Survey of Existing Grades Four to Eight Mathematics in Five countries:

Kenya, Tanzania, Uganda, Indonesia and Pakistan

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Prepared by: Dr. Carla Rudder

Executive Summary

According to UNESCO (2014), there are approximately 250 million children globally not obtaining the basic level of literacy and numeracy, even after attending school for a minimum of four years or more. The conclusion one can reach from this data is that the children are not receiving a quality education. The children are disadvantaged based on the country, region, socio-economic level and sometimes their gender.

"Mathematics is the most international of all curriculum subjects" (Anthony and Walshaw, 2009) and therefore has many similarities in the topics presented to the students of the same age and grade internationally. Topics need to be presented in a similar order, as mathematics builds on prior knowledge and understanding as students progress through the educational system. Textbooks and curriculums share similarities in the topics introduced and the order in which they are presented. Therefore, the thought would be that all students have the same mathematics background and should perform at similar levels; however, this is not the case for many students. Differences are found in the way mathematics topics are presented and in those presenting the material.

Pedagogy, preparedness of the teacher, school resources, and the depth in which a topic is taught are just the beginning of reasons why there are such large differences in the attainment level of students in upper primary mathematics. According to Anthony and Walshaw (2009), for mathematics teachers to be effective in the classroom, they need to have solid pedagogical knowledge to engage students, to increase proficiency and to challenge students. Other differences can be found in the classroom ideology of student – centered versus teacher – centered, individual work versus group work, and the amount of homework given to students. Several differences are more complex such as calculator usage or non-calculator usage, how a teacher uses a calculator in the classroom, the use of mathematical

manipulatives and technology, all of which can be dependent on financing within the country and/or school.

The purpose of the research conducted for this survey was to explore numeracy teaching and learning in the upper primary grades (four to eight) in five countries: Kenya, Tanzania, Uganda, Indonesia and Pakistan. The focus of this study was to investigate the following areas:

1. existing teaching and learning standards, materials and national policies;
2. exploration and analysis of the pedagogical quality of existing materials, performance standards and national policies;
3. analysis of gaps in both core and supplemental materials; and
4. recommendations for addressing the needs in upper primary mathematics including pedagogical and curricular needs.

The research was conducted by evaluating the information available for each country such as, but not limited, to textbooks, curriculum documents, previous research articles which analyzed and documented findings on teachers' behavior, teaching methods, students' results on previous assessments and last, educational ministries' future goals and expectations.

Overall Findings

1. Existing Teaching and Learning Standards, Materials and National Policies

In accordance with the Millennium Development Goals, set forth by the United Nations Development Program (UNDP, 2000), all countries surveyed offer free public education for primary students. However, many of the countries did not prepare the schools or their teachers in order to accommodate the increase in students that would enroll. Student to teacher ratios can reach as high as 90:1 in Kenya (Metto & Makewa, 2014) and 62:1 in Uganda (Wayne & Martin, 2015). In rural areas of Pakistan there could be one or two teachers for the entire school and all grades are included within the same classroom (Balochistan Education Sector, 2013). Large class sizes and/or multi-grade classes would place a large burden on teachers, and they would need to be qualified and experienced to

accommodate different class sizes and variations (Opolot-Okurut, 2006; Balochistan Education Sector, 2013). Unfortunately, teacher preparation is lacking in all five of the countries reviewed for this study and therefore could be a consideration in the low achievement levels of their students. There is evidence to support the idea that there is a strong positive correlation between teacher's knowledge and student achievement (Altinok, 2013).

The qualifications needed for teaching mathematics in upper primary school varies by country. However, the lowest in Uganda required was a two-year diploma (International Mathematics Union, 2014). Other countries such as Kenya (Metto & Makewa, 2014), Indonesia, (OECD, 2015) and Pakistan, (National Plan of Action for All, 2003) have lowered their requirements in order to recruit more teachers for the increased student populations. Two of the five countries, Indonesia and Uganda, set requirements for the number of mathematics courses a teacher needs in order to teach primary mathematics (Human Development Department, 2010, and Najjumba & Marshall, 2013).

The high student to teacher ratios and the low qualifications of the teachers in the classroom have resulted in the majority of classes being teacher-centered and focused on rote learning (Metto & Makewa, 2014; Balochistan Education Sector, 2013; Human Development Department, 2010; Education for All 2015). Within the curriculums there is little emphasis on critical thinking or problem solving (Human Development Department, 2010). Students are being taught by focusing on an examination and not for conceptual understanding. Without the understanding of basic mathematical concepts, students struggle as the material becomes more complex (Opolot-Okurut, 2006; Balochistan Education Sector; Human Development Department, 2010).

2. Exploration and Analysis of the Pedagogical Quality of Existing Materials, Performance Standards and National Policies

All five countries researched stated the desire to have more student – centered learning environments. Kenya has taken an additional step in creating a policy which will "Enhance pedagogical approaches that support creativity, innovation, critical thinking and sustainable development" (p. 17, Ministry of Education, Science and Technology, 2015). Pakistan introduced teaching strategies into their 2006 National Curriculum, to include investigation and problem solving. However, pre-service teacher training does not cover topics such as the curriculum, usage of textbooks, assessment methods or children's learning development, all critical to aid the teacher in encouraging both investigation and problem solving. Both of these examples demonstrate the disconnect between the expectations from the education's ministries when they create national policies, what is being taught to pre-service teachers, and what is taking place in classrooms. Therefore, even with the emphasis from the ministries to have a student – centered classroom, the classes continue to be teacher – led, focused on rote memorization and final examinations.

The existing material depends on the location as well as the economic resources of the schools. Textbooks are the primary resource used to create material for mathematics classes. They are heavily relied upon to create assessments and to structure their class lessons. It is important to note that even with textbooks being a common reference for teachers, in many cases, students do not have access to the textbook. In Uganda, approximately 94% of the students do not have access to the textbook (Wane & Martin, 2015), whereas in Kenya the textbook to student ratio was 1:1 in 2009; however, that ratio has declined in recent years as the student population has increased without an increase in resources (Metto & Makewa, 2014).

The overall mathematical performance of the students within the five countries is consistently low and are not meeting the set targets of the respective countries or internationally. Indonesia participated in the Trends in Mathematics and Science Study (TIMSS), an internationally recognized assessment, to compare Indonesian students in grade 4 and 8 with their counterparts globally. In 2011 TIMSS results, Indonesia ranked 38 out of 45 countries, which was well below the "low" level for mathematics. TIMSS also recognized a decline in mathematics attainment since 2006 for the eighth grade Indonesian students. Reasons for the low level of attainment in Indonesia have been attributed to the pedagogy and complexity of mathematics being presented in the classroom. Only 3% of the mathematics taught is of high complexity. The majority of the problems are proof based and not application of mathematics; therefore, students are not required to utilize their mathematical knowledge in unfamiliar situations. Little to no decision making is needed in how to solve a problem. Eighty-eight percent of the problems are symbolic and involve mathematical language. There is a lack of real world contextual problems (problem solving) presented in the class. The other four countries discussed within this research are similar in that neither problem solving nor critical thinking is encouraged or displayed in the classroom (Ministry of Education, Kenya Institute of Education, 2002; Najjumba & Marshall, 2013; National Plan of Action on Education for All Pakistan, 2003).

3. Gaps in Both Core and Supplemental Materials

Usage of textbooks are a starting point along with a strong curriculum to teach basic mathematics. All five countries reviewed have a similar basic curriculum and a textbook for teachers to use in class as a reference. However, only using this stagnant method does not allow mathematics investigation, critical thinking or problem solving on the part of the students. There was little to no mention of mathematics manipulatives being used within the classroom of all countries. The research on Indonesia demonstrated 28% of the classes used manipulatives in the classroom (Human Development

Department, 2010). Many basic mathematics topics being taught at the upper primary level can be introduced visually to students in order to achieve a higher level of understanding. Wane and Martin (2016) noted the lowest areas of achievement for the mathematics assessment on the Service Delivery Indicators (SDI) were for students in Uganda. They were comparing fractions, reading a clock, interpreting graphical data, division of fractions and one- variable algebra problems. All of these topics would be best introduced using visual aids and mathematical manipulatives. When comparing the SDI mathematics assessment results for Uganda, Kenya (2012) and Tanzania (2011 and 2014), Uganda scored lowest in these areas (13th out of 14); however the SDI results showed that Uganda had the most resources for the classroom of the listed three countries.

4. Recommendations

In 2014 it was reported by the International Mathematics Union (IMU), that "Both primary and secondary level mathematics education are weak in most African countries…" (p.2, IMU, 2014). Anthony and Walshaw (2009) state that "Mathematics education is a key to increasing the post-school and citizenship opportunities of young people, but today, as in the past, many students struggle with mathematics…" (p.6). Students who struggle with mathematics can become adults who struggle with mathematics, and thus creating unqualified teachers teaching mathematics. Weaknesses can be found in teacher mathematics preparation and knowledge in addition to weakness in presentation of the mathematics material in the classroom. Therefore, the following recommendations are offered as a possible solution to improve students' mathematics capabilities:

1. Enhance pre-service teacher training and in-service professional development;
2. Increase the critical thinking and problem solving in both the curriculum and in classrooms;
3. Increase the use of mathematical manipulatives; and
4. Participate in an international study such as TIMSS or a regional examination such as the SACMEQ.

Introduction

This report explored numeracy teaching and learning in upper primary mathematics grades four to eight for five countries: Kenya, Tanzania, Uganda, Indonesia and Pakistan. The focus of the report was to examine the following three topics: existing teaching and learning standards, materials and national policies, exploration and analysis of the pedagogical quality of existing materials, performance standards and national policies and finally an analysis of gaps in both core and supplemental materials for all five countries. The report is organized by topic and analyzes the five countries within each topic.

1. Existing Teaching and Learning Standards, Materials and National Policies

Kenya

A. Teaching and Learning Standards

According to UWEZO (2013) the average numeracy pass rate, over three survey rounds of individual tests for children aged 10+ have remained consistent at 67%, 69% and 68% respectively. The implication of the assessment is that approximately 30% of grade four and above students do not have the basic numeracy skills. There were no specific numeracy issues stated in the current research. In general, 70% of primary six Kenyan students lack numeracy competencies such as translating verbal, graphic, or tabular information into mathematics language need to solve problems (Ministry of Education, Science and Technology, 2015).

The results of the 2013 UWEZO survey and findings from the Ministry of Education, Science and Technology both demonstrate that the students are not receiving adequate mathematics instruction or support at the primary level. To investigate a reason for the lack of preparation of the primary students, the preparation of the primary teacher was first reviewed.

The Primary Teacher Education (PTE) curriculum and implementation is not aligned with the teacher education model which envisions the teacher as a reflective practitioner. The curriculum for the PTE is content heavy and therefore time is limited for knowledge development. The PTE curriculum is not aligned with the mathematics curriculum and leaves pre-service teachers with little understanding on how to help students understand mathematics. New graduates of the program are not equipped with how to assist students which are struggling in mathematics, they tend to present the material in the same manor, therefore achieving the same results (Learning to Teach Reading and Mathematics)

B. Teaching and Learning Materials

Metto and Makewa (2014) found that there was a lack of resources in the public primary schools. In 2009, there was approximately a 1:1 student to textbook ratio for upper primary school; however, this has since declined to a 4:1 ratio. The New Edition Primary Mathematics textbooks (2016) offer students examples and exercises for practice. The teachers' edition offers the teachers; notes, materials needed, mathematical vocabulary, activities and a suggested time frame for each topic. The teachers' edition should offer extension problems for the more advanced student. The public primary schools lack computers or internet facilities, and more importantly, the teachers lack the computer skills needed for technology.

C. National Policies around Teaching and Learning Materials

The new 2015 Kenyan national curriculum was created to strengthen students' primary education, in all subjects. The new mathematics curriculum attempts to address the 70% of primary six students who are not numerically competent and will be a "Competence Based Curriculum." The new Competence Based Curriculum will attempt to define minimum standards of achievement to ensure students have the competence needed for progression to the next grade level. There are four main areas of focus for the new curriculum:

1. **Establish a competency based curriculum at each level** – by designing a new curriculum focused on learning outcomes, developing and approving new syllabi and curriculum support materials, informing all stakeholders about the new curriculum and encouraging interdisciplinary and holistic learning to be incorporated in the curriculum.
2. **Utilize technology to enhance innovation in the implementation of a competence based curriculum**. This will involve designing digital content to support the new curriculum, identifying and procuring the appropriate technology, and building the curriculum implementers' skills using digital content to support various learning styles.
3. **Enhance pedagogical approaches that support creativity, innovation, critical thinking and sustainable development.** To accomplish this objective, the pre-service teachers education training curricular at all levels must be revised to enable teachers to assist students in acquiring the minimum competencies for each level, build the capacity of teachers to enable them to impart knowledge, skills, values and attitudes for implementation of the reformed curriculum, designing a comprehensive program to assist teachers in being innovative and to incorporate modern instructional approaches in their teaching. Another goal will be to develop and approve ICT courses, and to prepare teacher in-service programs to equip them to support children with special needs, children in emergency situations, working children, and children in nomadic communities.
4. **Enhance teacher quality for effective implementation to ensure acquisition of competencies that include life skills** – by developing and implementing a national teacher education policy, upgrading the primary teacher education into a diploma program, establishing ICT based resources for teachers on the competency-based curriculum approach, conducting continuous research on contemporary global trends in effective pedagogical approaches, as well as coordinating in-service teacher training and promotion transformative aspects of education.

D. Conclusion

Kenya's Ministry of Education needs to focus primarily on teacher preparation. Pre-service teaching programs should be aligned with the Ministry's expectation of what should be happening in the classroom. Secondly, teachers need more resources in the classroom, more specifically technology.

Tanzania

In reviewing Tanzania, it is important to mention that Zanzibar is a semi-autonomous region of Tanzania. Therefore, the educational systems are different between mainland Tanzania and Zanzibar.

A. Teaching and Learning Standards

In 2006, 1,005 students, from across mainland Tanzania and Zanzibar, took the 'A' Level examinations and 96% of the students passed; however, only approximately fifty of the students (5%) passed the mathematics portion. Students are not gaining the knowledge needed to be successful in mathematics, and the evidence is seen in the exam results. The 2008 Zanzibar Sector Plan reported 34.2% of standard six students reached the minimum level of achievement in mathematics, and only 2.6% reached the desirable level for the same assessment. The LANES project, which took place across Tanzania, started in 2014 -15, focused on raising the students' arithmetic proficiency along with reading and writing. The initial assessment demonstrated that 92% of students could not master the basic skills of standard two mathematics which consisted of addition, subtraction and pattern completion. During the eight years from 2006 'A' level results, where only 5% of the students passed the mathematics portion, until the 2014 LANES project initial benchmark, where only 8% of the students passed the mathematics portion, results there is no evident progress seen in students' mathematical proficiency (Global Partnership for Education, 2017).

The primary mathematics curriculum for mainland Tanzania is detailed, has logical progression through the grades and builds upon students' previous expected learned knowledge (Bhalalusesa, Westbrook, & Lussier, 2011). Teaching strategies are also given to teachers for specific topics, emphasizing the use of mathematical manipulatives (Bhalalusesa, Westbrook, & Lussier, 2011). Eighty-three percent of teachers qualified, however only 16% of the teachers are qualified to teach mathematics. There is a cycle, which needs to be broken, of inadequate mathematics teaching and mathematics teacher preparation.

B. Teaching and Learning Materials

Resources are dependent on the area of the country. Major urban areas in Tanzania mainland will have more materials available than rural ones (Bhalalusesa, Westbrook, & Lussier, 2011). There are a lack of textbooks for students and there is a heavy dependence on donors. The lack of resources such as textbooks requires teachers to write everything on the blackboard and therefore students only have their notes for review.

There are six teacher resource centers in the Kilosa district of mainland Tanzania (Mohamed, 2013). Currently these resource centers are also lacking resources due to a lack of funding. Mohamed (2013) highlighted the benefits computers, books, a lecture hall chairs and a motorcycle could have for the teachers and the community. Benefits to the teachers included, internet access for new material, professional development, practical learning and computer training. These benefits the teacher gets would then in turn be passed on to the students.

The teacher resource centers in Zanzibar are also lacking in resources. As of 2008, in Zanzibar, the main teacher training center only had three computers for staff and students use. There was no internet access; however, this was on plan for availability in the near future. There was some basic equipment such as video cameras, video players, printers, televisions, radios, scanners and telephones. At the time

of the 2008 Zanzibar Sector Plan, no centers had internet, projectors, or photocopiers and three of the centers did not even have electricity. Without computers, teachers are not able to create vibrant and engaging resources without some basic resources including internet access. It is important to also note that the teachers have limited computer skills and there are not many educational technologists capable enough to assist in using the technology which is available (2008 Tanzania – Zanzibar Sector plan).

C. National Policies around Teaching and Learning Materials

Tanzania offers free public education for all primary children from 7 to 13 years of age. Due to the increase in enrollment, the teacher to student ratio can range from 1:35 to 1:59 depending on the area, such as Dar es Salaam and Simiyu respectively. It is important to note that the teacher to student ratio has declined consistently from 2003 to 2013, which indicates the increase in teachers entering the workforce (Education for All, 2014).

Teachers entering the workforce have attended teacher training programs and have been exposed to mathematics pedagogy to utilize in their classes. Primary teachers only need a Grade A certificate, which one can receive after completing four years of junior secondary school, and two years of residential training (Bhalalusesa, Westbrook, & Lussier, 2011). There is a push for student- centered teaching which has been promoted through the Child Friendly Schools (CFS) initiative. The main aim of the CFS initiative is to promote a school environment which is conducive to teaching and learning, and to promote child rights (Education for All, 2014).

D. Conclusion

The Ministry of Education for both Tanzania and Zanzibar should begin to focus on mathematics teacher preparation and in-service teacher professional development. To increase student mathematical achievement, the teachers should be better equipped to assist the students in their classes. Secondly

teachers in both Tanzania and Zanzibar need more resources to facilitate their teaching in the classrooms.

Uganda

A. Teaching and Learning Standards

In 2013, UWEZO administered a numeracy assessment, testing grade two mathematical skills (number recognition, place value and performing basic operations of addition, subtraction and division). In Uganda, only 44% of children aged 10+ passed this numeracy test. Uganda was the lowest performing African country of the three (Kenya, Tanzania and Uganda).

Wane and Martin's (2016) survey identified the topics of most concern for students in upper primary. The topics were: comparing fractions, reading a clock, interpreting graphical data, division of fractions and one – variable algebra problems. These topics are important to upper primary mathematics students as they are needed for higher level mathematics (secondary school) as well as life skills such as reading a clock and calculating or working with fractions.

Why are students in higher grades still unable to perform the mathematics of children in grade two?

In 2013, a Uganda Service Delivery Indicators (SDI) survey was conducted on 400 primary schools across Uganda. The findings from the survey demonstrated teachers' lack of subject knowledge and teacher absenteeism. Nineteen and a half percent of the teachers did not have mastery of the subject matter they were teaching. Wane and Martin (2016) also found that teachers are routinely absent from school and when they are in school, 52.3% of their time is not spent in the classroom teaching. As a result, primary four students in the northern region received ninety days less instruction than their counterparts in Kampala. There are large discrepancies between teachers in the northern and western

regions and the other regions participating in the survey in areas of knowledge and pedagogy. Teachers from Kampala and the central regions scored slightly higher than the other regions surveyed.

Teachers did score above average for minimum teacher knowledge with 19.4% (the average was 12.7%). Uganda teachers scored lowest on 13 of the 14 mathematics topics covered such as comparing fractions, reading a clock, interpreting graphical data, division of fractions and one-variable algebra. These are all topics which are important to upper primary mathematics. Even with the teachers' low performance, the student results were above average at 53.4%.

B. Teaching and Learning Materials

Uganda has textbooks which are approved by the Ministry of Education and cover the national curriculum. The textbooks offer worked examples and practice for the students to complete. However, 94.4% of students are without a textbook in the public schools (Wane & Martin, 2016). While most of the teachers' lessons are dependent on the textbook, the student's lack of a textbook to use as a reference when preparing homework or reviewing for a test is a hindrance to their obtaining the appropriate knowledge. Students are also without a textbook due to the high teacher to student ratios of approximately 1:80 (Opolot-Okurut, 2006) in the classroom. Large classes present additional concerns for the teacher such as discipline, preparing teaching and learning materials, interaction with students, and especially assisting students with special needs or learning difficulties.

C. National Policies Around Teaching and Learning Materials

The national policy of Universal Primary Education (UPE, 1997) guarantees seven years of free compulsory primary education for children ages 6 – 12. With the new UPE, the increase of children attending school has increased by four million students. The increase of students also raised the teacher – to – student ratio and has been challenging for teachers to maintain student achievement.

According to the National Assessment of Progress in Education (NAPE), only 53% of the students in primary six have the basic numeracy skills, which is an increase of …% from 2003.

The 2010 – 15 Educational Sector Plan of Uganda wants to ensure primary students acquire basic literacy, numeracy and life skills. In order to accomplish this, there is a seven-step plan proposed by the Ministry of Education:

a. Make the curriculum feasible and practical;
b. Adopt effective methods of instruction, and train teachers to use these methods;
c. Increase actual instruction time and rationalize the curriculum to focus on key skills and areas;
d. Focus attention of P1 to P3, ensuring adequate numbers of teachers are allocated to these classes to reduce PTR;
e. Examine primary pupils only in reading, writing, and mathematics;
f. Implement measures that minimize teacher and pupil absenteeism; and
g. Improve the learning environment through provision of instructional materials and school infrastructure.

It has also been noted that due to the focus on students completing primary education, there is an increased need for weekly mathematics instruction, as well as understanding and delivery of the curriculum and pedagogy. The purpose of the five-year strategy is to improve both the quality and relevance of the education.

D. Conclusion

The Ministry of Education for Uganda should begin to focus on mathematics teacher preparation and in-service teacher professional development. To increase student mathematical achievement, the teachers should be better equipped to assist the students in their classes. Secondly, students need access to textbooks. Textbooks will assist with students being able to pay more attention in class to the presented material and have a reference for when they are working independently at home.

Indonesia

A. Teaching and Learning Standards

According to the Organization for Economic Co-operation and Development (OECD, 2015), over 50% of Indonesian students 15 years old have not mastered basic mathematical skills. Overall, the country performs below the OECD average for numeracy. According to Trends in Mathematics and Science Study (TIMSS, 2010) there has been a decline in the understanding of mathematics for eighth grade students since 2006. In 2011 Indonesian students were 38th out of 45 countries for the TIMSS assessment for mathematics, placing them below the Low level.

TIMSS (2010) revealed that the majority of time in class is used for lecture (52%) and students answering closed questions. When students are given problems to solve, they are not encouraged to use more than one method or strategy. The average class is 70 minutes and are only conducted two to three days a week, resulting in fewer hours of teaching time. The class is typically divided into four parts: a. review of previous content, b. introduction of new content, c. practice and d. assessment.

A new curriculum was introduced in 2013 to develop critical thinking and creativity. The implementation of the new curriculum has been slow as there has not been adequate teacher training to support them during the transition. Teachers would like more training with the new curriculum, content, theme teaching, interactive pedagogy and group learning (OECD, 2015).

B. Teaching and Learning Materials

Materials and resources in Indonesia vary by district levels and are often inconsistent; however, most classes are well equipped (Human Development Department, 2010). Class resources vary with 9% using projectors, 13% using calculators and 93% using textbooks. Only 28% of classes use real world objects in the teaching of mathematics, which is very discouraging (Human Development Department, 2010).

Students in upper primary would benefit from using manipulatives when learning new concepts as this is helpful in them to visualize concepts.

Proofs are used in Indonesian classes and are recommended by the National Research Council (NRC) in assisting students in being able to express something as true using logical arguments for all cases. While more problems are proof-based, there is a lack of application problems (Human Development Department, 2010). Eliminating application problems limits students having to use their prior knowledge and problem solving strategies. The concepts of decision making involving which formula or mathematical process is needed when solving new problems is not being used. The lack of applications also reduces the investigation and use of alternative solutions.

OECD (2015) also noted shortfalls in lesson planning and student assessment. This can be attributed to the lack of training on the new curriculum. Training has been requested in implementing the new curriculum (OECD, 2015).

C. National Policies Around Teaching and Learning Materials

The Teacher Law was passed in December 2005 by the Indonesian Government which set minimum academic and professional requirements for teachers. 80% of the three million current teachers need to have their qualifications upgraded due to the increase of the minimum teacher qualification from two year to a four year diploma (Human Development Department, 2010). A new certification process was also implemented as a requirement. The purpose for the implementation of The Teacher Law was to improve both the quality of the teachers and their teaching. Indonesia will use the students' performance on international exams such as the International Association for the Evaluation of Educational Achievement (IEA), TIMSS, and the OECD Program for International Student Assessment (PISA) to measure the success of the Teacher Law (Human Development Department, 2010).

Student access to education varies by the region and district. These disparities are also found in the educational quality and teacher certification in remote and poor areas. Teachers from poorer rural areas are often less qualified and have a higher absenteeism rate than their colleagues in more affluent urban areas. Teachers in the rural areas also need to be trained in teaching in a multi-grade environment (OECD, 2015).

D. Conclusion

The Ministry of Education for Indonesia has increased the number of qualified teachers for mathematics and has a minimum requirement for prospective mathematics teachers. The area in which there should be a focus is with professional development for in-service teachers. When the Ministry of Education introduced a new mathematics curriculum, there was not adequate training for teachers.

Pakistan

A. Teaching and Learning Standards

The results of the Annual Status of Education Report (ASER, 2015) determined that children from the upper primary did not have the mathematical proficiency required of a primary two student. Students' level of mathematical achievement ranges between 16 and 39% and there is a positive correlation between the child's socio-economic level and their score. There are also slight differences in levels of achievement based on gender, where males tend to outperform their female classmates. Female students scored a range of 11 to 38% on division while male students ranged from 19 to 40% on the same topic.

There is a national curriculum in Pakistan. However, teachers rely heavily on textbooks to prepare class lessons and assessments. The classes are teacher – led and the students are expected to learn through rote memorization (Balochistan Education Sector, 2013-2018). The teaching method used in the

classroom could be a result of the lack of or inadequate pre-service teacher training. Teacher training does not cover topics such as curriculum development, textbooks, assessments and education planning – all essential topics in becoming an effective teacher (Balochistan Education Sector, 2013-2018).

The two year pre-service teacher training program results in a bachelor's in education. However, this curriculum does not address children's learning development. Teachers are also not trained for the classroom environment they will encounter upon completion of the program, such as multi-grade classrooms. When teachers are assigned to a single - teacher school with only one room, they are not able to attend to the needs of all the students or their varying academic levels and abilities. Therefore, not all students are engaged in the learning process (Balochistan Education Sector, 2013-2018).

B. Teaching and Learning Materials

Teachers are given the National Curriculum (2006) to teach from and are heavily dependent on textbooks to create their lesson plans and materials. While the textbooks used encourage rote learning, the language is often above the children's comprehension ability and the mathematics is not detailed in instructions or examples given to provide students with an impetus for conceptual understanding (Balochistan Education Sector, 2013-2018).

C. National Policies Around Teaching and Learning Materials

The Curriculum for all schools is provided for by the Ministry of Education (National Curriculum, 2006). Within the curriculum there are three main objectives, four themes and an outline for effective teaching strategies, investigation and problem solving.

The three main objectives of the National Mathematics Curriculum (2006) are to be:

1. more vibrant;
2. responsive to modern, socio-economic, technical, professional and labor market needs of the country; and

3. comparable to international standards.

The four themes of the National Mathematics Curriculum (2006) are:

1. designed to help students build the solid conceptual foundation in mathematics that will enable them to apply their knowledge skillfully and further their learning successfully;
2. emphasize the geometrical concepts that enable students to think logically, reason systematically and conjecture astutely;
3. stress graphics that enable students to visualize and interpret mathematical expressions correctly rather to manipulate them 'blindly'; and
4. recognize the benefits that current technologies can bring to the learning and succeeding at mathematics. It therefore integrates the use of appropriate technologies to enhance learning in an ever increasingly information-rich world.

The National Mathematics Curriculum (2006) is complete for grades four to eight and covers all of the material students should have been exposed to prior to entering secondary school. The curriculum builds on students' expected prior knowledge and has a logical progression through the grades. The inclusion of financial mathematics in grade eight is an added advantage, as it lends itself to real life application, reasoning and logical thinking.

Aligned with international standards there are five standards to the National Mathematics Curriculum (2006):

1. Standard 1: Numbers and Operations
2. Standard 2: Algebra
3. Standard 3: Measurement and Geometry
4. Standard 4: Information Handling
5. Standard 5: Reasoning and Logical Thinking

Of the students participating in the 2013 and 2014 ASER only 50% of grade five students in the Islamabad Capital territory were proficient at third grade division. In response to the results of the 2013 and 2014 ASER, the Minimum National Standard for Quality Education (MNSQE) was approved for implementation in February 2016 and would be interprovincial. Included in the MNSQE were the following new standards for teaching:

1. Standard 1: Subject Matter Knowledge
2. Standard 2: Human Growth and Development

3. Standard 3: Knowledge of Islamic Ethical Values and Life Skills
4. Standard 4: Instructional Planning and Strategies
5. Standard 5: Assessment
6. Standard 6: Learning Environment
7. Standard 7: Effective Communication and Proficient Use of Information and Communication Technologies for Teaching and Learning Process
8. Standard 8: Collaboration and Partnerships
9. Standard 9: Continuous Professional Development and Code of Conduct
10. Standard 10: Teaching of English as Second/Foreign Language (ESL/EFL)

The National Mathematics Curriculum and the new MNSQE is thorough and encourages positive changes within the classroom. However, without proper pre-service teacher training, the teachers will have a difficult time bringing the standards into the classroom.

D. Conclusion

Pakistan's Ministry of Education should begin to focus on mathematics teacher preparation and in-service teacher professional development. To increase student mathematical achievement, the teachers should be trained to teach in a multi-grade classroom. Secondly teachers should be given further training in pedagogies. Teachers should not only use lectures as a mode of instruction.

The Education Ministries for all five countries discussed should devote more resources in teacher preparation and continued teacher development. To best teach and assist students, teachers need to be adequately trained in both content and pedagogy.

2. Exploration and Analysis of the Pedagogical Quality of Existing Materials, Performance Standards and National Policies

Kenya

A. Pedagogical quality of existing materials and performance standards

According to the Kenyan 2002 Primary Education Syllabus, the most recent syllabus available, there are set topics for each grade level. All of the grade levels incorporate some aspect of word problems with the exception of Grade Four. The topics included within each grade are:

1. **Standard Four**: Numbers (Whole, Fractions, Decimals, Whole Numbers), Measurement (Length, Perimeter and Area of Squares and Rectangles), Volume of Cubes and Cuboids, Capacity, Mass, Money, Time, Geometry, Algebra (using variables), Statistics
2. **Standard Five**: Numbers (Whole, Fractions, Decimals,), Measurement (Length, Area Include Triangles, Formulas for Area and Volume), Capacity, Mass, Money, Time, Geometry, Algebra (Simplification of expressions and simple equations with one unknown, Tables and Graphs, Scale Drawing
3. **Standard Six**: Numbers (whole, fractions, decimals, percentages)Measurement (Length, area and hectare, volume, capacity, mass) money, Postal Charges, Time and Speed, Geometry lines (bisecting, parallel and perpendicular), Angles (construction, vertically opposite and supplementary, Circles (center, radius and diameter), models of cubes and cuboids, nets, Algebra (Simplification of expressions and simple equations with one unknown and compare quantities with <, >, and =) Tables and Graphs, Scale Drawing
4. **Standard Seven:** Numbers (Whole, fraction, decimal, percentage) Measurement (length, perimeter of circles, triangle, and quadrilaterals, area of circles using formula, practically find area of trapezium and parallelogram, combined shapes, surface area of cubes, cuboids, and cylinders) Volume(cubes, cuboids and cylinders), Capacity (looking at relationships between capacity and volume), Mass, Money, Postal Charges, Time and Speed, Temperature, Geometry (angle properties, Pythagorean relations, construction of triangles and circles), Algebra find value of expressions through substitution, form and solve equations with one unknown, simplify inequalities in one unknown, Tables and Graphs (Statistics) Scale Drawing, Ratio and Proportion
5. **Standard Eight**: Numbers (square roots, conversions of percent to fractions to decimals and vice versa, operations on numbers percentage increase and decrease) Measurement should be able to work out problems regarding everything learned up this point, Geometry (construct triangles, circles inscribed in a triangle, construct rhombuses and trapeziums, nets of pyramids, faces, edges), Algebra, Tables and Graphs (statistics- mean median and mode), Scale Drawing, Ratio and Proportion

The curriculum shows a logical progression of topics and ideas. The Primary Education syllabus continues with guidance for teachers on methods used for continuous assessments and the competencies which should be tested. The methods for assessment should utilize one of three methods: written exercises, oral exercises and/or teacher observation. The competencies to be tested are:

1. knowledge of common mathematics concepts;
2. knowledge of specific mathematical facts;
3. understanding of general mathematical principles;
4. application of general mathematical principles; and
5. interpretation of information contained in charts, graphs and tables.

The time allotted to mathematics classes is approximately 35 minutes for the upper primary grades. As students' progress through the grades the amount of topics increase; however, the time allotted does not (Ministry of Education (Kenya), 2002). The new curriculum of 2015 should look to increase the time allotted to mathematics to ensure students are given the necessary amount of time for investigative approaches to new topics presented.

B. Pedagogical Quality of Existing National Policies

The 2015 National Curriculum Policy addresses the changes which should be made to create a student – led classroom and defines the minimum standards of achievement for each level, attempting to ensure students have the competence needed to progress to the next grade. More time is needed to see how the implementation of the new curriculum will address and improve the 70% of grade six students who are not numerically competent.

Tanzania

In reviewing Tanzania, it is important to mention that Zanzibar is a semi-autonomous region of Tanzania. Therefore, the educational systems are different between mainland Tanzania and Zanzibar.

A. Pedagogical Quality of Existing Materials and Performance Standards

The results of the 2011 and 2012 national results demonstrated that Tanzanian students were below average for mathematics. As a result, the Ministry of Education began to focus on two areas for improvement: recruitment of additional teachers and purchasing more "essential" textbooks. The textbooks for neither Tanzania mainland or Zanzibar were available for this survey. The LANES project (2014-15) focused on the improvement of teaching and learning of mathematics. The intermediate results demonstrated:

1. improved Methodology for Learning and Teaching…, at which the target was to develop a National Program for teaching Literacy and Numeracy for STD I and II;
2. increased skills for teaching Basic Literacy and Numeracy with targets to train 18,000 STD I and II teachers on the NPLN for 3Rs and 3860 NFE Center Facilitators on the same material and
3. to develop, print and distribute STD I and II 3Rs books to all 15,525 Primary schools.

These results focused on Primary Standard I and II. However, the increased mathematics proficiency resulting from these improvement will impact the upper primary results.

B. Pedagogical Quality of Existing National Policies

The LANES project (2014) was a three-year project with a proposed ending date of 2019. The end of LANES will lend more information regarding the implementation of new policies for teaching mathematics in primary school.

Uganda

A. Pedagogical Quality of Existing Materials and Performance Standards

The Ugandan Curriculum Center Strategic Plan created a student book and teacher guide for mathematics. Distribution of the material to all the schools proved to be the challenge. Even with a new student book and teacher guide, teachers mainly employ lectures within the mathematics classes. The large class sizes prevent individual attention to students as lecturing is the easiest way to teach

(Opolot-Okurut, 2006). The student textbooks used for mathematics follow a set pattern for each topic. There is an activity at the beginning, then a worked example, a section which encourages memorization and concluding with exercises to work. At the end of each unit is a unit test and keywords. The teacher guide divides each topic into subtopics and gives a step-by-step guide of what they should give to the students. There are support activities for slower learners and a few extended activities for the more advanced students. The textbook reviewed for this survey was developed by MK publishers for primary five (New Edition Primary Mathematics Four and Five, 2016)

Primary six teachers, which participated in the NAPE, scored 100% higher than the students. Even with this result, the teachers only scored between 50 and 70% for numeracy. Students and teachers have similar areas of strengths and weaknesses; geometry, measures, number patterns and fractions. The percent of correct answers increased from 30% to 42% for primary six students from 2006 – 2010.

B. Pedagogical Quality of Existing National Policies

The updated 2010 – 15 Uganda Education Sector Plan is attempting to change the classroom environment from teacher – led to student – led. While this an admirable goal, it is more important to envision how this can be achieved with the large class sizes.

C. Conclusion

The policies to enhance students' mathematical achievement is in place however will not be effective until teachers implement them into the classroom. Teachers need more support in ways of smaller classrooms and strategies to lead a student-centered classroom.

Indonesia

A. Pedagogical Quality of Existing Materials and Performance Standards

Lessons presented to students have goal statements and summaries which clarify the topic they are studying. Classes are typically teacher – led and the students are presented with closed problems. Unfortunately, there is only 20% of problem solving in a class. The observed classes demonstrated 3% of the class could be considered utilized for investigation and discovery, 10% was practical work and 15% was for discussion of the topic (TIMSS, 2010).

The 2010 TIMSS results demonstrated that classes with higher results had the following attributes:

1. higher student engagement;
2. more time spent on problem solving;
3. assessment related activities;
4. set up problems using by making a connection;
5. more proofs;
6. use of more mathematical language;
7. projectors used in class; and
8. lesson planning was done with teacher collaboration.

The classes presented were well organized, and used goal statements to introduce new topics and summaries. However, more time was spent on the set up of the class rather than the actual teaching the mathematics.

B. Pedagogical Quality of Existing National Policies

According to Law No. 14 of 2005, teachers should only teach the subject in which they are certified and they are only allowed one certification. Even with this law in place many teachers teach more than one subject (Human Development Department, 2010). A second law passed in 2007, Ministerial Decree No. 18, requiring teachers to have 24 class periods of mathematics in order to obtain a certification bonus. Even with these two laws in place, the students' level of achievement was noted to have decreased from 2006 to 2011 during their TIMSS participation (Human Development Department, 2010).

C. Conclusion

The National policies and laws, for Indonesia, are in place and the majority are being followed to support student mathematical achievement. The main area which should be focused on transforming the classroom from teacher led to student centered. Secondly there should be more time given to problem solving in the classroom.

Pakistan

A. Pedagogical Quality of Existing Materials and Performance Standards

The National Mathematics Curriculum (2006) outlined the main objectives and the themes as previously mentioned. Also included were "Effective Teaching Strategies."

The teaching strategies were outlined to assist teachers in creating a classroom environment where students construct their own understanding. The strategies given to the teachers were to be:

1. a planner of practical tasks for the students to consolidate and organize their informal knowledge;
2. an organizer of the establishment of mathematical tasks in the classroom so that the students can work in a social setting and develop rational understanding;
3. an encourager who asks questions, supports and develops students' mathematical thinking and communication;
4. a negotiator helping students to discuss various meaning/solutions of a concept/question and to achieve a common agreement; and
5. a mediator supporting the establishment of an environment where students express opinions and experiences in the classroom equally.

B. Pedagogical Quality of Existing National Policies

There are some obstacles preventing students from meeting the set targets of educational achievement in upper primary such as:

1. lack of facilities and resources;
2. shortage of teachers in rural areas;
3. absenteeism of teachers;
4. inadequate pre-service and in-service teacher training;
5. curriculum not relevant to rural students daily life;

6. course material not student focused; and
7. a variety of pedagogies not being used in the classroom.

(National Plan of Action on Education for All, 2003)

C. Conclusion

The National Plan of Action on Education for All (2003) outlined seven main obstacles which are preventing student achievement. Addressing the issues of facilities and resources along with offering a curriculum which is relevant to students' daily life students may begin to see improvements in mathematics.

3. Analysis of Gaps in Both Core and Supplemental Materials

Kenya

Kenya's new 2015 National Curriculum will utilize technology to address the lack of diversity in their teaching as well as the enhancement of the curriculum support materials, implying possible use of manipulatives, such as base ten blocks or fractions tiles. More time is needed to see how the planned enhancements have address the 70% of grade six students who could not translate verbal, graphic, or tabular information into mathematical language to solve problems. The primary grade four and five textbooks reviewed for the survey demonstrated a logical progression through the mathematics topics. The paired teachers' guide offers teachers instruction on how to plan the topic, objectives to cover, background information needed, notes and steps to take for each class lesson (New Edition Primary Mathematics Teachers' Book Five, 2016).

Tanzania

Resources such as mathematical manipulatives and textbooks are needed to aid in the teaching and understanding of mathematics. Further to these items, more focus on teacher subject knowledge and training would also be beneficial. The current LANES project (2014) is encouraging by addressing the

pedagogy and resources in the primary schools across Tanzania. The student results in 2019 will offer more relevant information regarding further resources and pre-service training required to increase the mathematics proficiency in upper primary mathematics.

Uganda

Najjumba and Marshall (2013) found geometry, measures and fractions to be the most challenging topics for primary six students. These three topics would be better taught using mathematics manipulatives instead of textbooks. However, with teacher – led classrooms and large class sizes, the usage of manipulatives could prove challenging without proper teacher training. Division was also a challenging topic for primary six students. Again, this is another topic which would be greatly aided by using manipulatives. The overall student performance with operations was 70% for the primary six; however, only 18% for geometry.

The student performance raised concerns with the pace and sequencing of the curriculum. The curriculum gives the proposed number of periods for each topic (National Curriculum Development Centre, Uganda, 2010). This should be given as a range with a note that teachers should use the students as a guide to determine when they should move on to the next topic. Sticking with rigid number of periods emphasizes a teacher led class instead of a student-centered class. Geometry was not a problem area in primary three; but, became a problem area for the primary six, thus demonstrating a decline in understanding. However, this is not an issue with the sequencing nor pace but possibly the pedagogy used when presenting the topic.

Indonesia

Indonesia was ahead of the other countries discussed in their use of real world objects in teaching mathematics. However, with the inconsistent allocation of resources, it is not always guaranteed when or if they will be available (Human Development Department, 2010). The use of manipulatives in a

mathematics class should be higher than the 28% currently seen in Indonesia. Calculators are used by 13% of students and the argument to discontinue using them because they are not allowed for the National Exams is valid. However, not using a calculator limits students from investigations, requiring larger number patterns. Rulers, protractors, compasses, and models were also used in the classroom but the most used tool was the blackboard (Human Development Department, 2010).

Pakistan

There is a large amount of students within rural areas who are without basic facilities in the schools (National Plan for Action on Education for All, 2003). There are areas which need furniture, mats, blackboards, chalk and charts. Without these basic resources teachers, will find it difficult to perform up to the expected standards.

4. Recommendations

In 2014 it was reported by the International Mathematics Union, that "Both primary and secondary level mathematics education are weak in most African countries…" (p.2, IMU, 2014). Anthony and Walshaw (2009) state that "Mathematics education is a key to increasing the post-school and citizenship opportunities of young people, but today, as in the past, many students struggle with mathematics…" (p.6). Students who struggle with mathematics become adults who struggle with mathematics, thus resulting in unqualified teachers teaching mathematics. Weaknesses can be found in the teacher mathematics preparation and content knowledge and in the presentation of the mathematics material in the classroom. Therefore, the recommendations for strengthening the teaching and learning of mathematics in upper primary school are:

1. **enhance Pre-service teacher training and In-service professional development;**
2. **increase the critical thinking and problem solving in the curriculum and classrooms;**
3. **increase the use of mathematical manipulates; and**

4. **participate in an international study such as TIMSS or a regional examination such as the SACMEQ.**

Teachers cannot teach subjects they are themselves weak in and have not had the proper training in pedagogies essential to teach the subject. The survey of five countries indicates that only two of the five countries, Uganda and Indonesia, have a mathematics requirement for their pre-service teachers (Human Development Department, 2010, and Najjumba & Marshall, 2013). Pre-service teacher training needs to focus on:

1. basic mathematics knowledge;
2. mathematics pedagogy;
3. creating a student-led classroom; and
4. engaging students in critical thinking and problem solving

The study also indicates that teacher-led classrooms do not engage students to think for themselves or to attempt new strategies when solving problems. Rote memorization was seen as the most common pedagogy for all countries reviewed for this study (Opolot-Okurut, 2006; Metto & Makewa, 2014; Balochistan Education Sector, 2013; Human Development Department, 2010; Education for All (Tanzania), 2014) even though policies, textbooks, etc. encouraged student-centered teaching and learning. Teachers expect students to follow the method which is taught, and this does not lead to students' conceptual understanding. However, teachers should not be expected to facilitate a student – led class when they themselves have not experienced it nor been taught in a pre-service teacher training course on how to engage in such activities. It is also important to highlight that all the countries reported have rural areas where multi-grade classrooms exist. These teachers need to be trained to organize, prepare and teach in this type of classroom environment. Kenya (Ministry of Education, 2015) has seen the need to increase the training of pre-service teachers and the plans are outlined in the New

Curriculum Policy. Najjumba and Marshall (2013) noted that Ugandan teachers needed more pedagogical training to fully engage students in understanding the presented topics.

For teachers which are currently teaching, they need professional development to assist in moving classrooms from a teacher led classroom to a student-centered one. It is important that current teachers, who may serve as mentors for incoming teachers, have benefited from methods which are aligned with the new curriculum and policies of the country.

One of the most valuable 21st century skills a student can be exposed to is critical thinking (Wagner, 2010; Scott, 2015). When the majority of mathematics problems a student is presented with are straight forward and they are told which strategy is needed, the student is not being challenged or taught how to think. As a result, they are therefore not being prepared for the needs of the future economy and workforce. In order to increase critical thinking and problem solving within the mathematics classes, teachers should prepare questions which depend on the students' use of prior mathematical knowledge, and not only the topic currently being taught. Students should be encouraged to attempt to solve problems using various strategies and to share their efforts with their peers. Through joint problem solving, students will discover various ways to solve similar problems. Having knowledge of several heuristics will allow students to become more confident and proficient when solving unfamiliar problems (Schoenfeld, 1992 and Rudder, 2006).

It is also recommended for teachers to use more resources and manipulatives in the classroom. The lack of textbooks in the classrooms has at least two negative impacts: teachers are required to write all of the material on the board and students need to have the opportunity to copy this information. This activity takes time for both teacher and student and could be better used on the teaching and understanding of mathematics. The lack of appropriate technology, such as computers or internet, does

not provide teachers access to more engaging and dynamic activities which could be used as supplemental materials to support and enhance the curriculum.

Usage of mathematical manipulatives can assist in students' understanding of the material. Presenting material in a concrete way would help students visualize concepts being presented and also allow them to investigate new topics. Students in upper primary grades have not progressed from the concrete to abstract cognitive levels. Visualization will help them to solidify abstract concepts being introduced. Manipulatives will aid in their learning, demonstrate mathematical concepts and demonstrate mathematics in their everyday lives.

An additional recommendation for all countries is to participate in an international examination, such as TIMSS, OCED- PISA or a regional assessment such as the SACMEQ (Southern and Eastern Africa Consortium for Monitoring Educational Quality). Indonesia has participated previously in TIMSS, and Pakistan is registered for TIMSS 2019. However, Kenya, Tanzania, and Uganda have not registered for participation in upcoming international assessments. Assessing students within the country against themselves does not offer a true evaluation of their current standing. Currently, the mathematics topics being taught for the five countries analyzed are similar to each other and to international standards. Therefore, the pedagogy used in the classroom provides an area of focus. TIMSS assesses more than students' achievement; it also offers qualitative analysis not captured in student results. This could also benefit each country's classroom practices. With the cost associated with an international assessment, the option of a regional assessment is a way for the country to evaluate itself amongst similar countries. The regional assessment could also incorporate qualitative question to assess students understanding such as solving a question in more than one way or an question asking students to explain their steps.

References

Altinok, N. (2013). *The Impact of Teacher Knowledge on Student Achievement in 14 Sub-Saharan African Countries.* Paper commissioned for the EFA Global Monitoring Report 2013/4, Teaching and learning: Achieving quality for all." Retrieved from http://unesdoc.unesco.org/images/0022/002258/225832e.pdf.

Annual Status of Education Report ASER – Pakistan 2014. Published January 8, 2015

Anthony, G., & Walshaw, M. (2009). *Effective pedagogy in mathematics.* Educational Practices Series – 19. International Academy of Education and International Bureau of Education.

Balochistan Education Sector 2013 – 2018. Government of Pakistan.

Bhalalusesa, E., Westbrook, J., & Lussier, K. (2011). *The Preparation of Teachers in Reading and Maths and its Influence on Practices in Tanzanian Primary Schools.* Tanzania's Country Report.

Education for All 2015 National Review Report: Pakistan. June 2014.

Education for All 2015 National Review Report: United Republic of Tanzania-Mainland. November 2014.

Fentiman, A., Sugrue, C., Wyse, D., & Dachi, H. (2013). *Pedagogy and Leadership in Tanzanian Primary School: A Whole School Approach exploring Classroom Realities in an Urban Setting.* Retrieved from University of Dar es Salaam Research Repository website: http://repository.udsm.ac.tz:8080/xmlui/handle/123456789/1072

Global Partnership for Education (2007). Education Sector Plan for Zanzibar. https://www.globalpartnership.org/content/zanzibar-education-development-program-20089-201516

Global Partnership for Education (2017). Progress report for the literacy and numeracy education support program in Tanzania (Mainland), supported by GPE for the period 2014-2015. https://www.globalpartnership.org/content/progress-report-mainland-tanzania

Government of Pakisatan. Minimum Standards for Quality Education in Pakistan: Attaining Standards for Improved Learning Outcomes and School Effectiveness

Government of Pakistan, Ministry of Education Islamabad. (2006). National Curriculum for Mathematics Grades 1 – 12.

Government of Pakistan, Ministry of Education Islamabad. (March 2003). National Plan of Action on Education for All (2001 – 2015) Pakistan.

Human Development Department (2010). Inside Indonesia's Mathematics Classrooms: A TIMSS video study of teaching practices and student achievement

International Mathematics Union (2014). *Mathematics in Africa: Challenges and Opportunities.* https://www.mathunion.org/fileadmin/CDC/cdc-uploads/CDC_MENAO/Africa_Report.pdf

Learning to Teach Reading and Mathematics and Influences on Practice: A Study of Teacher Education in Kenya. https://www.sussex.ac.uk/webteam/gateway/file.php?name=executive-summary-kenya.pdf&site=320

Metto, E. & Makewa, L. N. (2014). Learner-Centered Teaching: Can it work in Kenyan Public Primary Schools? *American Journal of Educational Research 2*(11A), 23 – 29.

Ministry of Education, Science and Technology (Kenya) (2015) *National Curriculum Policy*.

Ministry of Education, Kenya Institute of Education (2002) *Primary Education Syllabus.* Volume two.

Mohamed, S. H. (2013). TANZANIA TEACHERS REOURCE CENTRE (Case study Dumila TRC-Morogoro). http://www.academia.edu/9738653/TANZANIA_TEACHERS_REOURCE_CENTRE_Case_study_Dumila_TRC-Morogoro_ (Retrieved May 20, 2018).

Najjumba, I. M. and Marshall, J. H. (2013). *Improving Learning in Uganda Vol. II: Problematic Curriculum Areas and Teacher Effectiveness: Insights from National Assessments.* Washington, D.C.: World Bank. doi: 10.1596/978-0-8213-9850-0 License: Creative Commons Attribution CC BY 3.0

National Curriculum Development Centre. (2010). Curriculum Centre Strategic Plan (Uganda)

New Edition Primary Mathematics Four (2016). Kenya

New Edition Primary Mathematics Five (2016). Kenya

New Edition Primary Mathematics Five Teachers' Book (2016). Kenya

OECD/Asian Development Bank (2015). *Education in Indonesia: Rising to the Challenge*, OECD Publishing, Paris http://dx.doi.org/10.1787/9789264230750-en

Opolot-Okurut, C. (2006) Factors that Hinder Opportunities to learn Mathematics in Primary school Uganda (Conference Paper) Conference: **National Education Graduate Students' Conference**

Robinah K. & Robinah M., et.al. (July 2011). Learning to teach reading and mathematics and its influence on practice in Uganda

Rudder, C. A. (2006). Problem Solving: Case Studies Investigating the Strategies Used by Secondary American and Singaporean Students. http://diginole.lib.fsu.edu/islandora/search/catch_all_names_mt%3A(Rudder,%20%20Carla%20Amoi) (Retrieved May 20, 2018).

Schoenfeld, A. H. (1992). Learning to think mathematically: Problem solving, metacognition and sense making in mathematics. https://gse.berkeley.edu/sites/default/files/users/alan-h.-schoenfeld/Schoenfeld_1992%20Learning%20to%20Think%20Mathematically.pdf. (Retrieved May 20, 2018).

Scott, C. L. (2015). The Futures of Learning 2: What kind of learning for the 21st century? UNESCO Education Research and Foresight, Paris. [ERF Working Papers Series, No. 14].

Sindh-Education Sector Plan. Government of Pakistan.

The United Republic of Tanzania (2008). Education Sector Development Programme (2008 – 17). https://www.globalpartnership.org/content/tanzania-education-sector-development-programme-2008-17

Trends in Mathematics and Science Study (2010). https://nces.ed.gov/timss/

UWEZO (2013). *Are Our Children learning? Literacy and Numeracy across East Africa.*

Uganda Education Sector Plan 2010-2015

United Nations Development Programme (2000). UN Millennium Development Goals. New York City, New York. http://www.undp.org/content/undp/en/home/sdgoverview/mdg_goals.html (Retrieved May 12, 2018).

United Nations Educational, Scientific and Cultural Organization (2014). Education for all global monitoring report. http://unesdoc.unesco.org/images/0022/002256/225654e.pdf (Retrieved on September 2017).

Wagner, T. (2010). *Overcoming the Global Achievement Gap*. Cambridge, Massachusetts, Harvard University. http://www.aypf.org/documents/Wagner%20Slides%20-%20global%20achievement%20gap%20brief%205-10.pdf. Retrieved 15 January, 2018.

Wane, W. & Martin, G. (2013). *Education and health services in Uganda: data for results and accountability (English). Service delivery indicators.* Washington DC; World Bank. http://documents.worldbank.org/curated/en/680381468174903963/Education-and-health-services-in-Uganda-data-for-results-and-accountability

Wane, W.& Martin, G. (2015). Education service delivery in Tanzania. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/415111468179674045/Education-service-delivery-in-Tanzania

World Bank (2010). *Inside Indonesia's mathematics classrooms: a TIMSS video study of teaching practices and student achievement.* Washington DC: World Bank. http://documents.worldbank.org/curated/en/151301468283518230/Inside-Indonesias-mathematics-classrooms-a-TIMSS-video-study-of-teaching-practices-and-student-achievement