

## KEYNOTE ADDRESS

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

Nosisi N Feza  
Institute of Science and Technology Education  
University of South Africa  
South Africa  
Email: [Nosisi.piyose@gmail.com](mailto:Nosisi.piyose@gmail.com)

**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.

## Excellency

**Table 1: Top ten performing countries in TIMSS since 1999**

1999	2003	2007	2011
Singapore	Hong Kong SAR	Korea Republic of	Korea Republic of
Korea Republic of	Japan	Singapore	Singapore
Chinese Taipei	Chinese Taipei	Hong Kong SAR	Chinese Taipei
Hong Kong SAR	Belgium-Flemish	Japan	Hong Kong SAR
Japan	Netherlands	Hungary	Japan
Belgium-Flemish	Latvia	England	Russian Federation
Netherlands	Lithuania	Russian Federation	Israel
Slovak Republic	Russian Federation	United States	Finland
Hungary	England	Lithuania	United States
Canada	Hungary	Czech Republic	England

Source: Adapted from Reddy, V., Winnaar, L., Visser, M., Feza-Piyose, N., Arends, F., Prinsloo, C.H., Mthethwa, M., Juan, A. & Rogers, S. (2013). Highlights from TIMSS 2011 South Africa

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: 2 List of sources reviewed for this paper**

Author	Citation	Relevancy
Center on International Education benchmarking	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>	South Korea education
	South Korea Education reforms <a href="http://asiasociety.org/education/learning-world/south-korean-education-reforms">http://asiasociety.org/education/learning-world/south-korean-education-reforms</a>	
Sorensen, C. W. (1994)	Success and Education in South Korea, Comparative Education Review, 38(1), 10-35 <a href="https://csde.washington.edu/~scurran/files/readings/SIS511/sorensonEducation.pdf">https://csde.washington.edu/~scurran/files/readings/SIS511/sorensonEducation.pdf</a>	Reform and success
Lambert, T (1994)	A brief History of Singapore. Retrieved at <a href="http://www.singaporeexpats.com/about-singapore/brief-history.htm">http://www.singaporeexpats.com/about-singapore/brief-history.htm</a> by 15 December 2012.	Singapore Education

## 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 3: Timeline on curriculum changes in South Korea from 1955**

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

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**

Curriculum	Years	Reasons	Duration
Chinese Edition of the civics syllabus	1967 – 1978	Gaining independence in 1965	11 years
Piloting method of teaching English language	1971 -1973		3 years
Piloting methods of teaching Chinese language	1974 – 1976		2 years
Trial approach to revise and replace general science syllabus	1974 – 1978		4 years
Institutionalized innovations in curriculum development	1980 – 1995	Reducing education wastage and promote more effective learning	15 years
Textbook market liberalization	1996 – 2006	Becoming a national recognized publisher for a decade	10 years
PANPAC education	1990 – Present	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	

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**

Curriculum	Years	Reasons	Duration
Interim syllabus	1995 - 1997	Changing from Apartheid system to the democratic system	2 years
Curriculum 2005	1998 - 2001	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.	3 years
Revised National Curriculum Statement	2002 - 2011	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.	9 years
Curriculum Assessment Policy Statement	2012	Currently implemented	

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 6: Teacher evolution in South Korea from 1994**

Year	Teacher status	Challenges	Solutions
1999	Weakened teacher morale	Economic crisis Inequitable teacher retirement age reduced from 65 to 62, a reduction that was heavier compared to other sectors.	Comprehensive Plan to Develop the Teaching Profession announced in 2001 to heighten teacher morale
1997		Teacher supply decreased caused by increased demands on teachers by the seventh curriculum	In 1999 the Ministry of Education proposed a policy plan that creates "teaching profession full of zeal to teach and the pride to teach"
2001	Low teacher morale	Hostility towards teachers.	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

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 7: Teacher evolution in Singapore from 1962**

Year	Teacher status	Challenges	Solutions
1962 - 1965	Exhaustion from the six day work a week	Importing teachers outside the country	Recruiting teachers in training to assume partial teaching responsibility while in training Give female teachers equal pay as male counterparts
1966	Routine work dominated teacher work with no time for reflection, innovations and self-improvement	Number of pupils increased and teacher quality compromised	More teachers recruited
1970-1973	Teacher demand stabilized	Teacher quality	A one stop teacher training institution was established the Institute of Education (IE) with the mission to improve quality of teaching in schools.
1973 - 1999	Professional status	Teacher quality	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 it's degrees.
1996	Improved teacher quality	Teacher retention	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.
2001	Highly remunerated and receive incentives for excellency in their job		Promotion tracks and performance incentives were put in place for teachers. A new system of assessing teacher performance introduced to all schools.
	Beginning teachers receive induction		Inducted through talks, enrichment courses prior leaving school for full time teaching jobs. At school level mentoring sessions are offered.
2003	Nation's quality teachers	Excellence in teacher education	Development of a comprehensive teacher education framework that uses an expert consensus-building approach; a research-based approach; and a professional-consensus approach.

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 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**

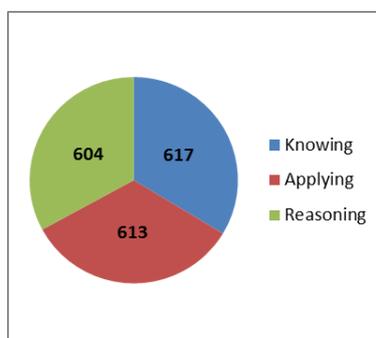
Year	Teacher status	Challenges	Solution
1994	Disaggregated teachers	Varied quality of teacher training in historical colleges	Incorporation of teacher education colleges
2001	Varied teacher qualifications	Unequal standards of colleges of teacher education	Colleges of education incorporated to Universities to improve the quality of teacher education programmes
2002 – 2006	Varied teacher qualification	Scarcity of materials to serve the incorporated education sectors	Catering for teachers with lower qualifications through a National Professional Diploma in Education through bursaries
2007-current	Declined interest in teaching and morale for teaching	Enrolments of teacher trainees went down Supply of teachers in certain subject such as language, mathematics and science went down Poor teachers attendance in school reported Lots of teacher strikes about teaching conditions, and teacher salaries	Fundza Lushaka comprehensive bursary for teacher training was launched Increased interest on teacher training

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.

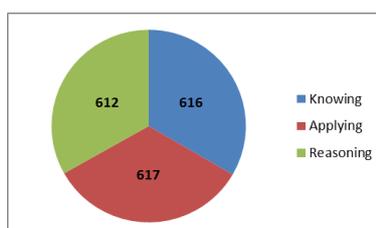
#### Singapore



**Figure 1: Singapore’s eighth grade students’ mathematics performance on cognitive domain**

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**

Figure 2 reveals equal distribution of knowledge and application followed by reasoning that is slightly lower.

### South Africa

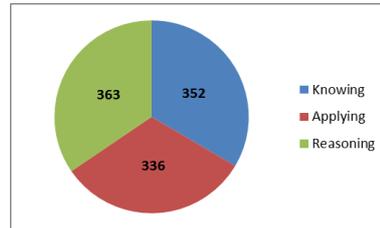


Figure 3: South African ninth grade students' mathematics performance on cognitive domains

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' inabilities. 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

- Adler, J. (2009). Mathematics for teaching matters. In Hurst, C. et al (Eds.) *Mathematics: Its Mine: Proceedings of the 22nd Biennial conference of the Australian Association of Mathematics Teachers INC. AAMT. Adelaide*. Pp. 3-6
- Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., Klusmann, U., Krauss, S., Neubrand, M., & Tsai, Y. (2010). Teachers' Mathematical Knowledge, Cognitive Activation in the Classroom, and Student Progress, *American Educational Research Journal*, 47(1), 133-180.
- Bennie, K., & Newstead, K. (1999). Obstacles to implementing a new curriculum. In M. J. Smit & A. S. Jordaan (Eds.), *Proceedings of the National Subject Symposium*, 150-157. Stellenbosch: University of Stellenbosch.
- Blömeke, S., Suhl, U., & Kaiser, G. (2011). Teacher Education Effectiveness: Quality and Equity of Future Primary Teachers' Mathematics and Mathematics Pedagogical Content Knowledge. *Journal of Teacher Education*, 62, 154-171.
- Byrd-Blake, M., Afolayan, M. O., Hunt, J. W., Fabunmi, M., Pryour, B. M., & Leander, R. (2010). Morale of Teachers in High Poverty Schools: A Post-NCLB Mixed Methods Analysis, *Education and Urban Society*, 42(4), 450-472.
- Douglas, J. (2005). Transformation of the South African schooling system: Teacher Professionalism and Education Transformation, The Centre for Education Policy Development, Braamfontein.
- EFA (2005). The Impact of education quality on development goals. *Global Monitoring Report*.
- Feza-Piyose, N. (2012b). Language a cultural capital for conceptualizing mathematics knowledge. *International Electronic Journal of Mathematics Education*, 7(2), 62-79.
- Feza, N. (2013). Looking beyond the Gap of African American students' performance: States Test and Text book driven curriculum unskill mathematics teachers. *International Journal of Research and Reviews in Applied Sciences*, 14(1), 90-99.
- Feza, N., & Diko, N. (2013). Building on using the strengths of mathematics teacher education in South Africa, *Global Research Journal on Mathematics and Science Education*, 2(1), 34-49.
- Gale, K. N., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for analysis of qualitative data in multi-disciplinary health research, *BMC Medical Research Methodology*, 13,117 retrieved at <http://www.biomedcentral.com/1471-2288/13/117> by 22 August 2014.
- Hans-Martin, F. (2007). Vulnerability: A generally applicable conceptual framework for climate change research, *Global Environmental Change*, 17, 155-167.

Hendricks, E. (2009). Good Practice Guidelined for Improving Educator Morale. Unpublished-Thesis submitted in Nelson Mandela Metropolitan University for the Magister in Business Administration. 13, 117 doi:10.1186/1471-2288-13-117.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of Teachers' Mathematical Knowledge for Teaching on Student Achievement, *American Educational Research Journal* 42(2), 371-406.

Howley, A., Larson, W., Andrianaivo, S., Rhodes, M., & Rhodes, M. & Howley, M. (2007). Standards-Based Reform of Mathematics Education in Rural High Schools, *Journal of Research in Rural Education*, 22(2), 1-11.

Jansen, J. & Taylor, N. (2003). Educational Change in South Africa 1994-2003: Case Studies in Large-Scale Education Reform, *Country Studies Education Reform and Management Publication Series*, 2(1).

Kleve, B. (2013). Social inequalities, meta-awareness and literacy in mathematics education, *Research in Mathematics Education*, 15(2), 197-198.

Kilpatrick, J. (2008). *The mathematics teacher and curriculum change*. Paper presented at the meeting ProfMat2008, Elvas, Portugal.

Kyeleve, I. J. (2009). The Influence of National Curriculum Reform on Teachers' Attitudes to and Practices of Modelling, as Mediated through three Different Implementations, *Brunei International Journal of Science & Mathematics Education*, 1(1), 85-99.

Lambert, T. (1994). A brief History of Singapore. Retrieved at <http://www.singaporeexpats.com/about-singapore/brief-history.htm> by 15 December 2012.

Liu, W. M. (2011). Social Class, Classism, and Mental and Physical Health. In William M Liu (Eds). *Social Class and Classism in the Helping Professions: Research Theory and Practice*. Sage Publications, Inc.

Martins, L.; & Veiga, P. (December, 2008). Socioeconomic Related Inequalities in Students' Mathematics Achievement in the European Union. Working Paper Series 38/2008 Núcleo de Investigação em Microeconomia Aplicada Universidade do Minho.

McTighe, J. & Seif, E. (2011). Teaching for Meaning and Understanding: A Summary of Underlying Theory and Research, *Pennsylvania Educational Leadership*, 24(1), 6-14.

Molefe, N., & Brodie, K. (2010). Teaching Mathematics in the Context of Curriculum Change. *Pythagoras*, 71, 3-12.

Mouton, N., Louw, G. P., Strydom, G.L. (2012). A Historical Analysis Of The Post-Apartheid Dispensation Education In South Africa (1994-2011). *International Business & Economics Research Journal*, 11(11), 1211-1221.

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.

Perumal, M. (2011). Key strategies to raise teacher morale and improve school climate. Distinguished Fulbright Awards in Teaching Programme, USA.

Reddy, V., Winnaar, L., Visser, M., Feza-Piyose, N., Arends, F., Prinsloo, C.H., Mthethwa, M., Juan, A. & Rogers, S. (2013). Highlights from TIMSS 2011 South Africa

Schmidt, W. H., Cogan, L., & Houang, R. (2011). The Role of Opportunity to Learn in Teacher Preparation: An International Context. *Journal of Teacher Education*, 62, 138-153

Shalem, Y., & Hoadley, U. (2009). The dual economy of schooling and teacher morale in South Africa, *International Studies in Sociology of Education*, 19(2), 119-134.

Sidiropoulos, H. (2008). The implementation of mandatory mathematics curriculum in South Africa: The case of mathematical literacy, *Submitted in partial fulfillment of the requirement for the PhD (Education)*, University of Pretoria.

Smith, T. M., Desimone, L. M., & Ueno, K. (2005). "Highly Qualified" to Do What? The Relationship Between NCLB Teacher Quality Mandates and the Use of Reform-Oriented Instruction in Middle School Mathematics, *Educational Evaluation and Policy Analysis*, 27(1), 75-109.

Steyn, G. M. (2002). A theoretical analysis of education motivation and morale, *Educare*, 31(1&2), 82-101.

TIMSS. (2011). International Student Achievement in the TIMSS Mathematics Content and Cognitive Domains, TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College from <http://timssandpirls.bc.edu/timss2011/international-results-mathematics.html> retrieved by 18 July 2013.

WCER. (2009). Challenges and Opportunities in Math Education Reform, *Research Highlights*, 20(4). Retrieved from <http://www.wcer.wisc.edu> by 15 July 2013.

Yukhoon, K. (2007). *Korean History for International Citizens*. Kim, Yongdeok: Seodaemun-gu, Seoul, Retrieved at <http://www.historyfoundation.or.kr> by 15 July 2013.