

The Impact of a National Curriculum on Equity Learning and Achievement: The Case of Curriculum 2005 in South Africa

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Abstract: This study explores the impact of Curriculum 2005 on equitable achievement in mathematics in South Africa. In 2007, 328 Grade 10 learners from eight high schools in the Gauteng Province of South Africa wrote a multiple choice mathematics achievement test based on the current curriculum. The results of the test were used to measure and explain equity in mathematics epistemic access in the light of the curriculum. The researcher employs a mixture of qualitative and quantitative designs to carry out the study as well as to statistically describe and explain the findings. The findings suggest that Curriculum 2005 does not seem to have reduced inequity in mathematics achievement for a number of reasons although at present equity in formal access has improved. Implications of the study to other countries are discussed.

Key words: Curriculum 2005; Curriculum reform, Equity

Introduction

South Africa introduced a reform curriculum in 1998 called the National Curriculum Statement (NCS) or Curriculum 2005 (Department of Education (DoE), 1998). A cherished goal of this curriculum is to increase equity and inclusiveness in educational access and attainment, including in mathematics (Department of Education, 2008). Yet since its inception, debates are continuing on its capacity to achieve this goal (see Jansen & Christie, 1999; Potenza & Monyokolo, 1999; Taylor, 2003). This research is undertaken on the basis of this debate; to study Curriculum 2005's effect in promoting equity in mathematics education.

This debate originates from the international scene that concurs that one of the major goals of curriculum reform is to increase educational access to all learners (e.g. NCTM, 1989, 1991). Therefore in recent times it is argued that an excellent education system cannot do without inclusiveness. The point of departure for educationists is how far the present reform curricula actually enhance equity. As far as mathematics education is concerned, there are two main opposing positions on this continuum. Researchers who criticise the efficacy of reform approaches in increasing equity, point out that reform curricula make mathematics less accessible

to most learners from disadvantaged groups. This, they argue, is because reform curricula expect learners to develop their own strategies to solving mathematics problems (Boaler, 2002; Lubienski, 2001). Lubienski commented that reform mathematics curricula can either add or remove barriers for lower class learners, while Delpit (1988) raised concerns about the efficacy of reform approaches in reducing inequity (in relation to the teaching of language); that some reform approaches may 'exacerbate inequalities because cultural and linguistic minority learners may expect teaching to be more direct' (p. 83). Delpit's admonition was that children from disadvantaged groups need to be explicitly taught the culture of knowledge and power, which would remain covert if it was not openly mediated to them. Similarly, Lubienski (2000) expressed reservations on the viability of mathematics reform approaches for lower socio-economic-status (SES) learners. She documented that 'lower SES learners preferred more external direction and sometimes approached problems in a way that caused them to miss the mathematical points' (p. 89). Lubienski thought that class cultural differences could account for how learners understood mathematics by way of open mathematical problems.

Other researchers notably Boaler (2002) and Hufferd-Ackles, Fuson & Sherin (2004) argue strongly that reform practices can reduce inequalities in learning and achievement in mathematics on learners from different backgrounds and those regarded as of low mathematical ability. In particular, their research points to the vital fact that equitable teaching must consider specific methodologies of teaching and learning that must be implemented in mathematics classrooms for equity to occur. Their argument is that the way the reform curriculum is enacted is critical to its success. Their research findings also suggest that learners who engage with reform pedagogies cultivate genuine interest in learning and applying mathematics in and outside the classroom. From the foregoing debates, it would appear that while reform curricula may have limitations, they do possess important merits with respect to equity in mathematics epistemic access and achievement.

The above discussion on the potential of reform curricula to effect equity is relevant in the South African situation, where a reform curriculum was introduced in the late 1990s. Curriculum 2005 in South Africa is outcome based, but it is largely silent on the methodological processes that teachers can adopt in order to facilitate achievement of learner outcomes (Jansen & Christie, 1999). The lack of clarity on the methods that teachers can apply in their teaching renders open the pedagogies they can employ to for learners to achieve learning outcomes and assessment standards. This means that in mathematics lessons disadvantaged learners may obtain little support from teachers as far as direct teaching is concerned, since the curriculum is non-prescriptive on teaching methods to be used. For this reason (and

those discussed earlier on), there are strong concerns in South Africa on the efficacy of Curriculum 2005 to deliver equity in mathematics education. Taylor (2003) exposes more shortcomings inherent on equity issues in Curriculum 2005:

The treatment of all schools and classrooms as if they were the same led to de facto privileging of better established (mainly ex-white) schools. That is, teachers in white schools were able to generate additional learning materials, were better qualified and their middle-class learners had more access to resources to support learning in a curriculum that was based on learner drive and initiative (p. 41)

Again, other researchers such as Potenza & Monyokolo (1999) criticise the outcome-based curriculum as, 'a destination without a map', (p. 231) in that it requires teachers to devise their own pedagogies for their learners to achieve the outcomes. As has been stated, this lack of explicit pedagogy to be used in implementing Curriculum 2005 is often blamed for Curriculum 2005's failure to achieve the outcomes as well as equity. The above authors' censure of Curriculum 2005 is not different from the criticism against the old curriculum about its failure to reduce inequity among learners from varied backgrounds.

Given the above arguments, it is imperative to research whether open pedagogical approaches encouraged by Curriculum 2005 in South Africa will differentially affect different groups of learners and hence affect equity. According to Ball (2003), important mathematical practices are often implicitly figured out by middle class learners, while the same may; unfortunately remain incomprehensible to disadvantaged learners if they do not obtain outside help. In contrast, middle class learners' home culture is mirrored in school, so they find it easier to interpret unsaid school requirements. However, working class learners need open direction (Delpit; 1988). Hence overt mathematical approaches may accommodate all learners.

However, mathematics educationists may argue against direct teaching on the basis that it encourages learners to view mathematics as a set of memorised and unconnected mechanical procedures (Skemp, 1976; van de Walle, 2001). They argue that open methods enable learners to gain invaluable critical thinking skills. Notwithstanding these important issues, this research will not be concerned about them at this time in as much as they affect the philosophy of Curriculum 2005.

Although it is not unusual to find some learners who come from impoverished families and communities doing very well in mathematics, this is against the trend. In the following excerpt, Metcalfe (2007), analyses general inequitable mathematics achievement in South Africa in detail:

Patterns of school performance are significantly influenced by socio-economic context, and race and class coincide in South Africa...In 2003, almost 1 in 10 of the white cohort achieved an A aggregate for Matric, as compared to just over 1 in 1000 of the black cohort (and half of these were attending 'suburban' schools). Two-thirds of HG math passes are produced by a small minority (7%) of schools – and only 0.6 % of these passes are produced in historically African schools...Thus we perpetuate historic inequalities in our schools (p. 12)

Research Focus

The purpose of the study was to measure and explain the impact of Curriculum 2005 on equity in South African schools, in terms of gender and socioeconomic status of learners in grade 10.

Research Question

Given that Curriculum 2007 has been in implementation for over a decade, how much has it achieved in delivering equity in mathematics in South Africa with respect to gender and socio-economic status differences of learners?

Literature Review

Equity in mathematics education

Secada (1989) argues that, 'equity concerns those areas in which rules and procedures are based on notions of justice - equity concerns itself with the exception rule. It involves our ability to say; 'Yes you are following the rules, but is it fair?'' (p. 69). Elucidating further, how the notion of equity can be understood between groups, Secada (1989) explained that accumulated differences between social classes or gender could be shown by some index. If this index differs from one demographic group to another, this demonstrates an existence of inequality. The groups then will not have parity as regards that index.

Esping-Andersen, Nicaise, Pont & Tunstal (2005) specify three types of equity in education:- opportunity, treatment and outcome. The first type concerns the background of a learner on entry into school. Esping-Andersen et. al. observe that equal opportunities focus on exogenous determinants of school success, which emanate from the learners' social conditions. These collateral conditions are human, social, cultural and material resources at children's disposal, which are likely to foster or retard learning. Boaler (1998) and Brodie (2002), argue that although the education system cannot be held responsible for inequalities in resources, it can contribute to overcoming such exogenous inequalities through

specific interventions. The second type of equity pertains to the teaching and learning experiences children encounter in the school setting. Unequal treatment deals with endogenous mechanisms within the school system that may generate inequalities and discrimination. Unequal treatment may relate to socially or culturally biased curricula, legal barriers to success, or discriminatory behaviour on the part of the teachers and other learners. The third type of equity occurs on learners' exit from school and what happens from then on. Equal outcomes emphasise the need to equalise the distribution of outcomes of education across social and or ethnic groups characterised by unequal a priori opportunities.

Equity in mathematics education can also be viewed in terms of formal and substantive access. Formal access is concerned with legislation or regulations resulting in all children getting access to schools, as well as remaining in school to study mathematics. It is signified by learners' presence in classrooms where mathematics is taught and learnt. Substantive access is learners' fruitful engagement with mathematics tasks resulting in them achieving 'mathematical proficiency', (Kilpatrick, Swafford & Findell, 2001). Formal access is a prerequisite but not a sufficient condition for substantive access because attendance to mathematics lessons does not guarantee successful learning of mathematics by every learner. Epistemic access concerns learners' authentic engagement with mathematics learning practices resulting in their acquisition of mathematical knowledge. The failure to bridge the gap between formal and epistemic access by some groups of learners imply that some groups of learners while present in mathematics classes remain 'outside' insiders as far as accessing mathematical knowledge and skills is concerned. Leikin & Zaslavsky (1997) referred to such action as active passivity where learners' activity in class may not be related to schoolwork.

Research Methodology

The study was undertaken through a mixture of qualitative and quantitative methods. Mixed methods are rigorous because quantitative methods can tell us what works and how much it works, while the qualitative methods can tell us how what works works (Creswell, 2007). Creswell regards quantitative research as the systematic investigation of objective and measurable properties of phenomena; in this case achievement equity in reform mathematics classes. Qualitative research is empathetic, striving to capture phenomena as experienced by the research participants themselves. My resort to mixed methods is based on my belief that no one method is enough or the best or more desirable because different methods produce different forms of knowledge, so mixed methods were the most pragmatic to thoroughly research the equity impact problem from all sides.

Design

A thirty question multiple choice test was issued to the learners. It was written over one and half hours. The reason while a multi-choice test was used was ease of administration and to increase reliability and validity of findings. One of the main reasons to use a multiple choice test is that I found that teachers were ready to help to mark the test.

Sample

On sampling, Merriam (1992), explicates that, ‘once the general problem has been identified, the task becomes to select the unit of analysis’ (p. 60). The unit of analysis is the object which is to be studied in terms of research variables that constitute the construct of interest (Brown & Dowling, 1998; Yin, 1994; McMillan & Schumacher, 1993). In my study, achievement in mathematics and equity were my objects of analysis. The unit of analysis is found within a sample. In this study, a sample of eight differently resourced schools in Gauteng Province was selected for the study. Some of the schools were co-education schools whereas some were Girls Only schools. One hour mathematics tests were administered to grade 10 learners to measure their mathematical competence. The tests were composed of items selected from relevant NCS outcomes and assessment standards for grade 10 that all the learners in the sample had studied.

The units of analysis in the study were mathematical competence in the tests on the background of learners’ gender and socio-economic status, and the use of reform approaches in mathematics teaching and learning.

Limitations of the Study

The study was carried out on only eight schools in a major city in Gauteng Province, South Africa. These schools then cannot be representative of the thousands of schools in the country on which the curriculum is implemented. A country-wide study of the impact of the curriculum on equity in all schools would have been ideal, but the time, financial and logistical constraints are unthinkable for a solo researcher. Even though a small strategically selected sample can provide valuable statistical estimates to population parameters this could not be done for similar logistical reasons.

That the study was also carried out only on grade 10 learners also means that the findings of this study can only be conjectural and inconclusive. However these limitations do not imply in any way that the results of this study cannot stand, as they hold for the research sample on which the study was undertaken.

Compliance with Ethical Standards

Research results found without adherence to proper ethical considerations are considered invalid (Opie, 2004). The ethical principles for research: voluntary participation, informed and understood consent, as well as confidentiality and anonymity of participants were followed. They were adhered to, for the protection of participants against invasion of privacy or harm (physical and/or psychological) resultant from their participation in this study. Permission and consent was sought from Gauteng Department of Education (GDE), the schools, the participant teachers, parents or guardians of minor learners and consenting learners via letters. In addition, guarantees of participants' confidentiality and anonymity were given prior to administering the tests.

Results and Discussion

In this section I analyse the results of the test for schools in my sample after the test was marked with the assistance of class teachers. The scores were then entered in a Microsoft Excel spreadsheet, with the gender, socio-economic and language of the learners noted.

Table 1

List of Selected High Schools and Performance in the Research Test by Gender

School	Average mark out of 40		Percentage of learners scoring more than 50 %	
	Female	Male	Female	Male
A	8.69	8.64	0%	0%
B	15.29	17.5	21%	37%
C	13.92	15.64	13%	22%
D	15,19	16.28	17%	19%
E	11.45	11.61	4%	4%
F	11.41	12.52	4%	7%
G	9.02	9.22	3%	5%
H	16.75	N/A	28%	N/A

Gender and Curriculum 2005

I analyse performance on the basis of gender on these schools (See Table 1). Gender is important in mathematics education because of stereotypes, and deficit orientations, girls are often treated differently in mathematics resulting in lower

achievement (Secada, 1989). There is the myth that boys are better at mathematics than girls. My calculations are based on the mathematics tests results. As far as performance above 50% ('the pass mark') is concerned, they show that although the percentage of boys and girls who passed slightly differed, in six out of eight schools, the boys did better than girls. In practically all co-educational schools in the sample, the percentage of males who did better than females was higher; I have calculated an average difference of 4.45% in favour of males in the eight schools. This shows that as far as achievement in mathematics is concerned, there was inequity of achievement between the sexes in favour of males. Gender often arises in mathematics education because in some communities girls often underachieve in mathematics. Another result is that a Girls Only High School (see Table 1) was a top performer, scoring very high average marks compared to co-educational schools. This is in accordance with research findings that girls outperform boys when they learn in girls only schools. This result negates the myth that boys are better at mathematics than girls as in this case, the girls outmatched the boys. Perhaps we can say that girls learn much better when in Girls Only schools.

In two schools, boys and girls had equal pass rates; 0% and 4%. These were the worst performing schools, in these schools gender did not matter as all performed poorly.

In analysing the results in terms of gender and Curriculum 2005, it seems that there is little that can be said. One reason about this is that the study did not do prior studies on achievement before implementation of C2005.

Socio-economic Status and Curriculum 2005

In the study, one inner city school (see School A, Table 1) has 99.99% black learners. These learners mostly reside in the apartments in the city centre. This school showed clearly the issue of inequity as not even one learner male or female passed the test, i.e. scored more than 50%. On the contrary the other school in the suburbs (see School B, Table 1), quite far from the CBD it serves many white learners and a few coloured, Indian and black learners, but the majority of the teachers are white. Passes at this school were much higher compared with the inner-city school.

The Product Moment Rank Correlation Coefficient between the socio-economic statuses of schools in terms of the learners attending those schools against the mathematics score was calculated. A correlation coefficient of 0.63 was found. This seems to indicate that there is strong link between socio-economic-status of learners and mathematics achievement.

Table 2
Best Performing Schools for the Research Test 2007

School	Language	Gender	School Type	Average Mark
A	Home language other than English	Co-Ed	Ex Model C	27.5
B	Home language other than English	Co-Ed	Ex Model C	14.8
C	English	Co-Ed	Ex Model C	14.8
D	English	Girls	Ex Model C	17.7
E	English	Co-Ed	Ex Model C	16.0

Language and Curriculum 2005

Another important finding is that schools that took the tests in their home language performed better than those that took the test in a non-home language that was mainly English (see Table 2). This occurrence seems to be an issue of language proficiency and socio-economic-status. This is because; most schools that took the test in home language had learners from higher SES families; mainly white. Hence their performance was a mirror of their social status. I also presume that learners performed well because they learnt mathematics in their first language as Setati (2008) has argued. The other schools that did well were highly resourced schools attended by high SES learners. This is much in contrast to the majority of the test takers who took the test in English, where English is their second language. So the language issue is also important as it affects mathematics epistemic access.

Other Factors Impinging on Equity

One reason why there is inequitable mathematics achievement is that teaching mathematics itself is not equitable. This is mainly due to very different teacher qualifications and what the teachers understand to be good mathematics. Poorly qualified teachers regard mathematical understanding as capability to carry out mathematical calculations in order to find the correct answer. This is referred to as instrumental understanding (Skemp, 1976). Better qualified teachers regard relational understanding (Skemp, 1976) as more important. Learners and teachers who subscribe to instrumental understanding of mathematics are poor problem solvers, as they do not think conceptually in order to make sense of the mathematics problems.

The inequity in mathematics achievement need to be researched in the light of the factors: language, teacher qualification and resources. For now it appears that Curriculum 2005 is not impacting equity in mathematics education because other variables are interfering. Further indications are that some teachers who teach in less advantaged schools in the sample lacked mastery of the mathematics they were

teaching. The solution to this problem has been South Africa employing many expatriate mathematics teachers, notably from neighbouring Zimbabwe. Consequently, although Curriculum 2005 has noble intentions on equity there are many factors preventing it from realising its goals. Further research on how teacher qualifications, language and resources need to be undertaken to explain how they interact with the reform curriculum to enhance equity in mathematics education.

Given that this study was undertaken in the South African setting, what are the implications of the study to policy makers and researchers in other countries?

Conclusion and Discussion

As equity in mathematics learning and outcomes necessitates reform perspectives, reform curricula worldwide ought to delineate workable teaching and learning approaches that target enriching the learning experiences of disadvantaged children. One such approach discussed in this paper is that teaching disadvantaged learners be direct rather than implicit. It is not helpful for reform curricula to be too vague or imprecise about how its aims and objectives can be learnt particularly by traditionally underachieving learners.

As teachers mediate the curriculum, their levels of mathematics content and pedagogic knowledge affect curriculum delivery. Therefore, resources permitting, all mathematics teachers need to acquire high levels of mathematics content, pedagogic and curriculum knowledge as requisites to teaching mathematics. In this regard, inequitable mathematics teacher quality, compromises equitable mathematics learning.

In support of reform curricula with respect to equity, it is vital that teachers become aware and come to believe that every learner if sufficiently helped is able to learn mathematics successfully. In this vein, it is vital that mathematics teachers begin to realise the importance of giving up stereotyped views of some learners and begin to treat all learners equally irrespective of their gender, social or economic background.

Further, to boost equity, it is at times pragmatic to give preferential tutorial support to disempowered groups of learners until they reach a certain level of mathematics competency after which that preferential support may be withdrawn. Thus variable curricula approaches must be availed to different learners according to their needs. The curriculum ought not to be a one-size-fits-all jacket. Equally treating unequally performing learners is in itself is inequitable.

Granted that the net value of any curriculum innovation is direct improvement of learner knowledge and skills, it is pragmatic that reform curricula infuse important merits of traditional curriculum with the new curriculum; for instance the fact that traditional curricula has been standing for many years in many countries is evidence to some of its vital attributes that must be sustained. Also, it is crucial that curriculum reform is designed in consultation with major stakeholders particularly teachers, so that they feel ownership of the reform and appreciate its methodology and philosophy.

As this research has shown, there is a relationship between learners' home language and achievement in mathematics. Hence research needs to determine ways of unlocking learners' home languages for the purposes of boosting mathematics learning for all.

Also, in all communities, schools and teachers who have achieved equitable mathematics learning must be studied and benchmarked so that others can learn what it is they are doing right. Their equity excellence practices must then be appraised for transfer. In the same vein, given that performance in mathematics among countries is not equitable (see Reddy, 2003), it is instructive to invest in international benchmarking of countries which have attained high levels of equity in mathematics education. It is hoped that research in the directions raised in this paper will provide entry points for beginning to understand how reform curricula can help the enhancement of equity in mathematics learning and achievement.

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