PRIMARY SCHOOL LEAVING EXAMINATIONS, BASIC INTELLECTUAL SKILLS, AND EQUITY: SOME EVIDENCE FROM KENYA

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INTRODUCTION

A salient characteristic of third - world education systems is that the basic, "open-access" cycle, during which all children may attend school irrespective of their achievement, is of brief duration. Most low-income countries can afford to provide unrestricted education to all who want it for only about six to nine years.

In Kenya, the open-access cycle runs for seven years, although a high proportion of pupils repeat at least one year, and so take eight or nine years to complete. At the end of this period, pupils must establish their right to further government-maintained education by achieving high scores in a national examination, known as the Certificate of Primary Education, or CPE. In 1978, about 250,000 pupils will sit this examination, and of these only a little over 30,000 will be admitted to government-maintained secondary schools at the beginning of 1979. The remaining 220,000 have three main alternatives open to them. About 70,000 are likely to return to primary school for a further year, in the hope of getting better CPE scores at a second attempt. A further 60,000 to 70,000 will enter unaided secondary schools, where despite paying fees three or four times higher than those charged in government schools, they will receive education that is much inferior. Finally, about 80,000 will try to find for themselves some form of activity which brings a financial return, mostly in farming or unskilled work.

Not surprisingly, the Certificate of Primary Education is highly unpopular. There is a great deal of pressure, from parents and educators alike, to abolish the examination altogether. Two recent influential reports, the International Labour Office Report of 1972 and the National Committee on Educational Objectives and Policies Report of 1976, both recommended that the basic cycle of education should be extended from seven to nine years, and that this longer cycle should be terminated by an entirely restructured examination. To ease the transition between education and employment, the final two years of this extended course would be heavily biased towards pre-vocational subjects.

But the advantages of the nine-year education system are not so clear-cut as these two reports suggest. Few if any countries spend a higher proportion of their public and private resources on education than Kenya. At present, over 30% of annual government expenditure goes to meet the costs of the formal education system, and if the costs of training programmes run by Education and other Ministries are included, the proportion goes up to over 40%. Extending the primary cycle from seven to nine years might well push expenditure beyond an acceptable level, especially if the final two years had a strong pre-vocational bias. Subjects such as carpentry, agriculture and office studies are much more costly to teach effectively than the traditional school subjects, for two main reasons. In the first place, heavy expenditure on equipment and materials is needed. A skillful mathematics teacher can manage quite well with an exercise book, pencil, and ruler for each pupil and a textbook shared between two or three; but a carpentry instructor can do little unless he has several sets of tools, workbenches, and a good supply of timber. Secondly, salaries to teachers of pre-vocational subjects must be higher than those paid to other primary teachers if the profession is to compete effectively with the private sector for the best people. Away from the classroom, the skills of a primary mathematics or English teacher are not highly valued in the labour market, but a secretarial teacher who can type a letter quickly and accurately or a carpentry instructor who can make a good-quality chair at low cost is in a strong bargaining position.

One way of meeting the increased costs would be to charge high fees for the additional years of the extended cycle. But this would mean abandoning the principle of open access: the additional years would remain selective, but with the important difference that the main criterion for selection would not be examination achievement, as at present, but rather the ability to pay. Many capable pupils from less-privileged backgrounds would be excluded.

The alternative would be to increase the share of government revenue allocated to education. But as we have seen, education already absorbs more than 30% of total government expenditure. Any further increase would almost certainly endanger investment in developments which directly create employment. A shilling put into extending the basic education cycle might well be a shilling taken out of irrigation development,

crop improvement, or industrialization. Education does not, of course, create jobs: it simply equips people with some of the skills they need to compete for existing employment opportunities. It would be a sad irony if a programme of educational expansion designed largely to relieve the problems of school-leaver unemployment were to act as a brake on the development of new employment opportunities.

Given these constraints, it seems inevitable that progress towards full implementation of the current proposals for primary school reform will be slow. There are still many parts of the country, particularly in the arid and semi-arid regions, where only a minority of children attend school at all, despite the fact that primary school fees are being progressively abolished. Both the ILO and the NCEOP Reports agree that first priority should be given to making the present basic cycle universal: only when this has been achieved should the cycle be extended from seven to nine years.

Even when the new primary system is in full operation, the problem of how to select pupils for access to further education will still remain. The Certificate of Primary Education may be abolished, but another selection examination, for pupils a little further along the educational pipeline, will have to take its place. In all probability, the new examination will resemble its predecessor in many aspects. The option of abandoning selection altogether, and allowing all pupils to continue their primary and secondary education for as long as they want, irrespective of their achievement, is not open to low-income countries such as Kenya.

Given that selection is inevitable, it is important to ensure that it is carried out as efficiently and fairly as possible. The consequences of success or failure in the Certificate of Primary Education are enormous. The highest-scoring candidates who enter the best national-catchment secondary schools can probably expect, on the average, lifetime earnings at least twenty times as high as those who fail to gain a place in any government-maintained secondary school.

Because its consequences are so drastic, the examination has powerful backwash effects on teaching in the upper primary school. In standards six and seven particularly, the effective curriculum is defined not by the content of the textbooks or the official syllabus, but by the questions included in recent CPE examinations. In one school visited

recently. standard seven pupils had sat no fewer than seventeen examinations during the first nine months of 1978, and most of the questions they had been asked had clearly been based on old CPE papers. About half of these seventeen examinations had been for the school's candidates only, but the others had been full-scale "mock" CPE's, starting with a number of "zonal mocks", sat by pupils from a group of adjacent schools, and culminating in a "district mock", sat by all pupils in the district.

In the sections which follow weshall discuss a programme of research and action carried out over the past five years, designed to reform the CPE. There have been two main aims : first, to improve the efficiency and equity of secondary school selection, and second, to utilise the backwash effects of the examination to ensure that the knowledge and skills taught in the upper primary standards are appropriate to the needs of pupils who will not enter secondary school.

B. CHANGES IN THE CPE EXAMINATION

Three of the four papers which make up the CPE examination are in multiple-choice form. These are English, Mathematics and the General Paper. Four alternative answers are provided to each question, so that a candidate who simply guesses has a 25% chance of answering correctly. The general paper is made up of a history section (20 questions) a geography section (20 questions) and a science section (40 questions). The mathematics papers contains 50 questions, while the number of questions in the English paper has varied between 40 and 70. These three objective papers are all marked by computer. The fourth paper, English Composition, is of course in essay-type form, and is marked by teams of secondary school teachers.

The CPE was first established in its present form in 1966. By the early 1970's it had been subjected to a good deal of criticism, much of which was summarised in the ILO and Bessey Reports, both published in 1972. Three main points were made:

1. The CPE was almost entirely a tool for secondary school selection; little attention was given to testing knowledge and skills needed by terminal pupils. In mathematics and science especially, the examiners wrote many items testing secondary-level topics, presumably on the grounds that if a candidate could cope with these topics at primary school, he would handle

them even better at secondary school. But an item analysis of the 1971 mathematics paper, discussed in the ILO Report, showed clearly that, paradoxically, it was precisely the items which explored secondary level skills which were least effective in discriminating between the more capable and less-capable candidates. By constract, many of the items which tested basic numeracy skills were highly efficient. The main reason why many secondary-level items discriminated weakly, was that most primary school teachers were themselves unable to cope with secondary-level mathematics, and hence could not teach it to their pupils. Thus all candidates, capable and less-capable, were reduced to random guessing.

These results suggested strongly that if the CPE examination were made more appropriate for terminal candidates, it would also become a better secondary school selector:

> In the past there has been a great deal of discussion on the apparent incompatibility of the two functions of the examination for the certificate of primary education: selecting pupils for secondary education and providing a leaving certificate for children who do not pursue their formal education beyond the primary stage. It has even been suggested that there should be two separate examinations. Our data, however, tend to show that this incompatibility is largely illusory. If the mathematics paper were confined to questions testing basic computational skills, numerical reasoning ability, and competence in solving practical mathematical problems, it would not only be a much more useful terminal examination than it is at present but it would also, in all probability, be a more efficient instrument of selection. The practical part of the paper could include shopkeeping problems, simple farming and business accounts, the calculation of crop yields, and a wide range of other problems likely to be met with by the school leaver engaged in agriculture or self-employment.

2. A high proportion of CPE questions, including nearly all of those in the general paper, tested nothing more than simple recall of memorised facts. In the words of the Bessey Report:

> The examination in its present form tests achievement only. It is not designed as a test of innate ability nor (which is not quite the same thing) as a predictor of performance in secondary school. It will therefore tend to be to a considerable extent a test of the primary teachers, and to that extent unfair.
>
> (Para. 13. 10, page 129)

It seemed apparent that if the CPE tested the ability to reason as well as the ability to remember, it would be both more efficient and

more equitable as a selection device. Pupils of high ability who did not show their potential in conventional tests of attainment because of poor teaching or other environmental handicaps would stand a much better chance of winning a secondary school place.

3. The questions asked in CPE tended to involve objects and situations more familiar to urban candidates, especially those from high-income backgrounds, than to rural candidates. The ILO Report noted, for example, that efforts to introduce a rural aspect into primary science teaching and to encourage pupils to draw on their local environment had been largely nullified by the selection examination. Only 17 of the 250 questions included in the 1971 CPE related in any way to agriculture.

Many examples of the urban and high-income bias of the CPE papers of the early 1970's could be given. For instance, one of the two comprehension passages included in the 1970 English paper concerned an experiment carried out in a school laboratory, involving a bunsen burner, a spirit lamp, and a mercury thermometer; while the other passage described how books in a school library are catalogued and arranged according to subject and author. Very few rural primary pupils have ever seen a science laboratory; while libraries, where they exist at all, usually consist of a shelf or two of books in a cupboard in the staffroom.

The reforms which have been introduced into the CPE examination were designed mainly to meet these three major criticisms. The changes can be summarised as follows:

1. The CPE is now a more effective terminal examination. The proportion of questions which test knowledge and skills useful to the primary school leaver has increased substantially.

2. Questions which require the candidate to demonstrate his ability to reason are now included in most subjects.

3. A high proportion of items now draw on situations and experiences familiar to rural children. It has not been found possible to eliminate urban or rural bias from individual items, but an attempt is now made to maintain a balance.

The changes outlined above were not conceived of as a unified programme of reform, to be introduced in all subjects at the same time.

Rather, the approach was gradual and pragmatic. The effects of each year's changes were monitored through item analysis, and decisions as to the next year's papers taken in the light of the findings. This process still continues; the 1979 papers will doubtless differ substantially from those set for 1978. Evaluation has always been retrospective: it has not been possible so far to pre-test new types of question before including them in the examination.

The details of the changes introduced differ a good deal from subject to subject, as does their timing. We shall discuss each subject in turn.

The changes were made until 1975, when the paper was modified so that it took more account of the context in which rural pupils hear and use the English language. Most rural English speakers, including teachers, have only a limited grasp of the conventions and idiomatic usages of the standard version of the language. They use English mainly in rather formal situations, where clarity of meaning is more important than fluency and variety of expression. Hence questions testing unusual words, phrases and idioms were eliminated from the paper altogether. Examples of such expressions from the 1973 and 1974 papers include "plucked up his courage", "not of his standing", "for company" and "in their teens". Similarly, it was decided that questions testing points of grammer where the commonly-heard Kenyan usage differs from the correct usage in standard English should be omitted in certain cases.

In addition to these changes, the balance of questions in the 1975 paper was altered sharply in favour of comprehension, at the expense of grammar and syntax. The proportion of comprehension questions rose from under 25% to 50%, while the proportion of grammar and syntax questions fell correspondingly. The remaining 25% involved verbal reasoning. With only slight variations, these proportions have been maintained since 1975.

Changes in the science section of the general paper started in 1974, and have been perhaps more radical than those for any other subject. They can be described under two main headings. First, there has been a change in the types of intellectual skill measured. Fewer questions now require straightforward recall of factual material, while more questions test higher-level cognitive skills, such as the ability to understand

relationships of cause and effect, and the ability to use reasoning to draw inferences from data. Second, there has been a change in the content of the questions. A substantial number now have a clear rural bias: some can be answered from observation of objects and situations common in rural environments; while others test knowledge or skills especially relevant to the needs of rural primary school leavers. We shall illustrate these changes with examples.

Until 1974, up to half the items in each year's science paper tested knowledge of technical terms:

Example No. 1 Soils which are found near lakes such as Rudolf and Magadi are usually

A	B	C	D
calcareous	volcanic	alluvial	saline

(No. 54, 1972 paper)

Example No. 2 When salt is mixed with water, salt will dissolve. Salt is said to be a

A	B	C	D
solvent	solute	solution	mixture

(No. 59, 1973 paper)

Example No. 3 The wires in an electric circuit are usually covered with substances such as plastic or cotton. These substances are called

A	B	C	D
conductors	resistances	radiators	insulators

(No. 85, 1972 paper)

As can be seen from Table 1, the number of knowledge items of this type was reduced from 19 in 1973 to only four in 1974. Since then, they have been virtually eliminated from the paper.

Table 1. CPE science: types of questions asked between 1973 and 1977

Item Type	Number of items				
	1973	1974	1975	1976	1977
Knowledge					
(a) Specialised items	19	4	0	1	0
(b) Non-specialised	9	8	6	8	10
Understanding	7	12	10	11	12
Observation	3	8	13	8	9
Reasoning	0	8	11	11	9

Note: Two questions in 1973 and one in 1976 involved mainly numerical calculation.

Other knowledge questions, not involving scientific terminology, still make up about one-quarter to one-fifth of the science paper. But a high proportion now test information which is especially relevant in rural areas:

Example No. 4 There have been several outbreaks of cholera in Kenya recently. Which of the following does NOT help to prevent the spread of cholera?

A. Digging pit latrines.
B. Boiling all drinking water.
C. Eating foods containing vitamins A and D.
D. Washing hands carefully before eating.

(No. 59, 1976 paper)

The proportion of items testing higher-level skills - understanding, observation and reasoning - has increased substantially in recent years as the proportion of knowledge items has dropped.

The boundary between knowledge and understanding items by no means always clear. Both types involve recall, but whereas knowledge items focus on specific facts, understanding items are concerned with how facts fit into wider contexts. In some questions, the candidate is asked to show how remembered facts can be applied to a new situation:

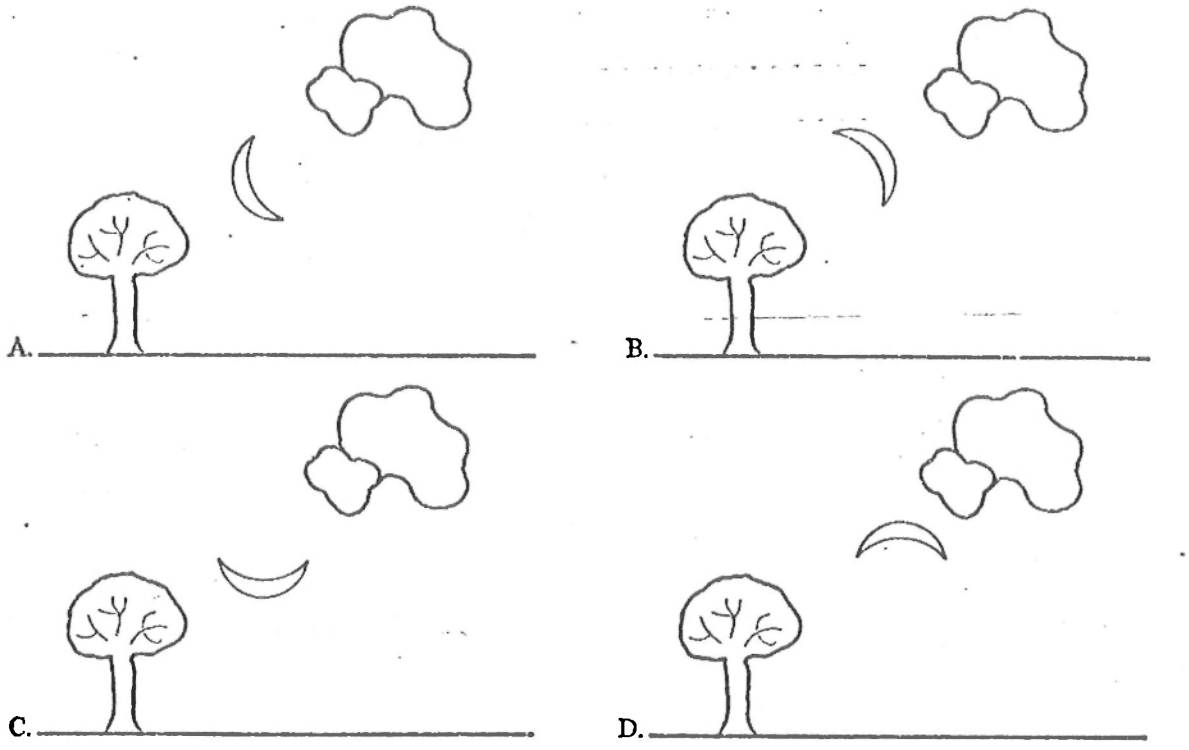
Example No. 5 Wanjiku works in a health clinic. A mother brings a small child suffering from kwashiokor. The mother says she cannot afford to buy meat, eggs, or milk for her child. What should Wanjiku advise her to do?

A. Give the child bananas or oranges from her shamba to eat each day.
B. Bring the child to the clinic each week for injections.
C. Feed the child with plenty of posho or ugali.
D. Use more beans or groundnuts in preparing the child's food.

(No. 68, 1977 paper)

In other items of this type, the candidate must show that he understands cause-and-effect relationships between facts. These items are concerned with the questions "how" and "why", and the word "because" often appears in the stem:

Example No. 7 Kamau saw the new moon shining very low in the sky. Which of the following did it look like?



(No. 49, 1977 paper)

Very few observation items were included in any science paper prior to 1974. They now make up about one quarter of the questions.

The final group consists of reasoning items. The pupils are given a set of facts in the stem of the question, and then asked to draw an inference from them. It is intended that the facts should be unfamiliar to the candidates. In other words, pupils must show that they can carry out the processes by which elementary scientific conclusions are established from data.

Example No. 6 Hadija put clay around the sides of her jiko (charcoal brazier), leaving the holes open, and let it dry. This made the jiko work much better because it

A. made the jiko heavier
B. allowed wood to be burned in the jiko
C. reduced the loss of heat from the sides
D. increased the flow of air to the jiko

(No. 59, 1977 paper)

A third group of items tests observation. An observation or experiment is described in the stem of the item, and the candidate is asked what he would expect to happen. It is, of course, possible to learn the answers to these questions from a textbook, but pupils who have carried out the observation have a clear advantage:

Examples No. 8 and 9 Use the information below to answer questions 62 and 63. Scientists in Kenya experimented with three different varieties of maize called Hybrid 511, Hybrid 613 and Composite IC. They wanted to find out which variety would give heavier crops at different altitudes. The results of their work are given below:

Height of the farm above sea-level	Weight of the crop per hectare with: Hybrid 511	Hybrid 613	Composite IC
500 metres (1600 ft)	3200 kg	2800 kg	4100 kg
1200 metres (4000 ft)	3400 kg	3300 kg	3800 kg
2000 metres (6500 ft)	4900 kg	7000 kg	3800 kg

62. Imagine you are an Agricultural Assistant working in Voi (400 metres above sea-level). Judging from these results, which one of the three varieties of maize would you think best to recommend to farmers in your area?

A. Hybrid 511
B. Hybrid 613
C. Composite IC
D. All varieties would be equally suitable.

63. Using the same results, which one of the following is correct?

A. At 2000 metres above sea-level, Hybrid 613 maize gave the heaviest crop.
B. The yield given by Hybrid 511 maize was the same at all altitudes
C. At 1200 metres above sea-level Hybrid 511 yielded a heavier crop than Composite IC.
D. Composite IC maize yields a heavier crop at 2000 metres than it does at 500 metres above sea-level.

(1977 paper)

The first reasoning questions appeared in CPE science in 1974. Since then, they have made up about one-quarter of the questions each year.

The questions quoted above were chosen to demonstrate the changes which have been made in the types of cognitive skill tested by CPE science since 1973. But they also illustrate the content changes. Questions No. 4, 7, 8, and 9 all have a clear rural bias. Few pupils in urban areas spend much time looking at the moon, nor do they know a great deal about different varieties of maize. No. 5 and 6 should favour pupils from low-income families in both rural and urban areas. Pupils from urban high-income families do not often use charcoal braziers, and they have little first-hand experience of the symptoms of kwashiokor.

Similarly, Nos. 4, 5, 6, 8 and 9 are examples of questions which are especially appropriate to a terminal examination. They all test knowledge and skills which are likely to be relevant to the needs of the CPE candidate who does not gain a secondary school place.

The changes made in the remaining papers can be described more briefly. In geography and history, the changes have paralleled closely those made in science, but they did not begin until 1976. The proportion of question testing memory for isolated facts - names, dates, places, etc. - has been sharply reduced. Correspondingly the proportion testing understanding of cause-and-effect relationships has been increased. The geography paper also includes reasoning items.

In mathematics, starting from 1974, items testing secondary-level skills (see page 5 above) were reduced in number. Fewer questions testing formal geometry were asked, and the algebraical problems were simplified. More recently, however, the picture has been complicated by the introduction of a new "modern mathematics" course. Many of the topics covered, including number bases, transformation geometry, and set theory, seem more appropriate to the secondary than to the primary level. Hence their introduction into CPE may reverse the effect of the previous changes. The first pupils who had followed the new syllabus sat CPE in 1977, but the full effects of the changeover on performance will not be apparent until the 1978 results are available.

C. EQUITY EFFECTS OF THE CHANGES IN CPE

Since 1973, the effects of the changes in CPE discussed in the previous section have been monitored, by comparing the performance of pupils from rural low-income, Nairobi low-income and Nairobi high-income backgrounds. The samples used are as follows:

1. The rural low-cost sample. This sample consists of 5% of all low-cost (Schedule A) schools in rural districts of Kenya, randomly chosen. All CPE candidates in the selected schools are included. The number of pupils in the sample has risen from about 8,300 in 1973 to 11,700 in 1977.

Schedule A schools now charge no fees at all in the first five standards, and only shs.60/- (US $8) in standards 6 and 7. Building fees and other charges, however, usually bring the total cost of attendance up to about shs.150/- per annum for an upper-standard pupil. Under the system of racially-segregated education operated in Kenya during the colonial period, Schedule A schools were reserved for pupils of African origin. They are now open to all ethnic groups, but in fact the great majority of pupils who attend them come from low-income African families. About 95% of all primary schools in Kenya are in the rural Schedule A category.

2. The Nairobi low-cost sample. This sample consists of 20% of the Schedule A schools controlled by the Nairobi City Council. These schools charge the same fees as Schedule A schools in other parts of the country, but their buildings and equipment are superior and their teachers better trained. The sample numbered about 800 pupils in 1973 and 900 in 1977.

3. The Nairobi high-cost sample. The third sample consists of all pupils sitting CPE from the eight Nairobi high-cost (Schedule C) schools. These schools originally catered for Europeans only, but a short time before Independence the racial criterion for admission was abandoned. However, the other two criteria - competency in English and ability to pay the fees - were retained. During the 1960's, the number of African children attending these schools rose rapidly, and they now make up about 90% of CPE candidates. Most of the remainder are Asians; fewer than 2% are Europeans. Schedule C schools teach through the medium of English from Standard 1, whereas most Schedule A schools now follow a mother-tongue programme for the first three years. The total cost of attending

a Schedule C school is about shs. 900/- per year. Competition for admission is intense: most Schedule C schools receive at least six applications for each Standard 1 place each year. This sample totalled about 500 candidates in 1973, and about 630 in 1977.

In each year since 1973, the average performance of candidates in these three samples has been determined for each CPE subject and each item. For simplicity we shall focus on only two of the samples: Nairobi high-cost and rural low-cost. Until 1975, the performance profiles of the two low-cost samples - rural and Nairobi - were strikingly similar; the proportion of pupils answering each item correctly did not usually differ by more than a few percentage points. Over the past three years more significant differences have begun to appear, but the major contrasts are still those between high-cost and low-cost schools.

Tables 2a and 2b. CPE performance differences between Nairobi high-cost and rural low-cost schools.

Table 2a. Expressed in standard deviation (z - score) units

	1973	1974	1975	1976	1977
English	2.0	2.26	2.02	1.50	1.73
Mathematics	1.5	1.20	1.01	1.07	1.24
Science	0.8	0.90	0.91	1.15	1.17
Geography	0.6	0.70	0.54	0.78	0.75
History	0.6	0.64	0.41	0.72	0.92

Note: The performance differences for 1973, especially those in science, history and geography, are approximate only.

Table 2b. Expressed as the proportion of pupils from rural low-cost schools scoring higher than the median candidate from Nairobi high-cost schools.

	1975	1976	1977
English	3.2%	4.2%	3.0%
Mathematics	18.0%	16.7%	10.6%
Science	19.6%	13.0%	13.8%
Geography	29.8%	22.9%	21.4%
History	33.0%	25.7%	17.6%

Tables 2a and 2b show the performance differences between the Nairobi high-cost and rural low-cost samples for the five years between 1973 and 1977. In Table 2a, the differences are expressed in standard deviation (or z - score) units. For example, in 1975 the average mathematics mark scored in Nairobi high-cost schools was 1.01 standard deviations higher than the average scored in rural low-cost schools. Because standard deviations are used instead of raw marks, the differences can be directly compared, from subject to subject and from year to year. For English, science, geography and history an asterix is placed alongside the entry for the year in which the first major changes were introduced. (No definite year can be identified for mathematics.)

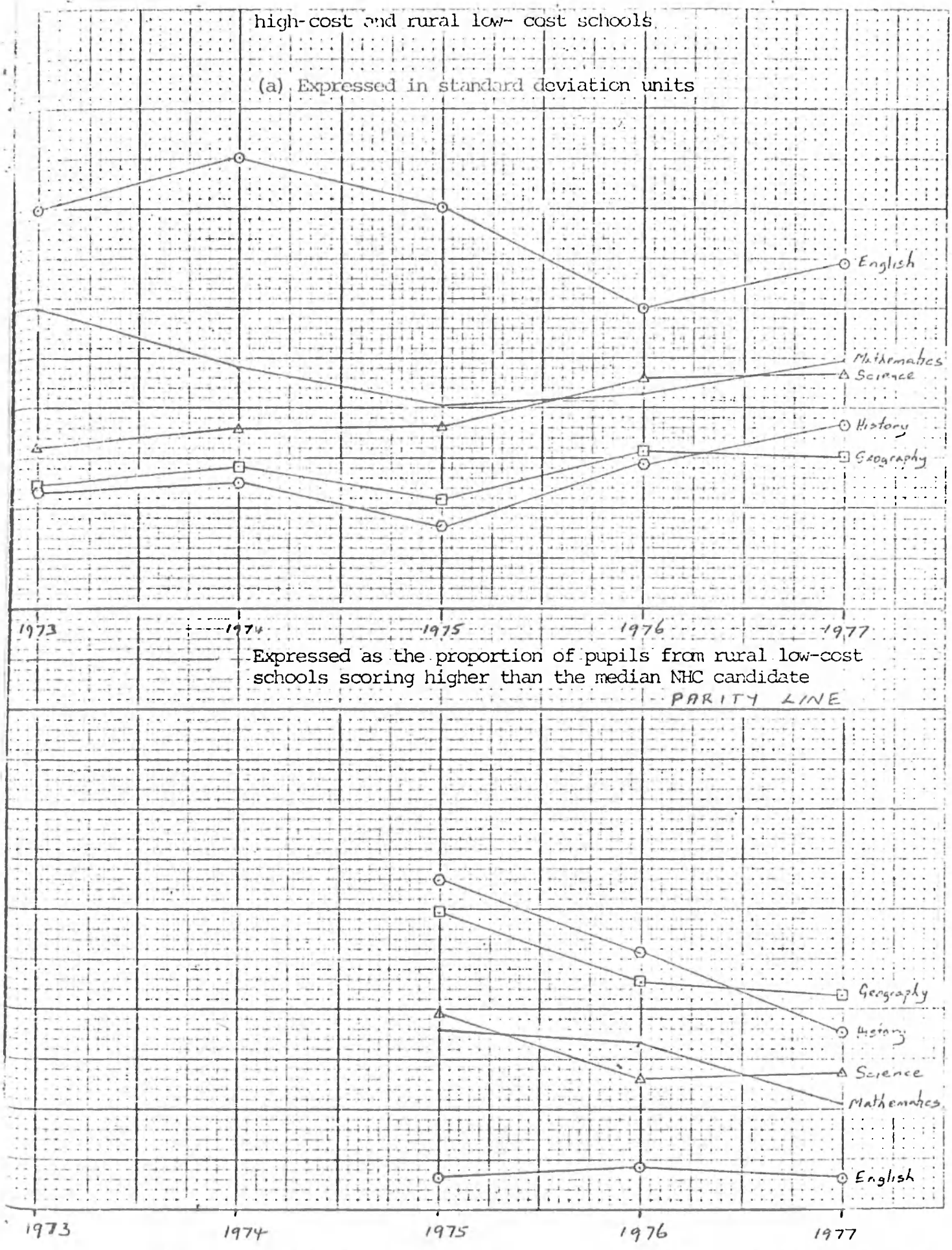
Table 2b shows the data in a more concrete form. It gives, for each subject and year, the proportion of rural low-cost candidates who performed better than the middle (medium) Nairobi high-cost candidate. In 1975, for example, 33.0% of rural low-cost candidates performed better in history than the median Nairobi high-cost candidate. Parity of performance between the two samples would, of course, be achieved if the proportion reached 50%. Unfortunately, the data needed to calculate the differences in this way are not available for 1973 and 1974.

The data of Tables 2a and 2b must, of course, be interpreted in opposite directions: a high performance gap is indicated in Table 2a by a high figure, but in Table 2b by a low figure. Figures 1a and 1b show the same data as Tables 2a and 2b respectively, but in graphical form.

It is immediately apparent that the changes in CPE have not reduced the overall performance gap between Nairobi high-cost and rural low-cost pupils, as had been hoped. On the contrary, in science, history and geography the gap has widened since the reforms were introduced. Only in English is there evidence of an overall narrowing and even this trend was partially reversed in 1977.

We shall consider the changes in science first. It will be remembered from the previous section that the first reforms in the subject were introduced in 1974, and extended in subsequent years. The proportion of items testing recall of specific facts was reduced over a two-year period from about three-quarters to about one-quarter, and the proportion testing higher-level skills, including scientific reasoning, correspondingly increased. Further, the content of the paper was changed so that many more

Figures 1a and 1b CPE performance differences between Nairobi high-cost and rural low-cost schools



items drew on objects and experiences familiar to rural pupils. But despite these reforms, the performance advantage enjoyed by Nairobi pupils in high-cost schools rose from 0.8 to 0.9 of a standard deviation between 1973 and 1974, and since then has continued to grow steadily. In 1975, 19.6% of rural low-cost pupils performed as well as the median Nairobi high-cost pupils, but in 1977 this proportion was only 13.8%.

In history and geography, the first moves away from pure knowledge items did not come until 1976. But as with science, the reforms were associated with an increase in the performance gap. Between 1975 and 1977, the proportion of rural low-cost pupils performing better than the median Nairobi high-cost pupils dropped from 33.0% to 17.6% in history, and from 29.8% to 21.4% in geography. No consistent changes had been apparent before the reforms.

The pattern in English is different. In 1974, the performance gap between the two samples was no less than 2.26 standard deviations, nearly twice as large as the gap for mathematics, and more than three times as large as those for geography and history. As we have already seen, modifications to the English paper began in 1975, when items testing idiomatic or unusual meanings were omitted, the proportion of grammar items was reduced, and more straightforward, descriptive passages were chosen for the comprehension items.(1) The performance gap dropped to 2.02 and 1.50 in 1975 and 1976 respectively, but in 1977 there was a small rise to 1.73.

No clear trend can be seen in the profile for mathematics. The performance gap dropped between 1973 and 1975, but rose again between 1975 and 1977. The partial changeover to the new mathematics syllabus may have had some influence on the result for 1977, but the full effects will not be apparent until the 1978 examination has been analysed.

We can now examine the relationship between the increase in the performance gap for science, history and geography, and the reforms introduced in these subjects. First, to what extent can the increase be attributed to

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1. A detailed account of the English items which caused rural low-cost pupils particular difficulties is given in the item analysis of the 1974 CPE, pp 10-18 and Appendix B, (Institute of Development Studies, Nairobi, 1975). See also H.C.A. Somerset: Aptitude tests, socio-economic background, and secondary school selection: the possibilities and limits of change. IDS Nairobi Discussion Paper No. 249, 1977.

the change in emphasis from knowledge items to items testing higher-level intellectual skills? Table 3 sets out the evidence for science, aggregated for the four years 1973 to 1976.

Table 3. CPE science 1973-76: performance gaps between Nairobi high-cost and rural low-cost pupils in items involving various types of intellectual skills

Type of item	Number of items	Proportion answering correctly Nairobi high-cost	Rural low-cost	Performance gap
Knowledge:				
(a) Specialised items	23	63.72%	52.64%	11.08%
(b) Non-specialised	29	72.51%	59.95%	12.56%
Understanding	35	66.87%	52.00%	14.87%
Observation	28	68.78%	51.10%	17.68%
Reasoning	28	66.00%	45.61%	20.39%

Note: Items which showed technical defects in construction are omitted from this and subsequent tables.

It is clear that rural low-cost pupils are at much less of a disadvantage in the pure recall items than they are in items testing higher-level skills. They are relatively most successful in remembering the meanings of scientific terms - solute, saline, calcareous and the like. Their average score in items of this type was only 11.08% behind that of Nairobi high-cost pupils. In items testing understanding of causes and reasons the performance gap rises to 14.87%, and in observation items to 17.68%. But it is in items involving scientific reasoning that rural low-cost pupils are at their greatest disadvantage: their average score is 20.39% lower than that of the Nairobi high-cost sample. Far from reducing the effects of poor teaching and other environmental handicaps on the performance of rural low-cost pupils, the move away from pure knowledge items seems to have exacerbated the differences.

The effects of the changes in skill-level just discussed were to some extent compensated by the content changes. It is not difficult to identify items from recent papers where, because they had greater familiarity with the subject matter, rural pupils closed or even reversed the performance gap. For example, the question on precautions to be taken against cholera from the 1976 paper quoted above (see example No.4, page 9), was answered correctly by 53.6% of rural low-cost candidates, as compared with only 50.6%

of Nairobi high-cost and 50.7% of Nairobi low-cost candidates. Similarly, a question in the 1975 paper concerning the effects of cattle ticks was answered correctly by 35.9%, 33.8% and 23.8% of candidates in the three samples respectively.

Perhaps the most successful item in this respect has been the question concerning the shape of the new moon (page 11 above). As with the two previous examples, this question gave an advantage to rural as against urban candidates, but in addition it produced a clear bias in favour of pupils from the less-developed rural areas. Details can be seen in Figure 2. In Turkana District, a remote pastoral area in the northwestern corner of the country, the proportion answering correctly was as high as 43%. This district was followed by Kilifi (39%), Wajir (39%) and Kwale (38%). These are all predominantly Muslim districts where, of course, the sighting of the new moon signifies the ending of Ramadhan. In other pastoral districts, and also the marginal agricultural areas of Eastern Province, the proportion answering correctly varied between 25% and 37%. In the high-potential agricultural areas, running in a belt from Meru District westwards to Lake Victoria, the proportion did not rise above 24%. But performance was poorest of all in the Nairobi high-cost sample: only 14% answered correctly. The commonest answers were A (37%) and B(39%), which suggest that many of these pupils answered from their reading of books published in Europe or America, which show the crescent of the new moon pointing to one side (sometimes, in children's books, embellished with a face), rather than from observation of the new moon as it appears in Kenya, with its horns pointing upwards.

It can be seen from these examples that in some cases the content of a science item can produce a performance bias in favour of rural pupils. However, in the examinations analysed so far, the effects of the content changes have been much weaker than the opposite effects of the skill-level changes. Hence the nett effect of the two reforms has been to widen the NHC - RLC performance gap. When an item has been based on rural subject-matter, but has involved a higher-level skill such as scientific reasoning, Nairobi high-cost pupils have usually enjoyed a clear advantage. In the reasoning items quoted on page 12 above (examples 8 and 9) the performance gaps were 27.5% and 25.2% respectively, despite the fact that both items concerned the yields from different types of hybrid maize, a topic with which the rural pupils were probably more familiar.

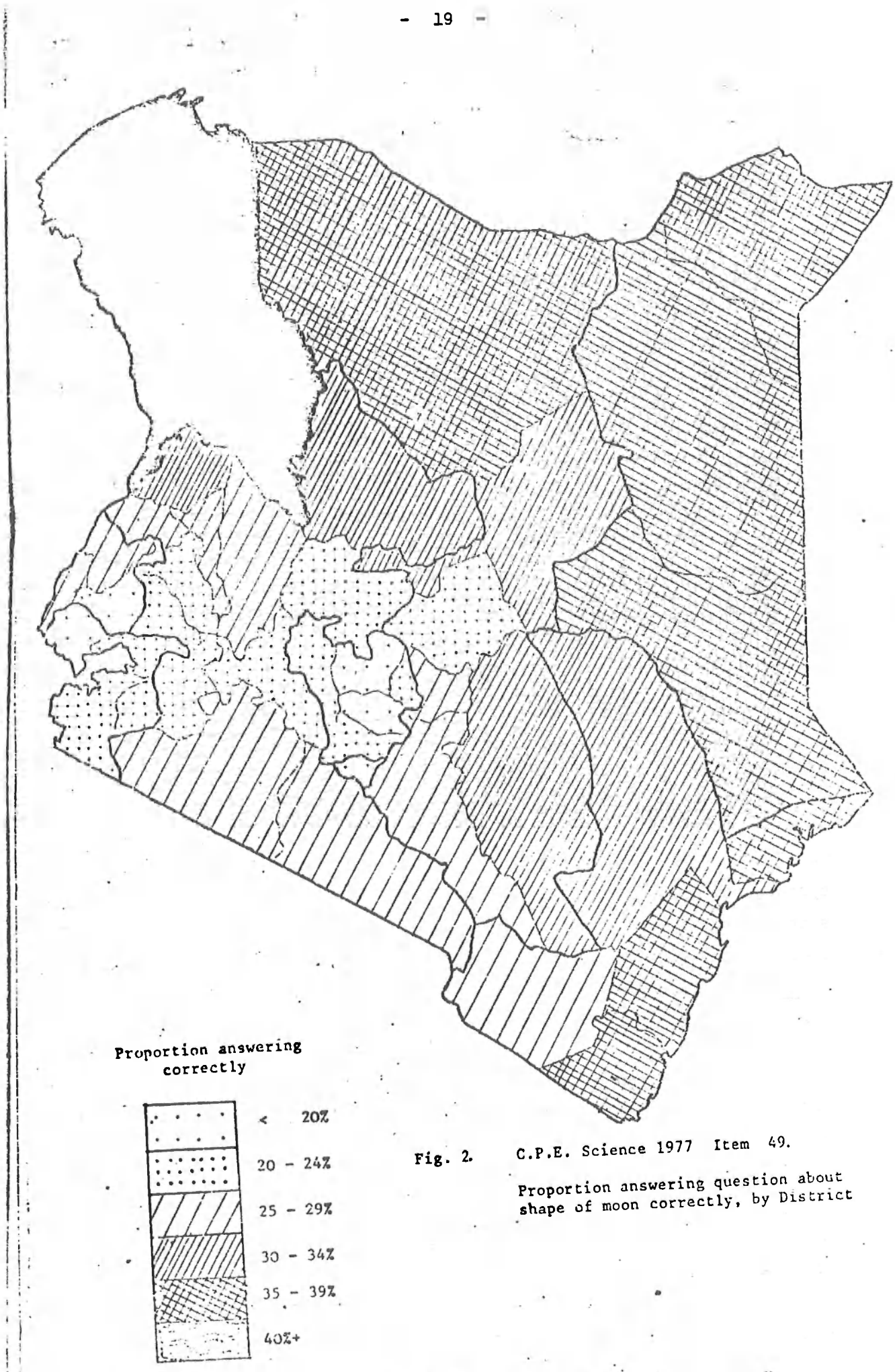

Fig. 2. C.P.E. Science 1977 Item 49.

Proportion answering question about shape of moon correctly, by District

Table 4. CPE English 1973 - 76: Mean difficulty levels of the various item types in Nairobi high-cost and rural low-cost schools.

Type of item	Number of items	Proportion answering correctly Nairobi high-cost	Rural low-cost	Performance gap
Comprehension				
(a) Fictional passages	33	73.48%	36.79%	36.69%
(b) Descriptive passages	35	74.03%	42.89%	31.14%
Grammar and syntax	119	84.03%	55.02%	29.01%
Verbal reasoning	39	73.56%	51.25%	22.31%

Table 4 looks at performance in English according to item types. It can be seen that the differences between the Nairobi high-cost and rural low-cost samples are much larger than those for science given in Table 3. This, of course, is what we would expect from the aggregate trends, discussed on page 18.

There is a more important point to be made. The reasoning items in the English and science papers show very similar performance gaps: 22.3% for English, and 20.4% for science. But in science as we have seen, the achievement (non-reasoning) items produce differences which are lower than this level; whereas in English, the achievement items produce differences which are substantially higher. Questions testing knowledge of grammar and syntax, for example, show an average performance gap of 29.0%, and comprehension questions based on fictional passages an average gap of 36.7%. Hence an increase in the proportion of reasoning items in both papers will simultaneously reduce the advantage of Nairobi high-cost pupils in English, and increase their advantage in science.

We may offer the following interpretation of these results. Far from being relatively immune to the effects of teaching quality, reasoning ability and to some extent other higher-level intellectual skills are particularly prone to such effects. A skilled teacher tries to make facts understandable to his pupils by placing them in a context of cause-and-effect linkages. He also tries to show the pupils how to create these linkages for themselves through reasoning. A pupil who has not received this guidance will be handicapped in answering questions involving higher-level skills, no matter how competent and conscientious he is at memorisation.

Weak teachers, by contrast, specialise in the teaching of isolated facts. In subjects such as science, history and geography they copy from a textbook onto the blackboard catalogues of names, dates, places and definitions which the children reproduce in their exercise books and learn by heart. Little attempt is made to identify patternings among the facts, or to use the facts to draw inferences.[1]

Until recently, this strategy of memorization worked quite well in these subjects. As we have seen, about three-quarters of the questions asked in science prior to 1974 were pure knowledge items. Moreover, most of pieces of information tested were drawn from a fairly limited pool, whose boundaries were defined by the content of previous CPE papers. The same questions tended to recur year after year, with only slight modifications. A rough count indicates that a candidate who had memorised about 120 to 150 definitions would have been able to answer successfully about three-quarters of the knowledge items involving terminology which appeared in CPE science between 1966 and 1973. For example, the terms "igneous", "metamorphic" and "sedimentary" appeared in questions for three successive years; in one year they were used in both the science and geography papers. Thus a conscientious pupil who learned the answers to all the questions in past papers could be certain of scoring well in CPE science, irrespective of his teacher's ability. This is not true of items testing reasoning ability.

With English, however, the situation is quite different. Preparation which focusses on the content of previous papers is virtually useless. The range of questions that can be asked is much wider than in science, history or geography, so it is rare to find the same or a similar question repeated in more than one paper. But more important than this, real mastery of the usages and idioms of English does not come from formal teaching, but from immersion in an environment where the language is used consistently. Because they use English not only in formal learning situations but also as an every-day means of communication, Nairobi high-cost pupils have a huge advantage. The fact that rural low-cost pupils performed relatively better in the verbal reasoning items than in the English achievement items does not mean that reasoning ability is largely immune to teacher quality effects; it simply indicates that the reasoning items are less heavily dependent on language competence.

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1. In several low-quality schools visited recently, teachers had been drilling pupils in the correct answers to scientific reasoning questions in recent CPE papers, on the grounds that the same questions might be asked again!

The interpretation just suggested depends crucially on the assumption that the differences between the Nairobi high-cost and rural low-cost pupils in verbal and scientific reasoning scores are due to school quality factors, and not to differences in home background or even in inherited potential. To investigate this point, two samples of low-cost schools in one district of Kenya have been drawn; one consisting of 16 schools which performed particularly well in the 1976 CPE and the other of 16 schools which performed badly. All the schools in the sample are day schools. The district chosen is fertile and densely settled, and nearly all families grow either coffee or tea as cash crops. The samples are matched as closely as possible by geographic location, distance from urban centres, and types of cash-crop grown. Each sample consists of about 10 per cent of all schools in the district. In 1977, the ten schools with the highest 1976 CPE mean scores and the nine with the lowest mean scores were visited, and socio-economic status data obtained from the CPE candidates. For practical reasons, it was not possible to visit all 32 schools. Table 5 shows the occupations of the fathers of the pupils in the two samples, together with comparable data from four Nairobi high-cost schools, obtained in 1978. (See page 25)

It can be seen that the differences between the high-quality and low-quality rural samples are negligible. A few more fathers from the high-quality schools hold or have held white collar jobs, and a few more from the low-quality schools are, or have been, businessmen. But these differences are within the limits of chance variation.

On the other hand, there is a major cleavage between the Nairobi high-cost sample and the two rural samples. No fewer than 76.1% of the NHC fathers are professionals, or in senior managerial positions. The comparable proportions for the rural high quality (RHQ) and rural low quality (RLQ) samples are 0.6% and 0.7% respectively.

Table 5: Father's occupations of CPE candidates in rural high-quality, rural low-quality, and Nairobi high-cost schools.

Father's occupation	Nairobi high-cost		Rural low-cost (a) high-quality		(b) low-quality	
	n	%	n	%	n	%
Professional	43	17.8%	3	0.6%	4	0.7%
Managerial	141	58.3%	-	-	-	-
Teaching (primary)	5	2.1%	60	11.3%	54	10.0%
Other sub-professional	3	1.2%	15	2.8%	15	2.8%
Clerical	11	4.5%	26	4.9%	17	3.1%
Total white collar	203	83.9%	104	19.7%	90	16.7%
Uniformed forces	1	0.4%	26	4.9%	23	4.3%
Skilled workers	5	2.1%	66	12.5%	45	8.3%
Semi-skilled workers	2	0.8%	67	12.7%	84	15.6%
Unskilled workers	0	-	33	6.2%	15	2.8%
Total manual	8	3.3%	192	36.3%	167	30.9%
Business	29	12.0%	68	12.9%	123	22.8%
Farming	2	0.8%	165	31.2%	160	29.6%
Total	242	-	529	-	540	-

Note: Fathers who are now working as farmers but who have previously held jobs or run businesses are classified under their previous occupations. The proportions currently working as farmers are 47.4% in the rural high-quality sample, 49.1% in the rural low-quality sample, and 0.8% in the Nairobi high-cost sample.

Table 6: CPE English 1976: Mean performance in different item types in the Nairobi high-quality, rural high-quality, and rural low-quality samples.

Item type	Number of items	Proportion answering correctly Nairobi high-cost (a)	Nairobi high-quality (b)	rural low-quality
Reasoning				
(a) Letter series	5	89.33%	85.40%	70.57%
(b) Analogies	5	91.72%	87.63%	75.01%
Grammar and syntax	10	85.97%	78.17%	62.6%
Comprehension:				
(a) Descriptive, harambee project	6	78.78%	72.48%	59.41%
(b) African folk tale	4	87.88%	74.66%	55.06%
(c) Descriptive, Portugues forts	6	66.89%	52.35%	40.81%

Table 6 shows the average performance of the Nairobi high-cost, rural high-quality, and rural low-quality samples in the different types of items included in the 1976 English paper.

The results are unequivocal: performance in verbal reasoning questions is highly sensitive to the effects of school quality. In the letter-series questions, which require virtually no knowledge of English, rural pupils from high-quality schools scored only 3.9% lower than Nairobi high-cost pupils, despite their socio-economic handicaps. On the other hand, they scored as much as 14.8% higher than rural pupils in low-quality schools, despite their similar backgrounds. Expressed in another way, the quality of the education these rural pupils had received enabled them to close as much as 79% of the NHC - RLQ performance gap. Similarly in the analogies questions, which require only knowledge of everyday words, RHQ pupils averaged only 4.1% lower than NHC pupils, but 12.6% higher than RLQ pupils. In other words they closed 76% of the HNC - RLQ gap.

But in the English achievement items, especially those involving comprehension, the rural pupils, form high-quality schools were less successful. Many of these questions required a command of the English language

which no rural school can provide, no matter how competent its teachers. In general, the performance of RHQ candidates in these sections of the paper fell about midway between that of the NHC and RLQ candidates.

These results suggest strongly that the huge performance advantage enjoyed by Nairobi high-cost pupils in the English paper can be ascribed entirely to two sources: first, the superior quality of the education they receive; and second, their greater familiarity with the language. When rural schools provide high-quality education, pupils close the performance gap on the Nairobi high-cost pupils to the extent that the questions test verbal reasoning ability rather than language competence. There is no evidence whatsoever to suggest that Nairobi high-cost pupils have superior capacity for abstract thought.

D. SOME IMPLICATIONS OF THE RESULTS

When the programme described in this paper was started, one of our major concerns was the low and uneven quality of education offered in Kenya's primary schools. Each year the secondary school recruitment lists are dominated by candidates from a few primary schools in each district. It is not uncommon to find one primary school sending more than half its CPE candidates to government secondary schools, while adjacent schools, drawing on pupils from very similar backgrounds, send few or none. Reasoning questions, it seemed, might help to reduce these discrepancies. We shared the commonly-held view that such questions were less vulnerable to the effects of environmental factors than conventional attainment questions, and so could enable us to identify pupils of high potential who had been badly taught.

The data discussed in the previous section, however, have forced us to revise our views. Reasoning questions in the English paper do help to reduce the discrepancies, because they are less dependent on language competence. But in science and geography, reasoning items are more affected by teacher quality than content questions.

If our only concern was to make secondary school access more equitable, the implications of our findings would be clear. Reasoning items should be retained in the English paper , but in other subjects they should be eliminated, together with questions testing other higher-level

skills. The CPE papers in history, geography and science would consist entirely of knowledge items, each testing an isolated fact - the name of a town or river, the year in which an historical event took place, the definition of a scientific term.

But thus would be no solution. Education which fragments knowledge into isolated packages is no education at all. On the contrary, education must be concerned with connections and patternings, causes and consequences. If it is not, it provides the learner with no guide to action A farmer, for example, may know the scientific names of all the major plant nutrients, but this information by itself will not help him decide how to increase his farm earnings. To do this, he must be able to gather, sift, and organise a wide range of data: the suitability of different parts of his farm for various crops, the costs of fertilisers and other inputs, market prices, and the like.

The argument for testing reasoning skill in CPE has nothing to do with equity in secondary-school access. It is simply this: the ability to think effectively is the most important skill of all, both for the secondary school entrant and the primary school leaver. Moreover, it is a skill that is teachable.

If we want a primary school education which is both relevant and equitable, there is no escaping the problem of quality. The core subjects and the core skills must be taught much more effectively than they are at present. But as we have seen, the recent proposals for primary school reform have focussed on extending the duration of the cycle, and on adding new pre-vocational subjects to the curriculum. These proposals have become the centre for public debate, and have thus diverted attention from the key issue.