2.6 Zambia

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2.6.1 School Curriculum

The latest mathematics syllabus for Grades 1–7 in Zambia was published in 2003 and that for Grades 10–12 in 2002, although that for Grades 8 and 9 has not been renewed since 1983. The general aims of the syllabus for Grade 1–7 are as follows.

1. To equip the child with necessary knowledge and skills to enable him/her to live effectively in this modern age of Science and Technology and to contribute to the social and economical development of Zambia.
2. To stimulate and encourage creativity and problem solving.
3. To develop the mathematics abilities of a child to his/her full potential and assist him/her to study Mathematics as a discipline and to use it as a tool in various subject areas.
4. To assist the child to understand mathematical concept in order that he/she may better comprehend his/her environment.
5. To develop in the child an appreciation of Mathematics in the traditional environment.
6. To develop interest in Mathematics and encourage a spirit of inquiry.
7. To build up understanding and appreciation of basic mathematical concepts and computational skills in order to apply them in everyday life.
8. To develop clear mathematical thinking and expression in the child
9. To develop ability to recognize problems and to solve them with related
10. To develop and foster order, speed and accuracy.
11. To provide the child with the necessary mathematical knowledge and skills in order for him/her to be productive and self reliant.
12. To develop in the child a positive attitude towards production, entrepreneurialship and self-reliance.
13. To provide the necessary mathematical pre-requisites for further education.

(Mathematics Syllabus Grade 1-7, 2003, pp.5,6)

The mathematics syllabus in Zambia has the feature of being like a "spiral"; the same topics can be found in the syllabus of several grades and taught repeatedly in the period of 9 years of basic education. This appears to be the effect of the British Mathematics Curriculum that was adapted during the "Modernization of Mathematics Education."

2.6.2 Basic Information

(1) Schooling Age

According to Zambian policy, children are expected to begin schooling at the age of 7. However, in practice, the ages at which children enter school vary because in certain cases, children who

reach the age of 7 are unable to find seats in schools, particularly in urban areas; while in certain cases parents are unable to raise money for school requirements and hence delay sending the child to school. In rural areas, certain children live at a substantial distance from a school and their parents only send their children when they are old enough to walk long distances to school. As a result of this, there is a wide range in terms of age of children within a class.

(2) School Calendar and Examination

The school year in Zambia begins in January and ends in December. The school year is divided into 3 terms, as shown in table 1, and each term has a duration of 3 months. There is a one-month break between each term.

Table 1. School calendar (year)

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
	1st Term			2nd Term				3rd Term			

At the end of Grade 7, students take a national examination and those who are able to attain the cut-off marks proceed to Grade 8. All items in the Grade 7 examination are multiple-choice and presented in English. Similarly, at the end of Grade 9, students take a national examination and those who qualify proceed to Grade 10. The plans are that in future, if there are sufficient number of seats available in Grade 8, students from Grade 7 must be promoted automatically to Grade 8.

(3) Promotion System

The school system in Zambia is changing from the system of 7 years of primary education, 2 years of junior secondary education, 3 years of senior secondary education, and 2–7 years of tertiary (higher) education to 9 years of basic education, 3 years of high school education, and 2–7 years of tertiary (higher) education.

This change is still underway; therefore, two school systems are coexisting at present. The speed of this school reformation is rather slow in rural areas; as a result of this, there are schools in these areas that continue to have only lower-basic (Grades 1–4) and middle-basic (Grades 5–7) grades, although they are known as basic schools.

Table 2. Education system in Zambia

Before Education Reform			
Primary School		Secondary School	
7 years		2 years (Lower)	3 years (Upper)
After Education Reform			
Basic School			High School
3 years (Lower)	4 years (Middle)	2 years (Upper)	3 years

(4) Medium of Instruction

The official language in Zambia is English, although there are approximately 72 tribes that have their own language (dialect), which is usually spoken in their homes. English is also the medium of instruction; therefore, teachers basically conduct lessons in every subject in English. However, students, particularly in the initial years of schooling, usually speak local languages outside classes and school. Thus, students—particularly in lower grades—face difficulty in

understanding or speaking English. Occasionally, certain teachers use a local language to explain certain things to students; however, the problem is that certain students may not understand the local language and therefore will not be able to communicate with the teachers. In certain cases, the teacher may not know how to speak the main local language.

2.6.3 Results from the First Year Field Survey

(1) Survey Schedule

A one-man delegation visited Zambia from January 17, 2005 to January 27, 2005 in order to facilitate the field survey with his Zambian counterpart. This implies that data collection was conducted just two weeks after the commencement of the first term. The detailed schedule for data collection is tabulated as follows.

Table 3. Schedule of data collection

Date	Activity
16th / Jan / 2005	Arrival in Lusaka, Zambia
17th- 19th / Jan / 2005	Preparation of the survey Discussion with District Education Offices and Targeted Schools
20th – 27th / Jan / 2005	Data collection in two sample schools in Lusaka Province and their subsequent remedial work
28th / Jan / 2005	Departure from Lusaka, Zambia

(2) Target Schools and Samples

[1] Sampling procedures

From among the 9 provinces in Zambia, Lusaka—the capital province—was selected as a sample due to the time constraints for completing data collection. According to the Central Statistic Office, the extra-departmental organization under the Finance Ministry, an urban area is defined by 3 criteria—population size, economic activity, and facilities available in the area[1]. Taking into consideration these criteria, from among 4 districts in the province, Lusaka District was selected to represent the urban area and Chongwe District to represent the rural area.

For the selection of average schools in both urban and rural areas, the survey team requested each District Education Office (DEO) to recommend appropriate schools. From the discussion with District Education Standards Officers (DESOs), we selected one average government school each from both urban and rural districts. The criteria taken into consideration were as follows:

a. Ranking of the sample schools according to the results of National Final Exam,

b. Social and economical strata in the catchment area of the sample schools.

However, the survey team was unable to go through the actual data related to the abovementioned criteria.

For the selection of a sample Grade 4 class in the urban average school, it was reported that classes are not formed according to the results of the students. Thus, they are all assumed as being uniform and one sample Grade 4 class was selected since the timing of its lesson was able

[1] In addition to this definition, an urban area must have a minimum population size of 5,000 people. The main economic activity of the population must be non-agricultural, such as wage employment. In addition, the area must have basic modern facilities such as piped water, tarred roads, post office, police station, health facility, etc.

to fit into the overall schedule for data collection. In the average rural school, there is only one Grade 4 class; thus, all the Grade 4 students have been targeted in this survey.

[2] Basic school information

As mentioned earlier, Zambia is currently transforming its school system from a 7-year primary and 5-year secondary education to a 9-year basic and 3-year high school education. Particularly in remote areas, there remain a few basic schools that accommodate only 4 grades due to a number of constraints. Due to these situations, there are various sizes of basic schools depending on the level of progress in their transformation; two of our sample schools are not exceptional.

The following table presents the details of the sample schools.

Table 4. Location of schools

	School location
Urban Primary School	2 km from the capital city, Lusaka
Rural Primary School	58 km from the capital city, Lusaka 13 km from District centre

[3] Size of samples and their distribution by school location, sex, and age

As mentioned earlier in sample procedure, we selected one class each from both urban and rural average primary schools. In the rural average school, there was only one Grade 4 class; therefore, we decided to include all the Grade 4 students in the class.

There were certain situations that made it difficult to determine the number of sample students in each school. Prominent among these situations were

a. Timing: The timing of our data collection overlapped with the registration period for both schools. This resulted in variability in the number of sample students. There were a few changes in the number of students due to the influx and outflux of repeaters from Grade 5 and to Grade 3, respectively.

b. Weather: The month of January is a part of the rainy season in Zambia. As a result, students' attendance actually depended on the weather. In the rural school, a number of students remained absent until the second day of our data collection due to the heavy rain in the morning.

Nonetheless, the following tables present the number and distribution of sample students by location, sex, and age. Due to the Government's policy of age restriction for school admission and existence of repeaters and dropouts, age distribution appears very wide and the peak is toward the older age group from the expected enrolling age of 10.

Table 5. Distribution of sample

	Grade	Male	Female	Total
Urban Primary School	4	29	21	50
Rural Primary School	4	16	17	33
Total	-	45	38	83

Table 6. Distribution of students' age

Age (years)	No. of Pupils		
	Urban	Rural	Total
8	0	0	0
9	1	1	2
10	3	3	6
11	8	14	22
12	7	2	9
13	20	10	30
14	9	1	10
15	2	2	4
Average	12.5 yrs	11.8 yrs	12.3 yrs

(3) Results of Student Questionnaire

Questionnaires were administered to the students by explaining the English version of each item in the questionnaire in Nyanja, which is the local language of instruction in the targeted districts. This method was agreed upon after observing that a majority of the targeted students did not possess sufficient reading comprehension in English. After having administered the questionnaire, the survey team also conducted a little remedial work individually with certain students in order to fill out the unanswered items or to confirm incorrectly marked items. In the rural school, the survey was conducted through individual interviews of the targeted students, and questionnaires were filled out by the Zambian counterparts. The followings are the major findings from the students' questionnaires.

[1] Frequency of use of English and Nyanja (local language of instruction in the area)

Unlike other participating countries, the survey team decided to question the frequency with which students use both the official and local languages of instruction in the targeted districts. In Zambia, in addition to the official language—English—7 major local languages have been selected as local languages of instruction in schools. Considering the composition of tribes in the concerned areas, one of these local languages was carefully decided upon and used in the schools. This arrangement can be said to be a sort of compromise as there are 73 tribes in the country. Therefore, it is possible that there are certain students whose mother tongue is different from the local language used in the schools and this situation may affect the achievement of students. In order to examine this influence, we had added an additional question to the questionnaire.

As shown in Table 5, only approximately 5% of all the targeted students answered that they either always or almost always speak English at home; all these students are from the rural school. This result may require some verification as it does not coincide with the achievement in mathematics tests.

On the other hand, a difference in the percentage of students who occasionally speak English can be explained by the difference in the number of opportunities these students have to interact with people other than their family members. It can be supposed that students in urban areas have a greater opportunity to interact with people around their house, in the market, etc.

With regard to the reasons behind the difference in the frequency in use of Nyanja between urban and rural schools, one reason is the uneven distribution of either fathers' or mothers' tribes in each school. 70–80 % of the students in the urban school have parents who are either Nyanja or its tribal cousin Benba; this figure is only approximately 30% in the rural school.

Similar to the case of speaking English, a difference in the level of interaction with people outside their houses can also contribute toward the difference in frequency of the use of Nyanja, as it is the most popular language of communication in public places in these districts.

Table 7. Pupil's distribution on frequency in use of English by location (%)

	Always	Almost Always	Sometimes	Never
Combined	1.2	3.7	65.9	29.3
Urban	0.0	0.0	76.0	24.0
Rural	3.1	9.4	50.0	37.5

Table 8. Pupil's distribution on frequency in use of Nyanja by location (%)

	Always	Almost Always	Sometimes	Never
Combined	42.7	25.6	30.5	1.2
Urban	44.0	34.0	20.0	2.0
Rural	40.6	12.5	46.9	0.0

Table 9. Pupil's distribution on their fathers' tribe by location (%)

	Nyanja	Bemba	Tonga	Lozi	Soli	Ndebele	Lenje	Others
Combined	41.0	20.5	2.4	7.2	4.8	12.0	4.8	7.2
Urban	50.0	32.0	4.0	12.0	0.0	0.0	0.0	2.0
Rural	27.3	3.0	0.0	0.0	12.1	30.3	12.1	15.2

Table 10. Pupil's distribution on their mothers' tribe by location (%)

	Nyanja	Bemba	Tonga	Lozi	Soli	Ndebele	Lenje	Others
Combined	46.3	13.4	11.0	4.9	1.2	7.3	4.9	11.0
Urban	58.0	16.0	16.0	6.0	0.0	0.0	2.0	2.0
Rural	28.1	9.4	3.1	3.1	3.1	18.8	9.4	25.0

[2] Possession of books and domestic items at home

Over 70 % of the targeted students in both urban and rural schools have 10 or less than 10 books at home. A majority of the targeted students in both schools have radios at home, while almost none of them have computers.

Table 11. Distribution of students' books (%)

	0-10 books	11-25 Books	26-100 books	100- books	No response	Crossed out
Combined	73.5	19.3	4.8	2.4	0.0	
Urban school	72.0	16.0	8.0	4.0	0.0	
Rural school	75.8	24.2	0.0	0.0	0.0	

Table 12. Distribution of students' home items (Yes, %)

	Calculator	TV	Radio	Desk	Quiet place	Dictionary	Books (Excluding text book)	Computer
Combined	39.8	56.6	91.6	39.8	50.6	34.9	56.6	2.4
Urban school	48.0	72.0	86.0	38.0	68.0	52.0	52.0	4.0
Rural school	27.3	33.3	100.0	42.4	24.2	9.1	63.6	0.0

Table 13. Students' attitude towards mathematics

Pupils' Perceptions	Average		
	Combined	Urban	Rural
1. I usually do well in mathematics	2.0	2.0	2.1
2. I would like to do more mathematics in school	1.5	1.4	1.7
3. Mathematics is harder for me than for many of my classmates	2.2	2.1	2.4
4. I enjoy learning mathematics	1.4	1.4	1.5
5. I am just not good at mathematics	2.5	2.1	3.2
6. I learn things quickly in mathematics	1.8	1.6	2.0
7. I think learning mathematics will help me in my daily life	1.9	1.6	2.4
8. I need mathematics to learn other school subjects	1.8	1.4	2.5
9. I need to do well in mathematics to get into the university of my choice	1.6	1.4	2.0
10. I need to do well in mathematics to get the job I want	1.7	1.3	2.0

The results presented in the above table reveal that students tended to have positive attitudes toward learning mathematics in schools as statements such as "I would like to do more mathematics in school," or "I enjoy learning mathematics" are valued positively. If we compare the perceptions of urban students with rural students, it may be stated that students in the rural school tended to be more neutral toward learning of mathematics than those in the urban school, particularly on questions regarding the meaning of learning mathematics in or outside school.

There is also an inconsistency in the urban students' perceptions toward their ability in mathematics. The positive statement of "I usually do well in mathematics," and negative ones such as "Mathematics is harder for me than for many of my classmates," and "I am just not good at mathematics" are equally perceived by students in the urban school.

[3] Frequency of students' activities in their mathematics lessons

The targeted students were asked to reveal the frequency of the following activities in their mathematics lessons according to f4 scales—1: every or almost every lesson, 2: about half of the lessons, 3: some lessons, or 4: never.

The table below shows that regardless of the location of the schools, a majority of the activities were not frequently conducted in class, except the following 3: "I practice adding, subtracting, multiplying, and dividing without using a calculator," I listen to the teacher talk," and "I work problems on my own."

Table 14. Students' activities in their mathematics lessons

Students' activities	Average		
	Combined	Urban	Rural
1. I practice adding, subtracting, multiplying, and dividing without using a calculator	2.1	1.3	3.3
2. I work on fractions and decimals	3.0	2.7	3.3
3. I measure things in the classroom and around the school	2.9	2.8	3.2
4. I make tables, charts, or graphs	3.1	2.8	3.5
5. I learn about shapes such as circles, triangles, and rectangles	2.2	1.7	2.9
6. I relate what I am learning in mathematics to my daily lives	2.5	2.0	3.4
7. I work with other students in small groups	2.6	2.0	3.5
8. I explain my answers	2.5	2.0	3.3
9. I listen to the teacher talk	1.3	1.4	1.1
10. I work problems on my own	1.8	1.7	1.9
11. I review my homework	2.2	1.8	2.9
12. I have a quiz or test	3.0	2.7	3.5
13. I use a calculator	3.4	3.0	4.0

[4] Students' perception of the school and teacher

Students were asked to rate their level of agreement with the following perceptions according to four scales—1: agree a lot, 2: agree a little, 3: disagree a little, or 4: disagree a lot.

The table below indicates that students in both locations have a positive opinion of their teachers and schools. On the other hand, students themselves believe that they are making an effort to do better in spite of their teachers' efforts and care.

Table 15. Pupils' perception towards school and teacher

Pupils' perceptions	Average		
	Combined	Urban	Rural
1. I like being in school	1.0	1.0	1.1
2. I think that students in my school try to do their best	1.9	2.0	1.8
3. I think that teachers in my school care about the students	1.1	1.1	1.1
4.I think that teachers in my school want students to do their best	1.1	1.2	1.1

[5] Time spent on other activities before or after school on a normal school day

According to the results shown below, approximately 40% of the students have no time to watch TV before or after school on a normal day. Almost 90% of the students do not have time to use the computer, and these figures are clearly related to the level of possession of these items.

On the other hand, over 40% of the students spend 1–2 hours to "play or talk with friends" and

"do jobs at home," while 65–75% of the students spent less than two hours to "play sports, " read a book for enjoyment," and "do homework."

Table 16. Pupils' activities before or after school on a normal school day (%)

	No time	Less than 1 hour	1-2 hours	More than 2 but less than 4 hours	4 or more hours
1. I watch TV	39.8	25.3	21.7	6.0	7.2
2. I play or talk with friends	0.0	24.1	45.8	13.3	16.9
3. I do jobs at home	2.4	25.3	44.6	18.1	9.6
4. I play sports	26.5	41.0	19.3	4.8	8.4
5. I read a book for enjoyment	27.7	48.2	13.3	2.4	8.4
6. I use computer	89.2	6.0	2.4	0.0	2.4
7. I do homework	7.2	65.1	19.3	6.0	2.4

[6] Number of family members including students themselves

According to the survey, a majority of the students in both urban and rural schools have 4–9 members in their families. However, students from the rural school tended to have more members than those from the urban schools.

Table 17. Distribution of students' family member

Family member	Pupils' Distribution		
	Combined	Urban	Rural
2-3 persons	8.4	12.0	3.0
4-6 persons	31.3	34.0	27.3
7-9 persons	37.3	38.0	36.4
10-12 persons	14.5	10.0	21.2
More than 12 persons	8.4	6.0	12.1

(4) Results of Achievement Test

Unlike what was done for the questionnaire, only the instructions for the achievement test were explained to the students in their local language of teaching at the beginning of the test. Thereafter, no further explanations were provided to the students regarding the test in order to avoid providing any clues to the answers.

[1] Students' achievements according to location and sex

The average score in the mathematics achievement test in Zambia was 12%. An examination of the average scores according to the categories reveal that they are also rather low regardless of location and sex. In this sense, it may not have much meaning to make a comparison across categories; however, if we dare do so, it may generally be stated that the difference between location (urban vs. rural) is much larger than that between sexes (male vs. female), as shown in the table below.

In detail, students in the urban school were able to achieve almost twice more than those in the rural school. According to sex, girl students performed better than boy students, which was

against our assumption.

Table 18. Distribution of students' right answer (%)

	Combined	Male	Female	Highest	Lowest
Combined	12.0	11.2	12.9	45.2	0.0
Urban school	15.1	14.4	16.0	45.2	0.0
Rural school	8.4	6.5	10.0	17.8	0.0

[2] Analysis of the results with regard to content domains

Similar to previous results in (1), the achievement of students is rather low across content domains. If the results are examined with regard to the type of questions, almost none of the students were able to answer the short-answer questions. With regard to multiple-choice questions, it appears that students were able to achieve slightly better in "measurement" and "algebra" in multiple-choice questions, although only a few students were responsible for this.

Table 19. Average rates of correct answers by content domain

Content domain	Multiple-choice		Short-answer		Total	
	No. of questions	Rates of correct answers (%)	No. of questions	Rates of correct answers (%)	No. of questions	Rates of correct answers (%)
Number	19	16.0	9	3.4	28	12.0
Measurement	12	20.5	4	0.0	16	15.4
Algebra	4	19.1	1	0.0	5	15.3
Data	4	16.8	4	0.3	8	8.5
Patterns, relations and functions	5	16.0	1	1.2	6	13.5
Geometry	4	12.4	6	3.7	10	7.2
Total	48	17.2	25	2.2	73	12.0

Table 20. Average rates of correct answers of content domain by urban and rural school (%)

Content domains	Urban school			Rural school		
	Multiple-choice	Short-answer	Total	Multiple-choice	Short-answer	Total
Number	20.1	5.1	15.3	11.2	1.4	8.1
Measurement	24.1	0.0	18.1	16.2	0.0	12.2
Algebra	21.7	0.0	17.4	16.0	0.0	12.8
Data	19.0	0.5	9.8	14.1	0.0	7.1
Patterns, relations and functions	21.3	2.2	18.1	9.7	0.0	8.1
Geometry	17.4	6.9	11.1	6.4	0.0	2.6

There was one aspect that was found strange in the multiple-choice questions. In a majority of the questions in the achievement test, 4 choices were provided. This implies that the rate of correct answers could be around 25%, even if students guess their answers. However, in all the domains, the rates were lower than 25%. A probable explanation for this is that almost 30% of

the students, on an average, either did not provide any answers at all or their answers were not meaningful.

Discussion

From the performance of the students in this survey, it can be said that a majority of the students were neither ready nor sufficiently competent to take this type of achievement test. With regard to the results from the questionnaire, certain factors from the viewpoints of either mathematics education or others must be indicated. In Zambian case factors in external subject education appear to affect students' actions more seriously. Prominent among them are as follows.

[1] Language

Language appeared to be one of the biggest factors that resulted in the low performances of students. As revealed by the questionnaire, over 90% of the students do not speak English frequently at home. Besides, reading comprehension in English was not sufficiently good to understand the level of language used in both the questionnaire and test. However, it must not be concluded that only their mother tongue must be used due to a number of reasons.

For example, a Zambian scholar expressed that there has been no attempt thus far to interpret the contents of mathematics to local languages in the written form; the contents are written in English. It was analyzed that this fact may have resulted in a certain understanding gap between learning in English and other mother tongues.

A second example may be with regard to the level of development in reading. While observing a lesson in one of the schools, there were several students who copied what the teacher was writing on the blackboard into a series of letters without spaces, which did not form words. This may reveal that such students did not obtain any meaning from the sentences written on the board. In such a case, there would not be much difference in giving written tests either in the local languages or English.

[2] Students' experience or preparedness for writing the exam

It appears that a majority of the students at this level were not used to taking tests that had an enormous volume of question papers, which were given to individual students. They were also not familiar with questions such as multiple-choice, sentence problems, open-ended questions, etc. In addition to the above, it was found that there are a number of skills required either explicitly or implicitly for taking exams. These could be understanding the multiple-choice answers in the context of the questions, matching the answer numbers to the actual written answers, recognizing the answering spaces for open-ended questions, deciphering the meaning of pictures in the context of the questions, etc, to mention a few.

A little more care must be given to knowing the extent that the students have developed such skills in writing exams and how far they can be trained in the targeted grade.

[3] Existence of silent responders

According to the findings in 2.2, there were a number of students who did not provide any answers or those that were meaningful; this made the results less credible for ascertaining the difficult, easy, or favorite topics for the students in Zambia.

On the other hand, this fact can be utilized for analyzing students' tendencies or preferences in answering questions by comparing the rates of responses with other findings in this survey.

For example, there is a large variation in the rates of students' responses toward answering questions, which varies from 87% to 6% on the opposite ends of the spectrum. By comparing

the type of questions according to the rates of responses with previous tests conducted by the school, the manner of solving questions, topics in the subject, a trend with regard to the experience of students with tests, their cognitive power, or preference of topics in mathematics may be ascertained.

Taking into consideration the abovementioned aspects, it is important to examine further the hindrances or perceptions that may impede the ability of the students to tackle questions not only from the viewpoint of mathematics education but also from the cognitive, cultural, and social viewpoints. This will, at a later stage, provide this research project with a few ideas to alter the current approach and adapt one that is more appropriate for ascertaining the real education scenario in countries such as Zambia.

2.6.4 Results from the Second Year Field Survey

(1) Survey Schedule

The survey was conducted during the period October 17–21, 2004; the details are provided in table 21.

Table 21. Schedule of data collection

Date	Activity
16th / Oct / 2005	Arrival to Lusaka, Zambia
17th / Oct / 2005	Discussion with Mr. Nkhata at University of Zambia
18th – 21st / Oct / 2005	Data collection in three sample schools
23rd / Oct / 2005	Departure from Lusaka, Zambia

(2) Target Schools and Samples

Until now, Urban School and Rural school A were selected as the target average schools. At this point, a comparison between the result of tests conducted with and without an explanation to the students in the local language will be provided. Rural School A has only one class in each grade; thus, an additional rural school must be included to make a comparison. Therefore, Rural School B was selected as an average rural school, located in Mazabuka District in the Southern Province of Zambia.

(Explanation in local language implies a translation, into the local language, of questions that are written in English, and an explanation regarding the manner in which to write the answers, particularly in the case of multiple-choice questions.)

Table 22. Location of schools

	School location
Urban Primary School	2 km from the capital city, Lusaka
Rural Primary School A	58 km from the capital city, Lusaka 13 km from District Centre
Rural Primary School B	24 km from District Centre

In the urban school, the test was conducted in 3 classes; however, it was observed that in one class, a teacher who was supervising the students provided them with a few answers. Therefore, the data pertaining to this particular class has not been included in the sample. Despite this, there were 2 classes out of which one was provided with an explanation of the test and the other

was not. Rural school B had 2 classes, although these were combined and one teacher taught both classes at the same time. In spite of this, one class was provided with an explanation of the test in local language and the other class was not. Rural school A had just one class, and the test was conducted with an explanation.

Table 23. Distribution of sample

	Grade	Boys	Girls	Total
Urban Primary School	4	34	35	69
Rural Primary School A	4	19	20	39
Rural Primary School B	4	37	12	49
Total	-	90	67	157

The achievement test included topics that students were expected to know in Grades 3–7, as shown in table 24. However, there were 2 questions that were not covered in the mathematics curriculum for Grades 1–7 in Zambia.

Table 24. Curriculum coverage of the achievement test

Question no.	Grade when covered
Q1 (1), Q1 (2), Q3 (1), Q3 (2) and Q4 (2)	Grade 3
Q2,	Grade 4
Q4 (1), Q4 (3), Q6 (1), Q6 (2), Q6 (3) and Q7	Grade 5
Q5 (1), Q5 (2) and Q5 (3)	Grade 6
Q8	Grade 7
Q9 and Q10	Not covered in any grade.

(3) Results of Achievement Test

The performance of the students who took the test is presented below, beginning with the overall performance, followed by the question-wise performance.

[1] Overall performance

Table 25 below shows the overall performance of students who took the test.

Table 25. Pupils' general performance

	Average	Male	female	Explanation	Without
Urban area	11.2%	12.1%	10.4%	15.6%	8.2%
Rural area	6.9%	5.8%	9.0%	8.7%	2.7%
All	8.8%	8.2%	9.7%	12.3%	6.2%

As can be seen from the above table, in the urban school, boys performed better than girls. There was also a large difference within the urban area between the performance of students who received explanation and those who did not—those who received the explanation performed better than those who did not. However, in the case of students in the rural area, girls performed much better than boys; however, even in this case the performance of those who received explanations was superior to those who did not. It is also evident that students in the urban school performed better than those in the rural one.

[2] Question-wise performance of students

Table 26 shows the question-wise performance of the students in the achievement test.

Table26. Question by question performance of pupils

	School in urban area			School in rural area		
	Total	With explanation	Without explanation	Total	With explanation	Without explanation
Q1 (1)	0%	0%	0%	26.1%	42.3%	17.4%
(2)	1.5%	3.6%	0%	20.5%	30.8%	17.4%
Q2	1.8%	7.1%	1.2%	1.1%	0%	0%
Q3 (1)	24.7%	42.9%	12.2%	9.7%	10.9%	2.2%
Q3 (2)	16.7%	20.8%	13.8%	8.7%	1.3%	8.7%
Q4 (1)	47.8%	64.3%	36.6%	15.1%	18.2%	0%
Q4 (2)	1.5%	3.6%	0%	1.4%	0%	0%
Q4 (3)	0.4%	0.9%	0%	1.1%	0%	2.2%
Q5 (1)	42.8%	57.1%	32.9%	26.1%	50.0%	0%
Q5 (2)	20.3%	17.9%	22.0%	10.2%	19.2%	4.4%
Q5 (3)	8.0%	5.4%	10.0%	10.2%	15.4%	4.4%
Q6 (1)	0%	0%	0%	4.3%	10.6%	2.2%
Q6 (2)	0%	0%	0%	1.0%	3.4%	0%
Q6 (3)	0%	0%	0%	3.4%	5.8%	2.2%
Q7	12.3%	30.6%	0%	0%	0%	0%
Q8	10.1%	0%	22.8%	0%	0%	0%
Q9	21.7%	28.6%	17.1%	1.4%	5.8%	0%
Q10	10.1%	25.0%	0%	1.1%	0%	0%
Total	11.2%	15.6%	8.2%	6.9%	8.7%	2.7%

(There are 2 schools in the rural area and "total" includes both; however, "with explanation" and "without explanation" are the results just in one school that has 2 classes to compare with.)

[3] Levels of inability of students in solving problems assigned according to school location

After taking the test, students were also interviewed in order to identify the levels of their inability to solve the problems assigned to them. The inabilities were identified and grouped into 3 levels as follows: unable to read the question presented, unable to understand the question/concept in the question, and unable to carry out the process of finding the answer to the problem presented. The frequency of these inabilities in the two categories of schools for questions 5 (3), 6 (1), and 8 are presented in table 27.

It is evident from the above table that a large number of students in both the urban and rural schools were able to read the question presented to them. However, very few students demonstrated an understanding of the question, i.e., they were not able to translate the content of the question into the local language. With regard to working out (process) the solution to the problem given, merely 2 students in the urban school demonstrated mastery of the process for part 3 of question 5. The remaining students were not able to work out the solution. Table 8 also shows that merely 3 students provided the correct answer for part 1 of question 6. Although certain students (numbers in brackets) provided correct answers for part 3 of question 5 and for question 8, they did this accidentally without using the correct processes.

Table 27. Pupils' levels of inability to solve problems given

Q. No.	Frequency of occurrence of inabilities									No. of pupils with Correct Answer		
	I. Reading			II. Understanding of Concept			III. Process					
	Urban (N=20)	Rural (N=30)	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Q5(3)	17	27	44	1	3	4	2	0	2	0(1)	0(1)	0(2)
Q6(1)	16	27	43	2	2	4	0	0	0	2	1	3
Q8	17	27	44	3	3	6	0	0	0	0(1)	0(1)	0(2)

[4] Levels of ability of students for solving problems according to their performance

Table 28 shows students' levels of ability for solving questions according to their performance.

Table 28. The students' errors of problem solving level according to their performance

Q. No.	Frequency of failure on Problem solving level									No. of students with Correct Answer		
	I. Reading			II. Understanding of Concept			III. Process					
	High performance	Low performance	Total	High performance	Low performance	Total	High performance	Low performance	Total	High performance	Low performance	Total
Q5(3)	19	25	44	4	0	4	2	0	2	0(2)	0	0(2)
Q6(1)	18	25	43	4	0	4	0	0	0	3	0	3
Q8	19	25	44	6	0	6	0	0	0	0(2)	0	0(2)

Table 29. Pupils' mistakes in problem solving in Q5 (3)

Q5 (3)	Urban school	Rural School	High performance	Low performance
Difficult words & Expressions	Grater than 1/4, 1/3	Grater than 1/4, 1/3	Grater than 1/4, 1/3	They could not read any words.
Any remarks regarding problem solving process	1/4 is grater than 1/3, since 4 is grater than 3.	1/4 is grater than 1/3, since 4 is grater than 3. 1/4 is grater than 1/3, since 1+4=5, 1+3=4 and 5 is grater than 4.	1/4 is grater than 1/3, since 4 is grater than 3. 1/4 is grater than 1/3, since 1+4=5, 1+3=4 and 5 is grater than 4.	1/4 is grater than 1/3, since 4 is grater than 3. 1/4 is grater than 1/3, since 1+4=5, 1+3=4 and 5 is grater than 4.

Table 30. Pupils' mistakes in problem solving in Q6 (1)

Q6 (1)	Urban school	Rural School	High performance	Low performance
Difficult words & Expressions	container	container	container	They could not read any words.
Any remarks regarding problem solving process	2/5+1/5=3/10 2/5+1/5=2+5+1+5 =13	2/5+1/5=3/10 2/5+1/5=2+5+1+5 =13	2/5+1/5=3/10 2/5+1/5=2+5+1+5 =13	2/5+1/5=3/10 2/5+1/5=2+5+1+5 =13

A majority of the students did not understand what the question implied so they merely guessed what needed to be done and added the numbers in the question.

Table 31. Pupils' mistakes in problem solving in Q8

Q8	Urban school	Rural School	High performance	Low performance
Difficult words & Expressions	Fraction Relationship Bought between	Fraction Relationship Bought between	Fraction Relationship Bought Between	They could not read any words.
Any remarks regarding problem solving process	5+3=8	5+3=8	5+3=8	Most of them did not answer anything

All the students did not understand the meaning of the question; therefore, it was explained in the local language. Then, they did understand the situation, which was that "Jody bought 5 kg of meat and George bought 3 kg of meat"; however, they did not understand what "the relationship between Judy's and George's meat in terms of weight" implied.

Discussion

1. Analysis of the Results of the Students' Achievement Test

Q1 (1) was an easy addition of fractions: 2/5 + 1/5. However, no students in the urban school answered correctly, and a large number of them wrote 3/10 as the answer. Thirteen students from among 157 added all the numbers that are shown there; this implies that they did 2 + 5 + 1 + 5 and got 13. Eighteen of them wrote 310 as the answer (3 may have been obtained from 2 + 1—the sum of the numerators, and 10 may have been obtained from 5 + 5—the sum of the denominators).

Q1 (2) was a subtraction of two fractions: 5/7 – 2/7. Thirty-one students provided the answer 3/0 and 16 of them answered 21, which is the sum of all the numbers there.

Merely 3 students provided the correct answer (3/7) to Q2 (Express the answer in a fraction—3 ÷ 7); 52 students wrote 2 or 2 remainder 1, which is the quotient of 7 ÷ 3.

With regard to sentence questions, a majority of the students appear to be unable to read or understand them well; this was true even in the classes that were provided explanation in the local language because a large number of students merely added the numbers provided in the questions, although they were not questions of addition. In the case of Q6 (3), the answer was 7, and in the case of Q8, it was 8.

A large number of students did not understand how to answer or what they were asked, so they wrote the answer at an inappropriate place, or what they wrote was incomprehensible.

In terms of the comparison between results of those students who were provided an explanation in the local language and those that were not, there were rather large differences. The greatest difference was that the students who were provided explanation in the local language knew how to write answers, particularly for multiple-choice questions; on the other hand, a majority of the students who were not provided any explanation failed to write the proper form of answers in the adequate place.

(4) Analysis of the Results of the Interview

It was rather difficult to communicate with the students in the interview because they did not understand English very well. A large number of students failed to read the questions aloud; certain students were unable to read even a single word. Students in the urban school could read more fluently as compared with students from the rural school.

Q5 (3) Which of the following is greater than the other? Write the correct choice (1, 2, or 3) in the parentheses.

1. A is greater than B. *2. B is greater than A* *3. A = B*

A: 1/4 B: 1/3 Answer ( )

A majority of the students believed that 1/4 was greater than 1/3 since 4 is greater than 3. They did not recognize that a fraction is a number, but just looked at each number shown there.

Q6(1) When you add 2/5l of water to 1/5l of water in a container, how much water is there in the container?

A large number of students were unable to read the question; however, they guessed what it stated and believed that the question asked for the 2 fractions to be added. Certain students did not even have a vague understanding of what they were supposed to do. When the meaning of the question was explained in local language they were able to understand it. However they were unable to add the fractions. Several students added not only the numerators, but also the denominators. Others calculated in the following manner: 2/5 + 1/5 = 2 + 5 + 1 + 5 = 13. Merely 3 students provided the correct answer.

When we asked the students to write the process of calculation on paper, several students were unable to use mathematical symbols like +, –, =, etc.; thus, the numerals appeared as 2 5 1 5 13 on the paper.

Q8 Judy bought 5 kg of meat. George bought 3 kg of meat. Write a fraction in the bracket to show the relationship between Judy's meat and George's meat in terms of weight.

George's meat is ( ) of Judy's meat.

None of the students understood the implication of the above question. When it was explained in the local language they were able to understand the quantity of meat that Judy and George bought; however, they were unable to understand what "relation" meant. They had not learned

fractions in terms of proportions, and this question was too advanced for their current knowledge.

In addition, certain students who provided the correct answer on the test did not answer correctly in the interview. It was possible that they were upset because they had not been interviewed in this manner before.

Conclusion

Several students calculated a fraction in the following manner: 1/2 = 1 + 2 = 3. This implies that students do not consider a fraction to be a number but a combination of two numbers that is supposed to be added.

Further, a majority of them do not understand English very well. They may be used to attending class without studying, where they can merely guess what the teachers are saying.

Future research must be conducted in order to explore what is required to improve the understanding of students with regard to mathematical concepts.

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