. (2007: 506), taking into consideration the sample size (n = 16), and the preference of choice (items) was limited to two options (internal control = 1 and external control = 0).

Table 1 shows the Comparative Mean Teacher Self-efficacy (TSE) scores of the three sample schools. The table shows clearly that the mathematics teachers of School C have the highest TSE mean score of 56.8 percent followed by School A with a mean score of 47.2 percent and lastly by School B with a mean score of 44.0 percent. The mathematics teachers of School C are therefore highly self-efficacious about the influence they exert over and above the external factors that might influence teaching, learning and assessment strategies, followed by School A whose mathematics teachers are also self-efficacious about their influence and lastly by School B whose teachers are less self-efficacious about their influence over their learners as opposed to external factors that might influence the ability of their learners.

Table 1: Mean TSE scores by school (n=16)

School	*Number of teachers*	*Mean scores (%)*
School A	5	47.2
School B	6	44.0
School C	5	56.8
Total	16	49.0

Table 2 shows the responses of the mathematics teachers per sample school in terms of their Teacher Self–efficacy (TSE) beliefs about their influence over their learners in the mathematics classroom. The graph shows that at School C (n = 5) the mean scores are most favor-

Table 2: Mean TSE scores by mathematics teachers per school (n=16)

TSE Ranges (%)	*School A n = 5*	*School B n = 6*	*School C n = 5*	*All the teachers n=16*	*% of all the teachers*
28 - 39		1	2	3	19
40 - 49	4	4		8	50
50 - 59	1	1		2	13
60 - 79			2	2	13
80 - 92			1	1	6
Total	5	6	5	16	100

able where 2 teachers (40%) TSE scores are between 28 – 39 percent, 2 teachers (40 %) are between 60 – 79 percent and 1 teacher (20%) is between 80 – 92 percent. School B (n = 6) shows less favorable TSE mean scores where 1 teacher (16.7 %) is between 28 – 39 percent, 4 teachers (66.6 %) are between 40 – 49 percent and 1 teacher (16.7 %) is between 50 – 59 percent. The mathematics teachers of School A (n = 5) are more self-efficacious than School B with 4 teachers (80 %) between 40 – 49 percent and 1 teacher (20 %) between 50-59 percent. The data show that the mathematics teachers of School C are highly self-efficacious, followed by the mathematics teachers of School A who also show positive Teacher Self-efficacy (TSE) beliefs and lastly by School B whose mathematics teachers show mostly negative TSE beliefs in exerting influence over their learners in the classroom as opposed to external factors outside the control of the teacher.

Semi-structured Interviews

The interpretation of the findings of the interviews is presented as per school in order to draw certain comparisons in terms of how the mathematics teachers responded to the themes under discussion, as shown in Table 3.

Mathematics Test

The responses of the grade 12 learners of the three sample schools are compared and grouped in the following performance ranges namely 0-19 (very poor), 20-39 (poor), 40-60 (average), 61-80 (good) and 81-100 (very good). Table 4 shows how the learners per sample school performed in each of the six mathematics dimensions.

Comparative Analysis of Algebra Scores

The Algebra section consisted of 15 statements. According to the data, 70 percent of the learners of School A (n=23) demonstrated good understanding of the relevant curriculum, followed by School C (n=51) with 27 percent learners and then School B (n=26) with 23 percent.

Comparative Analysis of Trigonometry Scores

The Trigonometry section consisted of seven statements. The data reflects that the learners of School A (n=23) were most effective (48 %), followed by School C (n=51) (24 percent) and then School B (n=26) (12%).

Comparative Analysis of Analytical Geometry Scores

The Analytical Geometry section consisted of five statements. The data shows that the learners of School A (n=23) were most effective (48%), followed by School C (n=51) (24 %) and then School B (n=26) (12 %).

Comparative Analysis of Transformation Geometry Scores

The Transformation Geometry section consisted of three statements. The data in the table reflects that the learners of School A (n=23) were

Table 3: Concise summary of responses by the mathematics teachers (n = 6)

Name of school	*Theme 1*	*Theme 2*	*Theme 3*
School A (n=2)	Overall positive	Overall positive	Overall positive
School B (n=2)	Overall negative	Overall negative	Overall negative
School C (n=2)	Overall positive	Overall positive	Overall positive

Table 4: Learners' achievement per school and per each of the six mathematics dimensions

Scores per school in each of the six mathematics dimension										
Performance ranges	*0-19*		*20-39*		*40-60*		*61-80*		*81-100*	
Algebra										
School A	0	0%	2	9%	5	22%	13	57%	3	13%
School B	0	0%	4	15%	16	62%	6	23%	0	0%
School C	0	0%	10	20%	27	53%	13	25%	1	2%
Total	0	0%	16	16%	48	48%	32	32%	4	4%
Trigonometry										
School A	0	0%	2	9%	10	43%	6	26%	5	22%
School B	0	0%	3	12%	20	77%	2	8%	1	4%
School C	5	10%	7	14%	27	53%	7	14%	5	10%
Total	5	5%	12	12%	57	57%	15	15%	11	11%
Analytical Geometry										
School A	0	0%	2	9%	10	43%	6	26%	5	22%
School B	0	0%	3	12%	20	77%	2	8%	1	4%
School C	5	10%	7	14%	27	53%	7	14%	5	10%
Total	5	5%	12	12%	57	57%	15	15%	11	11%
Transformation Geometry										
School A	0	0%	0	0%	3	13%	7	30%	13	57%
School B	0	0%	0	0%	12	46%	11	42%	3	12%
School C	1	2%	4	8%	19	37%	19	37%	8	16%
Total	1	1%	4	4%	34	34%	37	37%	24	24%
Data Handling										
School A	4	17%	7	30%	0	0%	8	35%	4	17%
School B	8	31%	15	58%	0	0%	2	8%	1	4%
School C	5	10%	23	45%	0	0%	21	41%	2	4%
Total	17	17%	45	45%	0	0%	31	31%	7	7%
Surface Area and Volume										
School A	11	48%	0	0%	0	0%	0	0%	12	52%
School B	17	65%	0	0%	0	0%	0	0%	9	35%
School C	34	67%	0	0%	0	0%	0	0%	17	33%
Total	62	62%	0	0%	0	0%	0	0%	38	38%

most effective (87 %), followed by School B (n=26) (54 %) and then School C (n=26) (53 %) very close with a difference of 1%.

Comparative Analysis of Data Handling Scores

The Data Handling section consisted of four statements. According to the information presented, the learners of School A (n=23) were most effective (52 %), followed by School C (n=51) (45 %) and then School B (n=26) (12 %).

Comparative Analysis of Surface Area and Volume Scores

The Surface Area and Volume Category scores of the learners are based on a single statement. These scores show that the learners of School A (n=23) were most effective (52 %), followed by School B (n=26) (35%) and School C (n=51) (33%), very close with a difference of 2 percent.

Comparative Analysis of Mathematics Scores Overall

The mean scores in all the mathematics categories are presented in Table 3. The graph shows that School A obtained the highest mean score in all the categories with 69.87 percent, followed by School C with a mean score of 55.20 percent and followed closely by School B with a mean score of 54.0 percent. The graph also shows that the mean scores of School A are the highest of the three schools for all the categories, followed by School C and then by School B. It could therefore be argued that the achievement of the learners of School A was the most satisfactory, followed by that of School C and lastly School B which was the poorest of the three sample schools. School B also shows much similarity with School A in terms of sample size, number of teachers and learners as well as resources, but it failed to deliver the same learner performance in the mathematics test as that achieved by learners in School A. The comparative mathematics test mean scores of the three schools are then presented in Table 5.

Table 5: Mean mathematical scores by school (n=100)

	School A Maths	*School B Maths*	*School C Maths*
N	23	26	51
Mean	69.87	54.00	55.20
S.D.	17.08	15.35	13.97
Minimum	44.92	20.04	31.71
Quartile 1	57.62	43.17	46.87
Median	67.14	48.25	53.45
Quartile 3	82.86	65.40	59.21
Maximum	100.00	86.35	96.67

Reliability and Validity

Cohen et al. (2000:105) describe *validity* as a demonstration that a particular instrument, in fact, measures what it purports to measure, while qualitative data might be addressed through the honesty, depth, richness and scope of the data achieved. The data collected amongst the mathematics teachers (n=16), are consistent with Cronbach's alpha Reliability (Internal Consistency), which use item analysis to calculate a consistency coefficient. The Cronbach alpha coefficient, according to Cohen et al. (2007: 506) is a measure of internal consistency among multi-item scales, which ranges from between 0 and 1. Cohen et al. (2007: 506) suggest the following reliability levels: less than 0.60 as unacceptably low reliability, 0.60 – 0.69 as marginally reliable, 0.70 – 0.79 as reliable, 0.80 – 0.90 as highly reliable and greater than 0.90 as very reliable.The data collected amongst all the mathematics teachers of the sample schools for the teacher self-efficacy data show a Cronbach's alpha Reliability (Internal Consistency) score of 0.68 very close to 0.7which according to Cohen et al. (2007) is the benchmark for internal consistency. The 0.68 score as shown in Table 6, could be argued to show marginal consistency, according to Cohen et al. (2007), taking into consideration the sample size (n=16), and the preference of choice (items) was limited to two options namely: internal control = 1 and external control = 0.

Table 6: Cronbach's alpha score for internal consistency

Teacher self-efficacy	*Cronbach's alpha*
TSE	0.68

Voice recordings have been made of the semi-structured interviews and have been saved in digital format on one compact audio disk and then transcribed *verbatim*. Two interviews with mathematics teachers per sample school have been voice-recorded and transcribed in the sequence of School A (n = 2), School B (n = 2) and finally School C (n = 2). The data collected amongst the learners of the sample schools for the mathematics test give a Cronbach's alpha score of 0.60, which according to Cohen et al. (2007: 506) could be argued that the multi-items show marginal internal consistency, taking into consideration that the probability of choosing the correct answer is 1/4 or 0.25. Table 7 shows the Cronbach's alpha scores for internal consistency of the mathematical disciplines.

Table 7: Cronbach's alpha score for internal consistency

Mathematical categories	*Cronbach's alpha*
Alg	0.60
Trig	0.40
AnGeo	0.35
TrGeo	0.30
Data	0.26
SAV	-
Maths	0.60

The use of quantitative data instruments (questionnaires and the mathematics test) and qualitative data instruments (interviews), which have shown acceptable consistency ranges in its analysis, have lent validity and reliability to the quantitative data and credibility and trustworthiness to the qualitative data.This study supports Henson's (2001: 4) theoretical framework, which defines teacher *self-efficacy* as a teacher's judgment of his/her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated. This study further supports (Swars 2005: 139) by which teacher self-efficacy is mentioned as a significant predictor of mathematics instructional strategies, and concurs that highly efficacious teachers are more effective mathematics teachers than teachers with a lower sense of efficacy.The context of this study is secondary schools situated in previously disadvantaged communities, hence confirming previous research by Hendricks (2012: 219) that the teacher self-efficacy of mathematics teachers in previously disadvantaged schools can override the socio-economic surroundings of those schools.

CONCLUSION

The comparisons in the different schools have shown certain patterns. In cases where the mathematics teachers felt more in control over the teaching, learning and assessment processes in the classroom, they contributed to a better understanding of mathematics by the learners. The study has also shown where mathematics teachers feel less in control over the teaching, learning and assessment processes in their school, a lack of conceptual understanding of mathematics by learners was evident.

REFERENCES

Babbie E 2004. *The Practice of Social Research.* 10th Edition. Belmont, Chapman University: Wadsworth/ Thompson Learning.

Bandura A 1977. Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review,* 84: 191-174.

Bandura A 1986. *Social Foundations of Thought and Action: A Social Cognitive Theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura A 1993. Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist,* 28(2): 117-148.

Bandura A 1997. *Self-efficacy in Changing Societies.* New York: Cambridge University Press.

Belmont Report 1979.The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research. From <http://ohsr. od. nih.gov/guidelines/belmont.html> (Retrieved on 12 December 2005).

Cakiroglu E 2000. *Pre-service Elementary Teachers' Sense of Reform Orientated Mathematics.* Doctoral Dissertation, Unpublished. Indiana: Indiana University.

Cohen C, Manion L, Morrison K 2000. *Research Methods in Education*. New York: Routledge Falmer.

Cohen C, Manion L, Morrison K 2007. *Research Methods in Education*. New York: Routledge.

Creswell JW, Plano Clark VL, Gutman ML, Hanson WE. 2003. Advanced mixed methods research designs. In: A Tahakkori, C Teddlie (Eds.): *Handbook of Mixed Methods in Social and Behavioral Research*. Thousand Oaks, CA: Sage, pp. 209-240.

Crick RD, McCombs B, Haddon A, Broadfoot P, Tew M 2007. The ecology of learning: Factors contributing to learner-centered classroom cultures. *Research Papers in Education,* 22(3): 267-307.

Department of Basic Education, (DBE) 2011. *National Curriculum and Assessment Policy Statement (CAPS) for Mathematics, GR10-12.* Pretoria: Government Printers.

Department of Basic Education 2014. *Report on Annual National Assessment. Results of 2014.Grade1 to 6 & 9.* Pretoria: Department of Basic Education.

Durheim K 2002. Quantitative measurement. In: M Terre Blanche, K Durrheim (Eds.): *Research in Practice: Applied Methods for the Social Sciences.* Cape Town: University of Cape Town Press, pp. 72-95.

Graven M 2002. Coping with new mathematics teacher roles in a contradictory context of curriculum change. *The Mathematics Educator,* 12(2): 21-28.

Hendricks WW 2012. *The Effect of Collective Efficacy on the Introduction of a New Curriculum by Mathematics Teachers*. PhD Thesis, Published. Port Elizabeth: Nelson Mandela Metropolitan University.

Henson RK 2001. Teacher Self-efficacy: Substantive Implications and Measurement Dilemmas. *Paper Presented at the Annual Meeting of the Educational Research Exchange,* Texas A & M University, Texas, and January, 26, 2001.

Maree JG, Erasmus CP 2006. Mathematics skills of Tswana-speaking learners in the North West Province of South Africa. *Early Child Development and Care,* 176(1): 1-18.

Maree JG, Louw CJ 2007. The nature, purpose and effectiveness of assessment in tertiary mathematics at Tswane University of Technology. *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie, Jaargang 26 No 4: December 2007.*

Moodaley R, Grobler A, Lens W 2006. Study orientation and causal attribution in mathematics achievement. *South African Journal of Psychology,* 36(3): 634-655.

Morse JM 2003. Principles of mixed methods and multimethod research design. In: A Tashakkori, C Teddlie (Eds.): *Handbook of Mixed Methods in Social and Behavioural Research*. Thousand Oaks, CA: Sage, pp. 189-208.

Motshekga A 2011. Statement on the Release of the Annual Assessment Results for 2011 by Ms Angie Motshega, Minister of Basic Education, Union Buildings. Report released on 28 June, 2011. From <http/ /www.education.gov.za> (Retrieved on 4 August 2011).

Naidoo D, Parker D 2005. The implications of mathematics teachers' identities and official discourse for democratic access to mathematics. *Perspectives in Education,* 23(1): 53-67.

National Department of Education (DOE) 2002. *Revised Curriculum Statement Grades R-9 (Schools, Policy).* Pretoria: Government Printers.

National Department of Education (DOE) 2003. *National Curriculum Statements 10-12 (General). Mathematics.* Pretoria: Government Printers.

National Department of Education (DOE) 2005. *Subject Assessment Guidelines Mathematics, National Curriculum Statement, Grades 10-12 (General).* Pretoria: Government Printers.

National Department of Education (DOE) 2007. Western Cape Education: MEC'S Announcement of 2007 Matric Results. From <http:// www.education.gov.za / ref. html> (Retrieved on 21 May 2008).

Olivier 2013. Reflection on the Training of Mathematics Teachers for the CAPS Curriculum – A Brief Report. *Report on CAPS Training of Maths Teacher.* Pretoria, South Africa, pp.15-21.

Parker D, Adler J 2005. Constraint or catalyst? The regulation of teacher education in South Africa. *Journal of Education,* 36: 59-78.

Parker D 2006. Grade 10-12 Mathematics curriculum reform in South Africa: A textual analysis of new national curriculum statements. *African Journal of Research in SMT Education,* 10(2): 59-73.

Rose JS, Medway FJ 1981. Measurements of teachers' beliefs in their control over students' outcome. *Journal of Educational Research,* 74: 185-190.

Sebela MP 2009. Using Teacher Action Research to Promote Constructivist Classroom Learning Environments in Mathematics in South Africa. From <http//www.aare.edu.au/01pap/seb01443.htm> (Retrieved on 26 March 2009).

Swars SL 2005. Examining perceptions of mathematics teaching effectiveness among elementary preservice teachers with differing levels of mathematics teacher efficacy. *Journal of Instructional Psychology,* 32(2): 139-147.

TIMSS 2003. *Country by Country Profiles of Achievements in the Mathematics Cognitive Domains*. USA: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.

Van der Walt MS, Maree JG 2007. Do mathematics learning facilitators implement metacognitive strategies? *South African Journal of Education,* 27(2): 223-241.

Van der Walt MS, Maree JG, Ellis SM 2008. Metacognition in the learning of mathematics in the senior phase: Some implications for the curriculum. *International Journal of Adolescence and Youth*, 14: 205-235.

Vithal R, Gopal N 2005. What learners say about the new South African curriculum reform? *Perspectives in Education,* 23*:* 45-59.

Wenta RG 2000. *Efficacy of Pre-service Elementary Mathematics Teachers*. Doctoral Dissertation, Unpublished. Indiana: Indiana University.

Paper received for publication on February 2016
Paper accepted for publication on November 2016