KEYNOTE ADDRESS
GOOD INTENTIONS ARE NOT ACTIONS: MATHEMATICS EDUCATION OF SOUTH AFRICA
DEMANDS ACTION AND PRIDE FROM THE CITIZENRY

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Abstract–A desktop review of three educational systems is conducted to gain insight on factors that hinder quality mathematics education in South Africa. Mathematics performance of South African students has been repeatedly reported to be at a lowest level compared to other countries. Research has highlighted social class as an emerging strong factor in the system that plays a significant contribution in this low performance. This paper examines the barriers behind aiming for excellence in the mathematics education of the country. This examination uses the highest performing countries’ stories to set the bar and highlight challenges. The findings indicate that social class, teacher morale and mathematics knowledge, and curriculum instability are key areas that challenge the country’s mathematics education system. This paper recommends international teacher exchange programmes, curriculum stability that puts the student in the center using national assessments to improve practice rigorously, and attention to teacher welfare.

Key words: Reforms, Curriculum Stability, Mathematics Knowledge, Teacher Welfare, Excellency

INTRODUCTION
The 2011 TIMSS findings compared to 2002 indicate hope for South Africa, however only a rigorous plan can rescue the South African education esteem. South African history of segregation continues to evolve itself in different forms. The country emerged from Apartheid with a new emerging status of classism that continues to deprive the poor who unfortunately continue to be dominated by the Africans, Coloured and Indians who were deprived during Apartheid. The curriculum reforms after 1994 focused at replacing the old curriculum with the new. The new school curriculum that the Council of Education Ministers (CEM) decided on was the Outcomes-Based Education (OBE). This curriculum was introduced in 1998 to the General Education and Training (grades 1 to 9) band with a plan to phase it in to all grades including the Further Education Training (grades 10 to 12) band by 2005. That led to the curriculum known as Curriculum 2005 (C 2005). It is important to note that when this curriculum was implemented it was only 3 years into the democratic administration with all the apartheid segregated structures still in place. The inheritance of poor quality education for the previously disadvantaged communities was more visible in implementing C 2005. Reviews on C 2005 suggested changes that lead to the Revised Curriculum Statement that the cohort of students who participated in TIMSS 2011 went through since 2002 to 2011. South Africa is not unique in this journey of curriculum changes and reforms driven by political changes, South Korea and Singapore two of the top performing countries in TIMSS went through these curriculum reforms and have managed to have their students as the lead performers in TIMSS.

This paper aims to highlight the factors that impede South Africa in achieving mathematics student performance that moves towards excellent mathematics learning and practices. The questions this paper responds to are: (1) what are the factors behind the poor mathematics performance in South Africa with particular focus to curriculum implementation and teacher readiness? (2) What are the strengths and weaknesses of the South African education system in adapting towards raised mathematics performance for Excellency? In responding to these questions, the three countries’ curriculum reforms will be presented and analysed to identify strengths and challenges that hinder excellence in mathematics education. The selection of the two Asian countries in this paper is based on Excellency, and similar historic political changes to South Africa. The paper will therefore present
the literature review, the research design of the paper, the findings will also be presented followed by discussion and recommendations.

LITERATURE REVIEW

Curriculum reforms

Mathematics reforms have been driven by the democratic nature of ruling that originates from the need for “Mathematics for all” (WCER, 2009, 1). However, TIMSS results indicate performance that is skewed positively to certain countries compared to others. The mathematics performance gap between first world countries combined with Asian countries is huge against developing countries. This gap can be associated with the curriculum students are engaged with and attain. Kilpatrick (2009) suggests that there are multiple ways of viewing school curriculum such as: “Intended: The administrator’s point of view; Implemented: The teachers’ point of view; and Attained or realized: The students’ point of view.” (p.109). This suggestion assumes that the curriculum inspiration drizzles directly from administrator to teacher to student, a questionable approach as Kilpatrick views intended curriculum as a “blue print” than a curriculum (Kilpatrick, 2009, 109). Hence, Kilpatrick defines curriculum as reality than the intended. The shortcomings of using intended curriculum as the benchmark in describing students’ performance can be observed in the students’ mathematics performance in TIMSS that reflects on the implemented curriculum than the intended one. As WCER (2009) states that “students are either tested on mathematical content they have not had the opportunity to learn, or they are tested on only a small part of what they have learned”(p.1). The aforementioned literature reveals the importance of the role of the teacher in the realization of curriculum although the teacher has no role in the designing of the curriculum. The definition of the curriculum regarding the assessments is challenged. Whose curriculum should be assessed from the three views used in the international assessments? If intended curriculum is accepted as the curriculum, who is being assessed by the international assessments, the administration, the teacher or the students? Therefore, it is important to note that international assessments are a benchmark for the education system not for reflecting on student knowledge. Regardless of the responses the teacher seems to be the core in delivering the curriculum. Klyeleve (2009) suggests the importance of teacher’s attitudes towards curriculum reform.

Curriculum reform in South Africa

Generally the curriculum reform in South Africa has been political driven. Moutin et al (2012) indicated that South African history and the curriculum changes after apartheid disabled education. They support their claim by reflecting on the National Senior Certificate results that indicated shortcomings of the outcome based education, also poor performance of South African learners in international studies such as TIMSS. Jansen and Taylor (2003) highlighted the major factors that had a greater impact in this disabling of education such as, inequities that the government struggles to address, and impact of HIV and AIDS in schooling. Bennie and Newstead (1999) suggested details of how teachers and schools were challenged by the new curriculum. According to them the documents provided by the department of education to guide were too technical and complex for teachers. In addition, they also highlight that the documents themselves lacked quality, as they had some errors, omissions and inappropriate content specifically in the foundation phase. With such challenges implementation of the new curriculum became difficult for teachers.

Mathematics curriculum reform in South Africa

Research on curriculum changes and implementation in mathematics education does not give evidence that is too far from the general curriculum change debate. Molefe and Brodie (2010) also highlight the shortfall of the curriculum documents in differentiating between the traditional practices with the reform accounts. This supports Jansen and Taylor (2003) in their critique of the quality of the curriculum documents. Sidiropoulos (2008) support this literature by indicating that classroom practices of mathematics teachers remain unaffected in spite of their enthusiasm in agreement with the reform. Parker (2006) reports noticeable changes regarding the approach to
mathematical knowledge and pedagogy suggested by the new curriculum. However, as indicated by Sidiropoulos (2008) practice remains unchanged.

Teacher preparedness
In highlighting characteristics of schools attended by students from low socio economic backgrounds teacher qualification is one of the factors that contribute to the quality of education received by students. Teacher knowledge has significant role on the instruction. Researchers reveal that the mathematics content knowledge and mathematics pedagogy knowledge are intertwined and interdependence for effective teaching of mathematics (Blömeke et al, 2011). Teacher knowledge for teaching mathematics involves multiple components. Smidt et al (2011) and McTighe & Seif (2011) suggest three types of knowledge needed by teachers that are: Mathematics content knowledge (MCK), Mathematics Pedagogy knowledge (MPK) Mathematics Pedagogy Content Knowledge originating from Shulman’s work on teacher knowledge. Findings of the studies that investigate the relationship between mathematics teacher knowledge for teaching and students’ mathematics performance reveal that improving teachers’ mathematical knowledge plays a significant role in students’ mathematics performance (Smidt et al, 2011; Hill et al, 2005; Feza & Diko, 2013). Blömeke et al (2011) reveal the interdependence of teacher mathematics knowledge and teacher mathematics pedagogy content knowledge in contributing to mathematics student performance. This suggests that mathematics knowledge alone is not enough as a requisite for teacher training. However, this knowledge is of no use if teacher morale is low.

Teacher morale
Teacher morale plays a significant role in quality teaching and learning as knowledge alone does not stimulate enthusiasm. Literatures suggest a number of factors that contributes towards teacher morale Perumal (2011) elicit that sources of low teacher morale are student-related, academic instruction with curriculum, teacher support, administrative challenges, and relationship problems. Perumal (2011) adds that students lack of commitment to their learning, their increasing levels of disrespect towards teachers and school and high absenteeism rate of students demotivate teachers in doing their job. Sandra Nichols cited by Perumal (2005) states that “Teachers suffer from low morale due in part to the low-pay-high-cost-of-living gap.”(p.6) Steyn (2002) also highlights salaries as one of the extrinsic motivating factor on teacher morale. In addition lack of support from parents, management and peers contributes to low teacher morale (Hendricks, 2009).

RESEARCH DESIGN
A qualitative desktop review of the three educational systems is conducted to extract lessons and determine areas of strengths that can be used in the South African system to achieve Excellency in mathematics education.

Participants
The participants of this study are three selected systems of education: South Africa, South Korea and Singapore.

In highlighting challenges in the South African mathematics education Singapore and South Korea are selected as models for Excellency in mathematics performance and history of colonization that is similar to the history of South Africa. These two countries stories are used to determine strengths if there are any and challenges that the South African system has on its way to excellency in mathematics education.
Table 1 reveals the consistency of high quality performance South Korea and Singapore demonstrate in the TIMSS findings. The highlights on the table indicate that since 1999 these two countries have maintained being the top two performing countries except in 2003 consecutively.

History of colonization

Singapore

According to Lambert (1994) in 1824 Singapore was officially a British colony until 1941. In 1942 it was taken by Japanese for three and half years and went back to British administration in 1946. Singapore gained self-government in 1959 after a Constitutional agreement was signed in London. In 1961 a merger was formed between the Federation of Malaysia, Singapore, Sarawak, North Borneo and Brunei and Malaysia was formed in 1963 with Brunei opting out. In 1965 Singapore was separated from Malaysia and became an independent, democratic country (Lambert, 1994).

South Korea

Korea was under the Japanese rule from 1910 to 1945 (Yukhoon, 2007). It took Korea a long time to be empowered enough to fight for their independence as in other colonized nations their lives were hardened under the Japanese Empire. Unfortunately, the liberation of Korea divided Korea into two: South Korea and North Korea with different allies. South Korea became an associate of the United States while North Korea became an associate of the Soviet Union until today (Yukhoon, 2007).

In summary these two countries have experienced what South Africa has although the experiences are unique to each country. Each of these three countries’ citizens knows how it is not to have a voice in your children’s education. They also experienced backlog when they received liberation that were intertwined with challenges in moving forward. For these commonalities South Africa can learn some strategies in facing its' challenges.

Data Collection

Desk top review of the mathematics education processes of each country. The following table present a list of sources used during the desktop review to obtain the synthesised data:

<table>
<thead>
<tr>
<th>Author</th>
<th>Citation</th>
<th>Relevancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center on International Education benchmarking</td>
<td>South Korea Overview <a href="http://www.ncee.org/programs-affiliates/center-on-international-education-benchmarking/top-performing-countries/south-korea-overview/">http://www.ncee.org/programs-affiliates/center-on-international-education-benchmarking/top-performing-countries/south-korea-overview/</a></td>
<td>South Korea education</td>
</tr>
<tr>
<td></td>
<td>South Korea Education reforms <a href="http://asia.society.org/education/learning-world/south-korean-education-reforms">http://asia.society.org/education/learning-world/south-korean-education-reforms</a></td>
<td></td>
</tr>
</tbody>
</table>
Data Analysis
Two methods of analysis are employed in this paper an analytical framework and a thematic approach. Analytical Framework is employed in this paper for it’s power in organising data using codes (Gale et al., 2013). Then later the codes were triangulated for trust worthiness and allowing themes to merge. This approached makes it easy to conduct a thematic analysis in this paper.

FINDINGS
Curriculum landscapes

South Korea
South Korea has been reformed six times since 1955 to 1999 because of the changes in leadership of the government. Below Table 1 presents in detail these reforms.

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Years</th>
<th>Reasons</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>National curriculum</td>
<td>1955 - 1962</td>
<td>First national curriculum in South Korea</td>
<td>7 years</td>
</tr>
<tr>
<td>Quantitative expansion of the national curriculum</td>
<td>1963 - 1972</td>
<td>After the military revolution</td>
<td>9 years</td>
</tr>
<tr>
<td>National Curriculum enhancing national quality, human education, knowledge and technical education</td>
<td>1973 - 1981</td>
<td>Amendment of the national constitution</td>
<td>8 years</td>
</tr>
<tr>
<td>Curriculum appropriate to Korean context</td>
<td>1982 - 1988</td>
<td>New military office in power, assassination of the former president</td>
<td>6 years</td>
</tr>
<tr>
<td>Maintaining the framework of the curriculum appropriate to Korean context</td>
<td>1989 - 1994</td>
<td>Democratic government in power</td>
<td>5 years</td>
</tr>
<tr>
<td>Curriculum cultivating morality and creativity</td>
<td>1995 - 1999</td>
<td>Democratic government cultivating morality, and creativity</td>
<td>4 years</td>
</tr>
<tr>
<td>2000 - present</td>
<td></td>
<td>Promoting students’ learning</td>
<td>+12 years</td>
</tr>
<tr>
<td>2005 - present</td>
<td></td>
<td>Established on demand curriculum revision</td>
<td>+8 years</td>
</tr>
<tr>
<td>Present</td>
<td></td>
<td>Aligning curriculum with knowledge based society</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 indicates clearly that in South Korea curriculum changes were political driven with political agendas from 1955 to 1999. When the democratic government took over the changes were driven by the needs from Korean identities to Korean values and maintaining Korean dignity between 1989 and 1999. Beyond 1999 the curriculum reforms began to focus to students’ learning and children and parents treated as consumers. The core curriculum has been kept stable and evolution of knowledge incorporated continuously.

Singapore
Singapore designed their first curriculum reform in 1965 that was a uniform curriculum between the years 1965 to 1980. This phase of reform brought stability in school management but it was weak in bilingual policy, had low literacy levels and high expenditure. The second reform was informed by a review conducted in educational system in 1979 and the curriculum was one of the highlighted areas than needed attention. The reform led to the launch of the Curriculum Development Institute of Singapore (CDIS) to develop curriculum and teaching materials and to implement a New Education System (NES). Improving mathematics and science curricula in both primary and secondary schools was one of the major priorities in the responsibilities allocated to the CDIS.
Table 4: Timeline on curriculum changes in Singapore from 1965

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Years</th>
<th>Reasons</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piloting method of teaching English language</td>
<td>1971 -1973</td>
<td></td>
<td>3 years</td>
</tr>
<tr>
<td>Piloting methods of teaching Chinese language</td>
<td>1974 – 1976</td>
<td></td>
<td>2 years</td>
</tr>
<tr>
<td>Trial approach to revise and replace general science syllabus</td>
<td>1974 – 1978</td>
<td></td>
<td>4 years</td>
</tr>
<tr>
<td>Institutionalized innovations in curriculum development</td>
<td>1980 – 1995</td>
<td>Reducing education wastage and promote more effective learning</td>
<td>15 years</td>
</tr>
<tr>
<td>Textbook market liberalization</td>
<td>1996 – 2006</td>
<td>Becoming a national recognized publisher for a decade</td>
<td>10 years</td>
</tr>
<tr>
<td>PANPAC education</td>
<td>1990 – Present</td>
<td>To gain international publishing capabilities in Brunei, China, United States, Malaysia, Caribbean, Pakistan, Vietnam, Thailand, Indonesia. Other developing countries have already invited PANPAC to assist them develop their own textbooks e.g. Egypt</td>
<td></td>
</tr>
</tbody>
</table>

Table 4 indicates that the reform was driven by change in government in 1967, however Singapore used a research based approach in reforming their curriculum with more focus on effective textbooks production. They maintained a core curriculum and have more influence on competitive textbook marketing which later became international recognized and used. The drive behind this reform was business based that increase competitiveness.

South Africa

In South Africa the similar changes of three reforms occurred from 1997 to 2009, however driven by different needs. In the beginning with the first curriculum was driven by the need to have a new curriculum after apartheid government (1998-2000). The second reform (2002-2009) was revised because of the teething problems of the democratic government such as inequitable infrastructural resources, teacher competencies, shortage of human resources and lack of quality supporting materials. However, the teething problems of the democratic government and ambitious goals of education led to lack of implementation plan of the revised curriculum, too much/many guidelines and interpretation of policies and unclear roles of subject advisors.

Below Table 5 presents changes in school curriculum implemented in South Africa post 1994, reasons for changes and teacher readiness.

Table 5: Timeline on curriculum changes in South Africa from 1994

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Years</th>
<th>Reasons</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interim syllabus</td>
<td>1995 - 1997</td>
<td>Changing from Apartheid system to the democratic system</td>
<td>2 years</td>
</tr>
<tr>
<td>Curriculum 2005</td>
<td>1998 - 2001</td>
<td>Skewed curriculum, lack of human resources for implementation, curriculum and assessment policy not aligned policy overload, no classroom transferability, inadequate teacher training, and inequitable quality of materials.</td>
<td>3 years</td>
</tr>
<tr>
<td>Revised National Curriculum Statement</td>
<td>2002 - 2011</td>
<td>Lack of a plan for implementation, an overabundance of policies, guidelines and interpretations of policies and guidelines at all levels of the education system, and unclear role of subject advisor.</td>
<td>9 years</td>
</tr>
<tr>
<td>Curriculum Assessment Policy Statement</td>
<td>2012</td>
<td>Currently implemented</td>
<td></td>
</tr>
</tbody>
</table>

Table 5 shows that the South African reform had similar historical nature of changing from an old government to the new government like the other two Asian countries. However, the curriculum changes in South Africa indicate curriculum design challenges and teacher preparedness compared to the citizenry shown by the other countries and an element of too much excitement. Firstly the curriculum was skewed, not aligned with assessment and inadequate teacher training. Again the following revision did not indicate any improvement on the teacher preparation and implementation, lack of human resources continues to be a challenge to implementation. However, too much jargon continues to overwhelm implementers.
Summary of the three countries reform approaches

The Singapore approach in curriculum reforms brings in the strength of conducting research prior rolling out rather than conducting reviews of what failed. This approach controls unnecessary waste of funds and resources. Excellence is another element that drives the Singapore approach by treating students and parents as consumers and striving for national and international recognition and leadership. The status of PANPAC education proves that Singapore education system has international status and continues to influence education globally.

South Korean reforms have lots of similarities with the South African reforms. The democratic government of Korea faced similar challenges of bringing back Koreans human dignity, values and creativity that were lost during the colonization regime. Therefore similar to South Africa their curriculum reforms aimed at restoring identities, values and creativity. However, the time spent on restoring the South Korean dignity was only 9 years, their focus skewed to student learning. Their curriculum developments ensured that the student is learning continuously.

South African reforms were driven by the need to rectify the South African history of oppression and division. This objective continues to be the focus of South African reforms to an extent that the curriculum reforms fail to bring the student at the center of the planning. The multiple interpretations of policies and guidelines indicate lack of clarity on the main objectives of the education. Teacher readiness continues to lag behind in the South African curriculum reform. Lack of prompt intervention strategy through pilot studies exhaust resources and impede progress.

Mathematics Teacher Readiness

Research has proven the vital role played by the teacher in student learning hence teacher readiness is important for any curriculum reform (Schmidt et al, 2011). Teacher readiness for curriculum reforms plays a significant role in the coverage of the curriculum at hand as it is the teacher who exposes students to the curriculum using effective strategies. Reflecting on teacher readiness will assist in understanding the depth of the curriculum coverage that can be associated with students’ performance. The three countries

South Korean Teacher readiness

South Korea teacher education was highly influenced by the government changes. Therefore their teacher education is reported from their first democratic government in 1994. Teacher profession had a sacred position in the Korean society. However, their struggle to legalize the Korea Teachers and Workers Union (KTWU) changed this status for teachers influencing teacher policies too. Table 6 presents the evolving status of Korean teacher education.

<table>
<thead>
<tr>
<th>Year</th>
<th>Teacher status</th>
<th>Challenges</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>Weakened teacher morale</td>
<td>Economic crisis Inequitable teacher retirement age reduced from 65 to 62, a reduction that was heavier compared to other sectors.</td>
<td>Comprehensive Plan to Develop the Teaching Profession announced in 2001 to heighten teacher morale</td>
</tr>
<tr>
<td>1997</td>
<td>Teacher supply decreased caused by increased demands on teachers by the seventh curriculum</td>
<td>In 1999 the Ministry of Education proposed a policy plan that creates “teaching profession full of zeal to teach and the pride to teach”</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>Low teacher morale</td>
<td>Hostility towards teachers.</td>
<td>Announcement of the “Comprehensive Plan to Develop the Teaching Profession” Measures to boost teacher morale 1)Reduced teacher work load by increasing the size of teacher quota 2)Increase teacher salaries 3)improve teacher welfare through research 4)Encourage teacher participation in competing for research projects 5)Increase support from volunteers</td>
</tr>
</tbody>
</table>

Table 6 reveals that Korean teachers went through many challenges that weakened their morale and affected the number of candidates to the field. South Korean Ministry of Education worked
energetically to fix this status by addressing teacher grievances directly. They nurtured the status of the teacher through reduction of workload, increasing salaries, improving teacher welfare, developing the research culture amongst teachers and increased support from volunteers.

**Singapore Teacher readiness**

Singapore teacher education went through changes in different time during 1960s the country faced with teachers with low moral due to their six day teaching strategy that led to exhaustion and demotivation. In 1962 the Singapore government recognized this plight and decided to take action. Table 7 presents the evolution of teacher preparation in Singapore over the years

<table>
<thead>
<tr>
<th>Year</th>
<th>Teacher status</th>
<th>Challenges</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962-1965</td>
<td>Exhaustion from the six day work a week</td>
<td>Importing teachers outside the country</td>
<td>Recruiting teachers in training to assume partial teaching responsibility while in training. Give female teachers equal pay as male counterparts.</td>
</tr>
<tr>
<td>1966</td>
<td>Routine work dominated teacher work with no time for reflection, innovations and self-improvement</td>
<td>Number of pupils increased and teacher quality compromised</td>
<td>More teachers recruited</td>
</tr>
<tr>
<td>1970-1973</td>
<td>Teacher demand stabilized</td>
<td>Teacher quality</td>
<td>A one stop teacher training institution was established the Institute of Education (IE) with the mission to improve quality of teaching in schools.</td>
</tr>
<tr>
<td>1973-1999</td>
<td>Professional status</td>
<td>Teacher quality</td>
<td>Upgrading professional standards by appointing Dr William Taylor from the University of London’s Institute of Education and providing grants to faculty to pursue higher degrees. Collaborating with overseas reputable colleges to enhance the Singapore education and its degrees.</td>
</tr>
<tr>
<td>1996</td>
<td>Improved teacher quality</td>
<td>Teacher retention</td>
<td>Continuous teacher upgrading and professional development, providing good salaries and promotion prospects in the education service, give incentives to teacher trainees in form of teacher salary with service benefits instead of bursary.</td>
</tr>
<tr>
<td>2001</td>
<td>Highly remunerated and receive incentives for excellency in their job</td>
<td>Promotion tracks and performance incentives were put in place for teachers. A new system of assessing teacher performance introduced to all schools.</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>Nation’s quality teachers</td>
<td>Excellence in teacher education</td>
<td>Development of a comprehensive teacher education framework that uses an expert consensus-building approach; a research-based approach; and a professional-consensus approach.</td>
</tr>
</tbody>
</table>

Table 7 indicates that Singapore teacher education evolved continuously as the needs rise. The Singaporeans approach in addressing teacher education is always inclusive of quality. When there was a demand for more teacher recruitment involved quality training. When there was a need to retain teachers retention approach did not only focus on incentives but professionalism, continuous learning, excellence and accountability through teacher performance assessment. Singapore provides induction to new teachers in order to maintain quality, encourage professionalism and motivate teachers. The status of the teacher in Singapore is high and therefore teachers themselves are used as experts, researchers, and professionals in maintaining quality teachers.

**South African Teacher Readiness**

South African teacher evolution share similar challenges with Singapore and South Korea. Teacher status and quality during the democratic era evolved at different levels. In conceptualizing the inherited challenges of the apartheid regime the National Teacher I Education Audit (1995) was conducted. This audit revealed that the general teacher education “quality was poor, inefficient and cost-ineffective” (2005, p. 3). Table 6 presents the evolution of teacher education in South Africa post 1994.
Table 8: Teacher evolution in South Africa from 1995

<table>
<thead>
<tr>
<th>Year</th>
<th>Teacher status</th>
<th>Challenges</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>Disaggregated teachers</td>
<td>Varied quality of teacher training in historical colleges</td>
<td>Incorporation of teacher education colleges</td>
</tr>
<tr>
<td>2001</td>
<td>Varied teacher qualifications</td>
<td>Unequal standards of colleges of teacher education</td>
<td>Colleges of education incorporated to Universities to improve the quality of teacher education programmes</td>
</tr>
<tr>
<td>2002 – 2006</td>
<td>Varied teacher qualification</td>
<td>Scarcity of materials to serve the incorporated education sectors</td>
<td>Catering for teachers with lower qualifications through a National Professional Diploma in Education through bursaries</td>
</tr>
<tr>
<td>2007–current</td>
<td>Declined interest in teaching and morale for teaching</td>
<td>Enrolments of teacher trainees went down</td>
<td>Fundza Lushaka comprehensive bursary for teacher training was launched Increased interest on teacher training</td>
</tr>
</tbody>
</table>

Table 8 reveals that South African incorporation of colleges was done without planning and looking on the impact the incorporation will have on producing teachers. Hence the shortage of teachers for certain subjects and rural schools came into place. The in-depth of inequalities was not properly addressed prior to designing catch up programmes. Teacher morale has been attended to through the comprehensive bursary to attract more teachers, however improving teacher morale of the practicing teacher still needs attention.

**Students’ Mathematics Performance on Cognitive Domains**

Below the cognitive performance of students from the three countries are presented. All three figures reveal an equal distribution of knowledge across the three domains.

**Singapore**

![Figure 1: Singapore’s eighth grade students’ mathematics performance on cognitive domain](image1)

Figure 1 indicates that Singapore students are slightly stronger on knowledge followed by ability to apply the knowledge. Reasoning abilities are slightly lower than knowledge and application.

**South Korea**

![Figure 2: South Korea’s eighth grade students’ mathematics performance on cognitive domains](image2)
Figure 2 reveals equal distribution of knowledge and application followed by reasoning that is slightly lower.

**South Africa**

![Figure 3: South African ninth grade students’ mathematics performance on cognitive domains](image_url)

South African students in Figure 3 indicate strength in reasoning than knowledge and slightly lower in application of knowledge. In addition their performance is below the international mean which is 500.

**DISCUSSION**

The findings of this paper are discussed by highlighting challenges in the South African mathematics education followed by lessons to be learnt from the two selected Asian countries.

**Challenges in South African mathematics education**

The findings of this paper highlight a number of challenges from the South African education, which are in different levels. The discussion will first focus on the challenges that are emerging from this paper and within those challenges influential factors will be highlighted. Curriculum reform, teacher preparedness, and student performance emerge from this paper as the challenges the education has.

**Curriculum reform**

The findings presented in this paper highlight the importance of teacher preparedness, curriculum stability, research based approach and putting a child in the center of reform as strengths of curriculum reforms. South African data indicates challenges in curriculum reforms because of the influential factors such as not having mathematical skilled human resources, inability to put a child as the center of reform, not aiming for curriculum stability, and not rolling out research based curriculum for effective practice. According to Howie (2003); Adler (2009) and Feza (2012) the lack of mathematical skilled human resource indicates the significant role social class has in the mathematics education of South African students. This lack of mathematical skilled human resource reflects to the country’s affluence in being able to produce such skill.

The inability to put the child as the center of the curriculum reform reflects miscommunication and misunderstanding of role of international assessments. For example, Kilpatrick’s (2009) detailed account on intended curriculum suggests that expecting students to perform well on intended curriculum is senseless rather than expect them to perform on the implemented curriculum. As suggested by Douglas (2009) the findings of the international assessments are not reporting students’ performance rather they report the mathematics education system’s performance of a country. I infer that the poor mathematics student performance on international assessments reflects the mathematics education system not students’ abilities. Hence, national assessments should be used to inform and improve teaching and learning of students.

Curriculum reforms have to happen when changes in the government happens, however the student should be the center of the change. The findings of this paper reveal that the student and parent should be treated as consumers, active teacher involvement as experts in curriculum reform is crucial and curriculum stability will be the starting point to maintain quality education.
Teacher preparedness
These findings also highlight the impact teacher morale has on improved quality mathematics education. Lessons from this data indicate that teacher complaints cannot be ignored for better education in general. Teacher salaries, work conditions, teacher health have significant impact on students’ success. Hence these findings reveal that improved teacher well-being develops teacher attitude for the benefit of the education as it happened in South Korea. Teacher education has to be intertwined with quality for better student output. Improving the status of the teacher holistically, using them as experts, researchers, and professionals is more rewarding in maintaining quality teachers a lesson from Singapore. In this paper, South African findings highlights low teacher morale, poor teacher knowledge, severe inequalities in the education system as main factors that continue to impede success in mathematics teaching and learning. Chilsom (2009) support these findings bringing forth their contribution to low teacher morale.

Student performance
South African student performance highlights reasoning abilities South African students have. However, these reasoning abilities are hindered by the lack of knowledge. Hence South African students perform below the international mean in general. These findings support Smidt et al (2011) in their findings that poor performing students in TIMSS are taught by teacher with poor mathematics content knowledge. Hence they propose together with Hill et al (2005); Feza & Diko (2013) that teacher mathematics knowledge needs to be improved for better mathematics learning. Adler (2009) suggests that in addition teachers’ knowledge for teaching has a significant role.

RECOMMENDATIONS
This paper recommends that South Africa accept that there is lack of expertise in the mathematics education and the country on its own cannot deal with this challenge. I recommend that the country engage with international counterparts on teacher exchange programmes to assist in addressing the lack of expertise. Mathematics teacher education needs to re-visit the admission requirements and strategies of increasing mathematical knowledge of student teachers. Improving teacher morale through incentives and addressing salary plight teachers have is no longer a debatable issue, and allowing teacher to become experts in their fields through research and incentivize attainment of such skills. On policy level, it is time for curriculum stability and focus on effective learning by putting the student where s/he belongs in the center. It is time for parents to roll their sleeves and be involved in quality education provisioning of their children.

REFERENCES


