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The Efficacy of Using Mother Language in the Teaching of Mathematics and Science in Primary Schools: Evidence from Grade One Classrooms in Kenya

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Abstract
Despite the evidence from multilingual education research that states the pedagogical benefits accrued when a child is taught in the mother language, obstacles to the acceptance of its use and implementation in education in Africa are enormous. Although Kenya's language in education policy states that mother language is to be used as a medium of instruction in the early grade years, most teachers use English in introducing children to formal learning. Is it that the teachers do not understand the benefits accrued when a child is introduced to learning in a language that he or she understands? It is against this backdrop that this study set forth to test the efficacy of using Gĩkũyũ (a mother language to many speakers in Kenya) and English (the official language in Kenya) in the teaching of Mathematics and Science in the early grade years to capture the influence the language used had on performance in the two subjects. To achieve the objective of this study, two standard one classes in Kiambu County were purposively sampled. Learners in the experimental class were taught Mathematics and Science using Gĩkũyũ while those in the control class were taught the two subjects using English. A pre-test and a post-test were administered before and after the teaching. Afterwards, the scores recorded in both tests were analyzed quantitatively using the Levene's Test for Equality of Variances and the emerging patterns discussed. The general finding is that teaching Mathematics and Science using Gĩkũyũ is an effective strategy that improves the performance of the two subjects in Kenyan primary schools. The study, therefore, recommends that Gĩkũyũ (and other mother languages) be adopted as a legitimate language of mathematical and scientific communication in areas where the language is spoken in order to facilitate multilingual learners' participation and success in Mathematics and Science.
Keywords: Mathematics, Science, Gĩkũyũ, English, mother language

INTRODUCTION

In the celebration of the International Mother Language Day (IMLD) in Kenya hosted at Kenyatta University on 21st February, 2014, under the theme: "Local Languages for Global

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Citizenship: Spotlight on Science," and which were organized by the Bible Translation and Literacy (BTL) of Kenya, the Kenya National Commission for UNESCO and Kenyatta University Institute of African Studies, and which the author of this paper attended as a member of the Multilingualism Network of East Africa (MLEN), the role of African languages in pedagogy was explored at length. The year's IMLD fete came against a backdrop of the raging debate of reintroduction of vernacular in the teaching process in the Kenyan schools as stipulated by the Ministry of Education through the Sessional Paper 14 of 2012 on reforming education and training sectors in Kenya (The Republic of Kenya, 2012). In a keynote address by Prof. Kithaka wa Mberia, a celebrated linguist in Kenya, he quipped: What is the role of learners' first language (L1) in early childhood language pedagogy in Kenya? This question, though not new, provoked the author of this paper to critically assess the above statement and specifically the relation between language and the performance of Mathematics and Science in Grade one in Kenyan primary schools given the negative attitude many Kenyans have towards the use of mother language in schools.

As highlighted in the introductory paragraph above, the problem of language proficiency as an obstacle to learning Mathematics and Science in Africa, for example, is a challenge (Adler, 2001; Howie, 2002). Unfortunately, the importance of the language factor by educators and researchers in both the research and practice domains is "little more than lip service" (Ellerton & Clarkson, 1996, p.1017). According to Webb (2010), for example:

> Classroom studies in several sub-Saharan states reveal that using a language that is not the learners' home language coerces educators to use teacher-centered methods of instruction which include chorus teaching, repetition, memorization, and recall (p.4).

In Mathematics, for example, the language used to convey ideas to students is abstract and replete with symbols (Langa, 2006) that differ from those of everyday language (Secada, 1992; Cuevas, 1984; Mestre, 1988), and this has become a topic of increased concern to Mathematics educators in recent years (Cuevas, 1984). Durkin (1991), for instance, argues that "Mathematics education begins in language, it advances and stumbles because of language, and its outcomes are often assessed in language (p 3).This quotation captures the important role of language as a resource in the teaching and learning of Mathematics. The same can be said of Science.

Although Kenyan primary schools have a home language as the language of learning and teaching (LoLT) in the first three years of schooling, the crossover to English as medium of instruction is normally made in Grade 4 (Koech, 1999)[1]. This is because learners at this level are supposed to have acquired a minimal threshold level of proficiency in English, a level of Cognitive Academic Language Proficiency (CALP), to function effectively on academic tasks that are cognitively demanding (Cummins, 1986). But is the language

[1] Koech was the Chairman of the Commission mandated in 1999 to recommend ways and means of enabling the education system to facilitate national unity, mutual social responsibility, accelerated industrial and technological development, life-long learning, and adaptation in response to changing circumstances in Kenya.

policy implemented in the classroom? Thus, it is against this backdrop that this study explores the effectiveness of English and Gĩkũyũ[2] in the teaching and learning of Mathematics and Science in multilingual contexts in Kenyan primary schools.

STATEMENT OF THE ISSUE

Despite the evidence from multilingual education research that states the cognitive, linguistic, personal and educational development benefits accrued when a child is introduced to formal learning in the mother language, obstacles to the acceptance of its use and implementation in education in Africa are enormous (Gacheche, 2010). The findings of a national Commission on education (Government of Kenya, 1999) observed that majority of elementary schools did not use mother language in their teaching. In the same vein, a study done in Kenya (Begi, 2014) to establish whether teachers in the early grade years were using mother language as a language of instruction as per the language policy points out that over 60% were using English instead of the mother language. The same study reports that 80% of the sampled parents did not support their children being taught in mother language. The media in Kenya, in their editorials, have indicated that the use of mother language has no educational advantages. Are such teachers and parents in Begi (2014) and media writers aware of the advantages of introducing the children to formal learning in languages that they understood? Is the academic performance influenced by the language used? A study that would focus on finding out whether a child's performance in Mathematics and Science, two key focus subjects in Kenya's education system, would be influenced by the language used (mother language and English) was timely in addressing some perceptions held by significant sections of the Kenyan society and beyond.

RATIONALE

First, our choice of Mathematics as a subject of study is based on the following reasons. First, in order to achieve the necessary in-depth mathematical understanding, effective communication of mathematical ideas is key (Thurston, 1995), since language forms an integral part of this communication. Equally, Secada (1992) argues that language is crucial for mathematical reasoning and for communicating ideas, claims, explanations and proofs. Anstrom (1997) puts is clearly that:

> Command of mathematical language plays an important role in the development of mathematical ability. The importance of language in mathematics instruction is often overlooked in the mistaken belief that [M]athematics is somehow independent of language proficiency. However, particularly with the increased emphasis placed on problem solving, command of mathematical language plays an important in the development of mathematical ability (p.25).

[2] Gĩkũyũ is a language in the Central Bantu branch of the Niger – Congo family spoken primarily by the Agĩkũyũ of Kenya. Gĩkũyũ belongs to the Kamba-Kikuyu subgroup of Bantu and is spoken in an area extending from Nairobi to the southern and southwestern slopes of Mt. Kenya in Kenya.

Similarly, according to National Council of Teachers of Mathematics [NCTM] (2000), Mathematics power is rooted in a strong conceptual understanding of Mathematics, and this conceptual base is best developed through concrete experiences and language. Several studies have also shown that the language problem is one of the factors contributing towards the poor performance of many students in Mathematics in multilingual contexts (Secada, 1992; Barton & Neville-Barton, 2003) since Mathematics register is abstract and non-redundant (Langa, 2006). Further, another reason why the language factor needs special attention is the fact that many learners are currently learning Mathematics in their second or third language (Ellerton & Clarkson, 1996). Moreover, research demonstrates that Mathematics alone is a language that is more complex than everyday English (Cuevas, 1984).

Second, our motivation to study Science is based on several reasons too. According to Wellington & Osborne (2001), one of the major difficulties experienced by learners of Science is learning "the language of science" (p.1). Thus, paying attention to language is primary in order to improve the quality of science education and every lesson should by implication, be a language lesson (Wellington & Osborne, 2001, p.3). Similarly, in a study on second language learning in Science, Rollnick (2000) notes:

> It is acknowledged that expecting students to learn a new and difficult subject through the medium of a second language is unreasonable, giving them a double task of mastering both science content and language (p. 100).

As the above quotation attests to, the task of learning Science entails the acquisition of two conceptually difficult and different skills at once - one is being related to language and the other to Science content. As Howie (2003) claims the most significant factor in learning Mathematics and Science is whether learners are fluent in English to understand the esoteric terms used.

LITERATURE REVIEW AND THEORETICAL BASES

There has been a good deal of research on the role of language in mathematics classrooms (O'Halloran, 2005; Pimm, 1987; Bartolini Bussi, 1998; Ellerton, Clarkson, & Clements, 2000) and the role of language in Science (for example, Wellington & Osborne, 2001; Rollnick, 2000) and they all show that poorly developed language skills in the Language of Learning and Teaching) affect performance. Lim (1998, as cited in Yushua, 2004), for instance, studied the relationship between language and Mathematics among Korean–American students and noted that bilingual students' success in problem solving is intertwined with their level of proficiency in English. The relationship between language proficiency and Mathematics performance has also been documented by researchers such as De Avila (1980), who found that the low achievement in mathematics of Latino English-language learners (ELL) can be attributed to low levels of English proficiency. Drawing on her analysis of South Africa's poor performance in the Third International Mathematics and Science Study of 1995, Howie (2003), on the other hand, argues that the solution to improving South African second language learners' performance in Mathematics is to develop their English language proficiency. In an article titled: "Why

don't kids learn math and science successfully?" Howie is quoted as saying that the most significant factor in learning Science and Mathematics is not whether the learners are rich or poor; it is whether they are fluent in English. In the same article, Howie makes an impassioned call on South Africa to choose only one language for teaching and learning Mathematics in multilingual classrooms.

Langa (2006) presents an investigation on how learners' home language can be used as a support for learning Mathematics. This qualitative case study was conducted in Phelindaba Primary School where learners use English as the language of learning and teaching. Phelindaba Primary School worked in collaboration with the Home Language Project to facilitate the learning of Mathematics using the learners' home language as a resource. Langa (2006) found that when learners use their home languages they interact better with their peers, the teachers and their tasks. The study also found that learners used home languages to achieve conceptual understanding, procedural fluency, adaptive reasoning and strategic competence, which would in turn develop their productive disposition (Langa, 2006). Similarly, Whale (2012) noted that using the learners' home language enhances communication and mathematical reasoning. Clarkson (1991) conducted a study in Papua New Guinea and noted that the influence of the learners' home language is cognitively important from primary school. He argues that the use of the learners' home languages could be used to good effect in the classroom to access the mathematical ideas of local cultures in the local language, without the fear of disadvantaging learners. However, Setati and Adler (2001) noted that while research on the relationship between learners' first language and learning has drawn much criticism because of its cognitive orientation, it is supportive of the maintenance of learners' home languages in their mathematics learning.

This study is guided by Vygotsky's theory of socio-cultural development[3]. According to Williams and Burden (1997), the sociocultural theory posits that learning experiences should be meaningful and relevant to the individual. Second, the theory opposes the idea of the discrete teaching of skills and argues that meaning should constitute the central aspect of any unit of study (www.ukessays.co.uk › Essays › English Language). Vygotsky argues that the speech structures mastered by the child become the basic structures of his thinking. Further, he argues that language and thinking can only develop if there is a social interaction between the child and an adult (Williams & Burden, 1997). Therefore, the social environment helps the child's cognitive development since the early word-meanings thus acquired become the embryos of concept formation. The implication is that using the child's home language or the language that is acquired in the child's immediate environment, which forms part of culture, is required for concept formation and thus learning in order to comprehend meaning. Thus, the surrounding culture

[3] Vygotsky's sociocultural theory of human learning describes learning as a social process and the origination of human intelligence in society or culture. The major tenet of Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition.

provides a child with the processes or means of their thinking (Vygotsky, 1962). This is probably what Vygotsky recognized as the assistance or scaffolding needed to bring about new skills and concepts within a child's Zone of Proximal Development (ZPD) https://prezi.com/.../learning-approaches-theory-and-practice/[4].

RESEARCH METHOD

Research Design

The research design for this study is eclectic in nature. First, it is an action research employing a mixed method design of quantitative and qualitative data. Quantitative data helped determine if there was a difference in test scores between pupils taught Mathematics and Science in Gĩkũyũ and those taught the same subjects through English. Creswell (2012) supports the use of both qualitative and quantitative approaches in tandem so that the overall strength of a study is greater than either one on its own. On the other hand, the action research design was implemented because the research took place in the classroom with the author of this paper as the researchers (Ferrance, 2000). Second, the study also employed a case study research. A case study research is an approach that supports deeper and more detailed investigation of the type that is normally necessary to answer how and why questions (Yin, 1994, p. 9)[5]. Case studies have often been viewed as a useful tool for the preliminary, exploratory stage of a research project, as a basis for the development of the "more structured" tools that are necessary in surveys and experiments (Rowley, 2002, p.16). According to Eisen-hardt (1989), case studies are "particularly well suited to new research areas or research areas for which existing theory seems inadequate (p. 548). A case study research was chosen because the case involved the teaching of Mathematics and Science, but the case could not be considered without the context, Kiambu County, Kenya, and more specifically, the classroom settings. Thus, it was in these settings that the teaching of Mathematics and Science took place. It would have been impossible for the author to have a true picture of the learners without considering the context within which the teaching occurred. This is why a case study research was deemed appropriate.

Study Locale, Population and Sample Size

Given the focus of the study, it was important to get an area in which the learners' home language is predominantly in teaching and learning in schools. Therefore, Kiambu County, Kenya, was purposively sampled. This is because in purposive sampling, researchers pick cases to be included in the sample. In this way, "they build up a sample

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[4] An important tenet of Vygotsky's theory is the idea that the potential for cognitive development is limited to a "zone of proximal development" (ZPD). This "zone" is the area of exploration for which the student is cognitively prepared, but requires help and social interaction to fully develop (Moll, 1994). The Vygotskian approach to early childhood education focuses on the activities and interactions that are most beneficial to young children in learning.

[5] The case is defined by Miles and Huberman (1994) as, "a phenomenon of some sort occurring in a bounded context. The case is, "in effect, your unit of analysis" (p. 25).

that is satisfactory to their needs" (Cohen and Manion, 1994, p. 89). The researchers, who are proficient in Gĩkũyũ and English, took part in the teaching of Mathematics and Science in Grade 1classes.

Data Collection Procedures and Analysis

Pre-tests on Mathematics and Science were administered by the researchers on the first day to the Grade 1 classes (cf. Appendix A and C). The Mathematics test contained twenty questions and was designed from Grade one text book (Nderitu, Kihara & Ong'uti, 2011). Similarly, the Science test contained twenty questions and was designed from Grade one text book (Berluti, Njenga & Embeywa, 2003). The pre-tests were marked and scores entered. On the second day, the researchers introduced the topic of additions and subtraction to Grade 1 classes, the experimental class, using Gĩkũyũ for a period of 35 minutes. The researcher, for example, translated and explained the mathematical terms "plus," "subtract," "remain," "left" and "take away" in Gĩkũyũ. The researchers also taught the topic "cleaning the body" to the experimental class, using Gĩkũyũ for a period of 35 minutes. Anatomical terms, for example, "fingernails", "hands", "toes", "faces", "eyes", "nose", "gums", "hair" and "teeth" and items that are normally used for cleaning the body like "toothbrush and toothpaste", "comb", "soap", "towel" and "handkerchief" were explained to the pupils in Gĩkũyũ. For the control classes, the two areas of additions and subtraction and the topic "cleaning the body" were taught for a period of 35 minutes using English. Post-tests, the same tests administered as the pre-tests, were given to the pupils on the third day. The researchers scored the post-tests and generated quantitative data which were analyzed using the Statistical Package for Social Sciences (SPSS). Afterwards, the scores recorded in both pre-tests and post-tests were analyzed quantitatively using the Levene's Test for Equality of Variances. The results were then presented in tables showing means and standard deviations and levels of statistical significance and the emerging patterns discussed.

FINDINGS

The Table below presents the results of data analysis and the interpretation and the discussion of the emerging patterns is based on these results.

Table 1. The mean and standard deviations of differences between the pretest and posttest on the experimental and control groups

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Maths diff	Experimental	29	4.17	3.095	.575	3.00	5.35	0	11
	Control	15	-.20	.414	.107	-.43	.03	-1	0
	Total	44	2.68	3.269	.493	1.69	3.68	-1	11
Science diff	Experimental	29	1.14	2.875	.534	.04	2.23	-5	8
	Control	15	.13	2.774	.716	-1.40	1.67	-5	4
	Total	44	.80	2.850	.430	-.07	1.66	-5	8

Table 1 above displays the means and standard deviations of the differences between the pretest and posttest on the experimental and control groups. As indicated in the Table above, the mean difference in the experimental group in both subjects is higher than that in the control group. The mean score obtained in the post test examination is higher than that in the pretest on the experimental group. On the other hand, the mean score of the pretest and posttest for the control group in the two subjects is more or less the same.

An analysis of variance (ANOVA) on the differences between the pretest and post test scores is also performed to determine whether the treatment (use of mother language on teaching) influences the performance of students in Mathematics and Science. The table below shows the results as obtained when we apply this test using the SPSS.

Table 2. Differences between the pretest and post test scores

		Sum of Squares	df	Mean Square	F	Sig.
Maths diff	Between Groups	189.008	1	189.008	29.343	.000
	Within Groups	270.538	42	6.441		
	Total	459.545	43			
Science diff	Between Groups	9.977	1	9.977	1.235	.273
	Within Groups	339.182	42	8.076		
	Total	349.159	43			

Table 2 above and Table 3 below show that there is a statistically significant relationship between the use of mother language and the performance of Mathematics subject, that is, the Sig=.000. On the performance of Science; however, the value for Sig is .273 which is above 0.05 hence we accept the null hypothesis that there is no influence on the use of mother language on the performance of science. This is also evident from the correlation table below.

Table 3. Correlation between difference in scores between the pretest and posttest and the different groups (experimental and control)

		Group	Maths diff	Science diff
Group	Pearson Correlation	1	-.641**	-.169
	Sig. (2-tailed)		.000	.273
	N	44	44	44
Maths diff	Pearson Correlation	-.641**	1	-.017
	Sig. (2-tailed)	.000		.912
	N	44	44	44
Science diff	Pearson Correlation	-.169	-.017	1
	Sig. (2-tailed)	.273	.912	
	N	44	44	44

**. Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION OF FINDINGS

The general finding of the study indicates that the use of Gĩkũyũ (and subsequently home languages) in the teaching of Mathematics and Science is effective and subsequently influences performance (cf. Table 1). The statistics indicates that the learners who were

exposed to Gĩkũyũ did much better in the posttest than their colleagues who were taught Mathematics and Science through English (cf. Table1). This finding suggests that Gĩkũyũ may have successfully scaffolded and promoted mathematical and scientific proficiency.

First, the performance of Mathematics improved after the learners were taught using the mother language (cf. Tables 1). This corroborates past studies which have proven that the use of native language in a Mathematics classroom enriches students' understanding of mathematical concepts (Adler, 1998, 2001; Setati, 1998; 2002; Setati and Adler, 2001; Setati and Barwell, 2006). Conversely, the performance of Mathematics is lower when learners were taught using English than when Gĩkũyũ was used (cf. Table 1). This is in line with Setati and Adler's (2001) argument that in multilingual settings, teachers have to teach English at the same time as they have to teach Mathematics since learners have not acquired the minimal threshold level of proficiency in English (Cummins, 1986). Similarly, Zevernbegen (2001) notes that where there is a great continuity between the home and school, there is a greater chance of success in Mathematics since "classroom interactions are imbued with cultural components that facilitate or inhibit access to the mathematical content" (p.204).

In Science, the performance also improved after the learners were taught using the mother language (cf. Tables 1). This improved performance is consonant with past literature which shows that the use of mother language enhances sense making, understanding of new ideas and conceptual discourses (Setati, 1998; Setati & Adler, 2001; Setati, Molefe & Langa, 2008). Thus, having used Gĩkũyũ to teach Science may have improved the comprehension of scientific terminologies and consequently the performance of Science in the posttest. Home languages are, therefore, fundamental for the learning of Science since understanding new ideas is a process that requires cultural tools. According to Setati (2002), when English is the sole language used, pupils are restricted in terms of classroom engagement and discussion probably contributing to low performance. Similarly, Webb (2010) notes that "using a language that is not the learners' home language coerces educators to use teacher-centered methods of instruction which include chorus teaching, repetition, memorization, and recall (p.4). This could probably have contributed to the lower performance in the Science subject when English is used to teach Science than when Gĩkũyũ is used. Home languages, therefore, are imperative to achieve higher levels of performance in both Mathematics and Science.

RECOMMENDATIONS

The findings of this paper indicate that the use of Gĩkũyũ could have implications to the teaching of Mathematics and Science to Grade one learners in Kenyan primary schools. The findings could, therefore, persuade educators on the need to tap on the richness of home languages to create opportunities for learning (Raborn, 1995). Thus, Gĩkũyũ (and perhaps other home languages) should be adopted as a legitimate language of mathematical and scientific communication in areas where the language is spoken in order to facilitate multilingual learners' participation and success in Mathematics and Science. According to Cummins and Swain (1986), for example, to achieve full first

language and cognitive development, the home language needs to be used as the medium of instruction at least for the first few years of primary school at a minimum.

Second, this paper recommends the incorporation of mother languages in the curriculum implementation given that learner's opportunities to reach higher levels of comprehension in Mathematics and Science require a variety of linguistic skills that second-language learners may not have mastered. Such a curriculum would scaffold the development of mathematical and scientific languages. This is possible since according to Bamgbose (2000), the use of indigenous languages in primary education has been successful in Nigeria. African languages have also successfully been used in education, for example, in South Africa with her 11 official languages (Desai, 2003), Oromo in Ethiopia, and Somali in Somalia (Griefenow-Mewis, 2002). Similarly, a revolutionary approach where learners' home languages are used as media of instruction with other languages being subjects is also recommended. This is in line with Prah's (2003) argument that all African learners, "from primary to tertiary level, should be educated in local languages, home languages, mother languages" (p.23).

Further, we recommend a shift of attitude towards Gĩkũyũ (and other home languages) by learners in the classroom. For example, although most parents want their children to gain access to the socioeconomic benefits for their children that come with being competent in English, we argue for a deliberate, proactive and strategic use of the learners' home languages as a transparent resource in the teaching and learning of Mathematics and Science in multilingual environments. In addition, people should shun stigmatizing Gĩkũyũ (and other home languages) since according to Setati (2002) and Kobia (2007) when English is used as the sole language; the learners are restricted in terms of classroom engagement and discussion.

CONCLUSIONS

The statistical analyses above have shown that there is a significant improvement in performance in the classes that apply Gĩkũyũ in the teaching of Mathematics and Science. The findings enhance the validity of the Vygotskian claim concerning the relationship among language use, social interaction and reasoning development. In classes where Gĩkũyũ is used, test scores improved significantly. Thus, the study concludes that the use of home languages give learners an opportunity to participate in a range of discourses that are essential for learning Mathematics and Science. We also conclude that not only is language used by teachers to communicate information to learners, language is necessary for the complete formulation of Mathematical and Scientific concepts and principles. Thus, Gĩkũyũ (and perhaps other home languages) should be adopted as a legitimate language of mathematical and scientific communication in Grade one classes in Kenyan primary schools.

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Appendix A: Mathematics Test

1) There were two birds on a tree. Three more birds came. How many birds are there altogether?
2) Mutuku drank 4 bottles of soda and James drank 5. How many bottles of soda did they drink altogether?
3) Luyombo had 4 bags of maize. He bought 4 more bags. How many bags did he have altogether?
4) Jeska's cow gave her 5 tins of milk in the morning and 4 in the evening. How many tins did Jeska get that day?
5) Eunice brought 4 cans of water in the morning. She brought 2 cans in the evening. How many cans of water did she bring altogether?
6) The shopkeeper sold 2 packets of tea on Monday. He sold 5 on Tuesday. How many packets did he sell in the two days?
7) Atieno bought a pen at 10 shillings. She also bought a book at 5 shillings. How much money did she pay for the two items?
8) Rahab bought a sweet at 7 shillings and a cake at 4 shillings. How much did she pay?
9) Maria had 12 eggs. John gave her 3 more eggs. How many did she get in total?
10) Twenty plus thirteen is equal to?
11) Eight oranges take away five oranges is……oranges.
12) Simbwa had 6 goats. He sold 2. How many goats does he have now?
13) Nangoli had 3 bananas. She ate 3. How many bananas were left?
14) Juma had 7 books. He gave Ali 4 books. How many books are left?
15) There were 39 pupils in a class. 3 pupils came late. How many were not late?
16) There are 3 sweets. Remove 2. How many remain?
17) There are 6 glasses. How many are left when 3 are subtracted?
18) There were 5 pencils on the table. John took 1. How many were left?
19) Kamau made 6 carvings. He sold 3. How many were left?
20) In Nafula's class, there are 13 pupils in the choir. 6 stand at the front. How many stand at the back?

Appendix B: Mathematics Test in Gĩkũyũ

1. Nĩkwarĩ na nyoni igĩrĩĩ mũtĩ igũrũ. Ingĩ ithatu igĩũka. Nĩ nyoni cigana ciothe hamwe?
2. Mutuku anyuire cuba inya cia soda na James ithano. Manyuire cuba cigana cia soda?
3. Luyombo arĩ na mĩhuko ĩna ya mbembe. Akĩgũra mĩhuko ĩngĩ ĩna. Arĩ na mĩhuko iigana yothe?
4. Ngombe cia Jeska imũheiire ndoo ithano cia iriia rũcini na inya hwainĩ. Oniire ndoo cigana mũthenya ũcio?
5. Eunice agũrire mĩtungi ĩna ya maĩi rũcini. Acoka agũra ĩĩrĩ hwainĩ. Agũrire ĩigana yothe?
6. Mwendia nduka endirie mbagiti igĩĩrĩ cia macani mwambĩirĩrio. Akĩendia ithano wakerĩ. Endirie mbagiti cigana ciothe?

7. Atieno agũrire karamu siringi ikũmi. Agĩcoka akĩgũra ibuku siringi ithano. Ararĩhire mbeca cigana ciothe?
8. Rahabu agũrire thwiti siringi mũgwanja na keki siringi inya. Arĩhire mbeca cigana?
9. Maria arĩ na matũmbi ikumi na merĩ. John akĩmũhe matumbĩ mangĩ matatũ. Ena maigana mothe?
10. Kĩbau kũongerera ikũmi na ithatũ nĩ cigana?
11. Macungwa manana kũruta macungwa matano nĩ macungwa maigana?
12. Simbwa arĩ na thenge ithatũ. Akĩendia igĩrĩ. Ena thenge cigana rĩu?
13. Nangoli arĩ na marigũ matatũ. Akĩrĩa matatũ. Matigarire maigana?
14. Juma arĩ na mabuku mũgwanja. Akĩhe Ali mana. Matigarire maigana?
15. Kwarĩ na arutwo mĩrongo ĩtatũ na kenda kĩrathi kĩmwe. Arutwo atatũ magĩũka macereirwo. Nĩ aigana matacereirwo?
16. Hena thuiti ithatũ. Ruta igĩrĩ. Ĩgũtigara cigana?
17. Hena ngirathi ithathatũ. Hegũtigara cigana ithatũ ciarutwo?
18. Harĩ na tũramu tũtatu metha igũrũ. John akĩoya kamwe. Twatigarire tũigana?
19. Kamau athondekire mĩhiano ĩtandatũ. Akĩendia itatũ. Yatigarire igana?
20. Kĩrathi kĩa Nafula kĩna arutwo ikũmi na atatũ kwayaini. Atandatũ marũgamaga mbere. Nĩaigana marũgamaga thutha?

Appendix C: Marking Scheme for Mathematics Test in both English and Gĩkũyũ

1)	5	Ithano
2)	9	Kenda
3)	8	Ĩnana
4)	9	Kenda
5)	6	Ĩtandatũ
6)	7	Mũgwanja
7)	15	Ikũmi na ithano
8)	11	Ikũmi na ĩmwe
9)	15	Ikũmi na matano
10)	33	Mĩrongo ĩtatũ na ithatũ
11)	3	Ithatũ
12)	1	Ĩmwe
13)	None	Noti
14)	3	Matatũ
15)	36	Mĩrongo ĩtatũ na atandatũ
16)	1	Ĩmwe
17)	0	Noti
18)	2	Twĩrĩ
19)	3	Ithatũ
20)	7	Mũgwanja

Appendix D: Test on Science

1) We wash our hands with water and ----------(soap, flour)
2) We must wash our hands our hands after visiting……..(friends, the toilet)
3) Dirty hands will make us……..(sick, fat)

4) We should keep our fingernails……(short, long)
5) Washing hands makes us……(clean, good)
6) Toes must be cleaned to avoid……..(smell, pain)
7) When we wake up, we……our faces. (wash, paint)
8) We use a……to wipe our faces (towel, blanket)
9) When washing the face with soap, our eyes should be ……(open, closed)
10) We use a handkerchief to……our noses (clean, block)
11) Handkerchiefs should not be……(shared, burnt)
12) We comb our hair using……..(fingers, a comb)
13) ……..hair is easy to keep clean. (short, long)
14) ……hair is difficult to keep clean. (short, long)
15) Tidy hair looks……..(bad, good)
16) We wash our bodies……..(every day, once a week)
17) We clean our bodies to……..diseases. (bring, avoid)
18) We clean our teeth using……(toothbrush and toothpaste, soil and water)
19) Clean teeth do not……..(shine, smell)
20) Bleeding gums are……..(brown, sick)

Appendix E: Test on Science in Gĩkũyũ

1) We wash our hands with water and……..(soap, flour)
Twĩthambaga moko na maĩ na……(thabuni, mũtu)

2) We must wash our hands after visiting……(friends, the toilet)
Twagĩrĩirwo nĩ gwĩthamba moko thutha wagũcerera……(arata, kĩoro)

3) Dirty hands will make us……..(sick, fat)
Moko mena gĩko no matũtue ……..(arwaru, anoru)

4) We should keep our fingernails……(short, long)
Twagĩrĩirwo nĩ kũiga ndwara ciitũ ciĩ……(nguhĩ, ndaihu)

5) Washing hands makes us……..(clean, good)
Gwĩthamba moko gũtũtuaga……..(atheru, eega)

6) Toes must be cleaned to avoid……..(smell, pain)
Ndwara ciagĩrĩirwo gũthambio nĩguo kũgirĩrĩia……(mũnungo, ruo)

7) When we wake up, we……our faces. (wash, paint)
Tũokĩra, tu……mothiũ maitũ. (thambia, kũhaka rangi)

8) We use a……to wipe our faces. (towel, blanket)
Tũhũthagĩra……..kũhura mothiũ maitũ. (taurũ, mũrĩngĩti).

9) When washing the face with soap, our eyes should be …… (open, closed)
Tũgĩthambia ũthiũ na thabuni , maitho maitũ magĩrĩirwo. (kũhingũrwo, kũhingwo).

10)We use a handkerchief to……our noses. (clean, block)
Tũhũthagĩra ngacibũ gũ……maniũrũ maitũ. (gũthambia, kũhinga)

11)Handkerchiefs should not be……(shared, burnt)
Ngacibũ citiagĩrĩirwo……(kũgayanwo, gũcinwo)

12)We comb our hair using…….. (fingers, a comb)
Tũcanũraga njũĩrĩ ciitũ na……..(ciara, gĩcanũri)

13)……..hair is easy to keep clean. (short, long)
Njuĩrĩ……..nĩ raithi kũiga ĩĩ theru (nguhĩ, ndaihu)

14)……hair is difficult to keep clean. (short, long)
Njuĩrĩ ……nĩ nditu kũiga ĩĩ theru (nguhĩ, ndaihu)

15)Tidy hair looks……(bad, good)
Njuĩrĩ theru ikoragwo ĩĩ……..(njũru, njega)

16)We wash our bodies…….. ……..(every day, once a week)
Twĩthambaga mĩĩrĩ iitũ……..(omũthenya, rĩmwe wiki)

17)We clean our bodies to……..diseases. (bring, avoid)
Twĩthambaga mĩĩrĩ iitũ……..mĩrĩmũ. (kũrehe, kũgirĩrĩria)

18)We clean our teeth using……(toothbrush and toothpaste, soil and water)
Twĩthambaga magego na…….. …. (mũkinyĩ na ndawa ya magego, tĩĩri na maĩ)

19)Clean teeth do not……..(shine, smell)
Magego matheru mati……..(henagia, nungaga)

20)Bleeding gums are……(brown, sick)
Kĩini kĩroira nĩ ……..(gĩtĩrĩ, kĩrwaru)

Appendix F: Marking Scheme for Science Test in both English and Gĩkũyũ

1) Soap	Thabuni
2) The toilet	Kĩoro
3) Sick	Arwaru
4) Short	Nguhĩ
5) Clean	Atheru

6) Smell	Mũnungo
7) Wash	Thambia,
8) Towel	Taurũ
9) Closed	Kũhingwo
10)Clean	Gũthambia
11)Shared	Kũgayanwo
12)A comb	Gĩcanũri
13) Short	Nguhĩ
14)Long	Ndaihu
15)Good	Njega
16)Every day	Omũthenya
17)Avoid	Kũgirĩrĩria
18)Toothbrush and toothpaste	Mũkinyĩ na ndawa ya magego
19)Smell	Nungaga
20)Sick	Kĩrwaru