

Cost-Effectiveness of Primary School Interventions
in English Speaking East and West Africa:

A Survey of Opinion by Education Planners and Economists

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Executive Summary

Sub-Saharan African countries are engaged in the difficult task of meeting the Millennium Development goals as well as the broader targets of Education for All, both of which seek to provide six full years of primary education of good quality. Until recently the focus was on keeping children in school and on finding the financial resources to pay teachers. Increasingly there is an interest in the quality side of the equation, as leaders and decision makers have begun to recognize that children can stay in school and not learn very much. This paper seeks to strengthen this changed focus by estimating the “cost effectiveness” of 46 potential “interventions” that could result in increased primary school learning.

Furthermore, throughout the world quality improvement is often sought through investments made on the basis of untested or partially tested assumptions about the cost-effectiveness of particular interventions. While education is increasingly considered the key to economic success --and investments in education by national governments as well as international agencies are growing--, current knowledge about cost-effectiveness in education is extraordinarily inadequate, especially considering the huge amounts of money that go into education.

Undertaking traditional empirical cost-effectiveness research in education is costly and time consuming. The authors sought a “short cut” this approach, though an approach which harnesses expert opinion on “what works” in education. A “typical” low income English speaking country, a composite of six East and West African countries (e.g., Ghana, Kenya, Malawi, Tanzania, Uganda, Zambia) was created. The authors decided that French speaking Africa as well as southern Africa had different characteristics and could be the subject of a future survey. The authors then devised a questionnaire which was given to twenty-three international education planners and economists, mainly located in universities and international agencies, all of whom were well acquainted with educational research, and who have an understanding of attempts at educational reform in the region. Each respondent was asked to estimate the potential impact of 46 possible primary school interventions on learning (as defined by the score on a standardized test given at the end of fourth grade), as well as the probability that these interventions would be adequately implemented. These interventions included those typically thought of in the African context as well as interventions used elsewhere in the world. The authors plugged in their own estimates of the incremental unit costs of these interventions, and then created an index ranking the cost-effectiveness of each of the 46 interventions.

The main conclusions from this exercise are as follows:

- There appear to be a number of low cost but effective interventions which can be utilized to increase learning; These include: assigning best teachers (for teaching to read and write) to first grade; enforcing regulations on the official length of the school year; enforcing student attendance policies; paying teachers regularly; using a revolving fund for textbooks; ending the practice of switching teachers during the school year; and rotating teachers and principals among schools.

- Some very expensive interventions may have a small impact on learning (per unit of required resources). These especially include computers, school feeding programs, longer daily schedule, smaller number of students per class, and raising teachers' salaries without complementary training and better selection criteria for new teachers.
- Some interventions are of moderate to high cost but could have a significant impact. These include : making textbooks available to each student, and providing a small library for each classroom. Other interventions with high probable impact are those related to a longer school year, decentralization, and mass media campaigns encouraging parents to pay more attention to learning and developmental needs of their children.
- All those polled consider implementation issues of great importance. Compared with Latin America, the potential impact of well implemented interventions is greater but implementation issues are much more difficult and relative costs higher.

The authors make no claim to the “scientific validity” of these estimates, since there is no substitute to rigorous traditional field research. Nonetheless, this exercise has created, for the first time, a list of interventions, their estimated costs, and estimates of cost-effectiveness of such interventions in African countries. The index can be used to: (i) identify inconsistencies, ambiguities, and contradictions in opinions of decision makers and researchers about cost-effectiveness; (ii) generate consensus building among decision makers; (iii) identify agendas for research which should eventually be the basis for objective decisions on education development; (iv) identify training needs for planners and practitioners; and (v) provide a useful tool to be used in training decision makers. The index will help to make education decision makers be more explicit about the justification for their decisions and about trade-offs. An exercise of this sort can be refined and improved for specific countries by contacting the best experts and under-taking more sophisticated analyses. A detailed comparison with similar studies carried out in other regions (e.g., Latin America) can provide additional insights.

I. Objectives and Approach

Sub Saharan Africa (SSA) is engaged in the difficult task of meeting the Millennium Development Goals as well as the broader targets of Education for All (EFA), both of which seek to provide six full years of primary education of good quality.

As reported in the most recent EFA monitoring report, in sub-Saharan Africa, less than two thirds of all entering students reach the last year of primary school. This is a significant improvement since these goals were set, but poverty, long term economic decline, the existence of "failed states," and the loss of many teachers to AIDS make the task of reaching 100% completion rates by the year 2015 difficult and may even make increased attention to learning achievement seem like a luxury. Nonetheless, while the initial focus of EFA was on children staying in school and on finding the money to pay increased numbers of teachers (see reports by the World Bank (Bruns et.al.)), increasingly there is a recognition that children can stay in school and not learn very much, making the achievement of six years a hollow achievement. Further, as research is increasingly demonstrating, "basic knowledge and skills --not educational attainment-- are key to reducing poverty" (World Bank 2005).

The extent of the problem in of learning in Africa can be seen in recent world wide tests. Botswana, Ghana, and South Africa participated in the TIMSS study of mathematics achievement in eighth grade. Compared with a world mean of 467, Ghana scored 276, South Africa, 264, and Botswana 366, as follows:

TABLE 1. Scores on 2003 TIMSS Study of Mathematics Achievement in Eighth Grade, Selected Countries

Country	Score
Singapore	605
Netherlands	536
USA	504
World Average	467
Iran	411
Chile	387
Botswana	366
Ghana	276
South Africa	264

Source: TIMSS. Note: Standard Deviation of 100.

The African countries scored the equivalent of 1 to 2 standard deviations below the world average and 3 ½ deviations below the world leaders. One standard deviation can be the equivalent of learning achieved over somewhere between one and two years of schooling. This means that eighth graders in the three African countries tested know as much about mathematics as third, fourth, fifth, or six graders in the rest of the world. Providing six years of education to all children in Africa is

therefore only a start to the process of building up the “knowledge capital” of Africa countries. Furthermore increased investments in primary education does not answer the question of how and where to spend the money.

Fortunately the region has a renewed focus on learning and the factors which impact on learning. The EFA Global Monitoring Report of 2005 (UNESCO) emphasized quality. The 2006 meeting of the Association for the Development of Education in Africa (ADEA) also emphasized the quality of basic education.¹ The Southern African Consortium for Monitoring Education Quality (SACMEQ) has been pioneering work on measuring learning achievement in Eastern and Southern Africa. SACMEQ provided summaries of scores of primary school students for the year 2000 on reading and mathematics in 12 countries. The results were as follows:

TABLE 2. Scores on Reading and Mathematics in SACMEQ Countries, 2000

Country	Reading Score	Mathematics Scores
Botswana	521	513
Kenya	543	563
Lesotho	451	447
Malawi	462	432
Mauritius	550	584
Mozambique	516	530
Namibia	472	430
Seychelles	582	554
South Africa	492	486
Swaziland	529	516
Tanzania	545	522
Uganda	482	430
Zambia	477	435
Zanzibar	489	478
Zimbabwe	504	n.a.

Source: SACMEQ. Mean of 500. Standard deviation of 100. A new study is underway.

Considering that South Africa scores better than Malawi, Uganda and Zambia (but worse than Kenya and Tanzania) , we can assume that the most if not all Sub-Saharan African countries would score at 300 or lower (two standard deviations below the average) if they were to participate in the TIMSS test.

While the SACMEQ effort as well as recent analyses and reports are moving in the right direction, , the approach to quality, defined by learning achievement, continues to lack a systematic focus. This

¹ The subject of the 2003 biennial meeting of ADEA was “The Quest for Quality.” One of the subjects of the 2006 meeting was “Conditions and Factors Underlying Effective Schools.” See www.adeanet.org.

paper seeks to strengthen this process by estimating the “cost-effectiveness” of 46 potential interventions in primary education. Specifically it estimate the expected increase in learning on a standardized test and compares this increase with estimates of the costs of each of these interventions. This approach is very timely because decision makers in primary education in Africa need to deepen their understanding of what “quality”. means. Furthermore, not only in Africa, but throughout the world, quality improvement is often sought through investments made on the basis of untested or partially tested assumptions about the impact of particular interventions. While education is increasingly considered the key to economic success --and investments in education by national governments as well as international agencies are growing--, current knowledge about cost-effectiveness in education is extraordinarily inadequate, especially considering the huge amounts of money expended.

Even though education is increasingly considered the key to economic success --and national governments are increasing their investments in education with loans from international agencies--, most educational investments are made on the basis of untested or partially tested assumptions about the cost-effectiveness of particular interventions. In fact current world-wide knowledge about cost-effectiveness in education is extraordinarily inadequate, especially considering the amount of money that goes into education. The problem is that measuring the cost-effectiveness of educational interventions is a difficult, time-consuming and costly task requiring sophisticated research instruments. In the developing world only a small number of studies on cost-effectiveness of educational interventions have been completed. Even these few studies are seldom taken into account when designing education reforms.

The development of an evidence based understanding of learning outcomes will take a long time. Developed countries are making an increasing but still inadequate effort. The problem is more difficult in developing countries since traditional empirical cost-effectiveness research in education is costly and time consuming and requires a high degree of expertise. In view of these difficulties, the authors proposed a “short cut” to traditional cost-effectiveness research through harnessing expert opinion to make estimates. Specifically thee authors devised a questionnaire which was given to twenty three education economists and planners, all of whom were well acquainted with educational research, and who had practical understandings of the potential and risks of attempts at educational reform in the region. Each respondent was asked to estimate the potential impact of 46 possible primary school interventions on learning achievement, as defined by the score on a standardized test given at the end of fourth grade, as well as the probability that these interventions would be adequately implemented. The authors plugged in their own estimates of the incremental unit costs of these interventions, and then created an index ranking the cost-effectiveness of each of the 46 interventions. These interventions included those typically thought of in the African context as well as interventions used elsewhere in the world. This methodology was developed in Latin America and is being applied for the first time to another region (Schiefelbein, Wolff, and Schiefelbein).

An opinion based estimate of cost effectiveness of relevant strategies is a unique short term alternative, while awaiting the results of necessary expensive and lengthy empirical evaluation studies. Best available judgments can be used systematically to check educational investments now made on the basis of untested or partially tested assumptions. The study is based on a “composite” English speaking African country, using data from Ghana, Kenya, Malawi, Tanzania, Uganda, and Zambia.

II. Methodology

Twenty three education economists and planners agreed to participate in this exercise. They were selected in the first place with an eye towards leading researchers and policy analysts of African education. In particular the authors looked for those who had published articles in professional journals, were quoted by other planners and practitioners, had access to relevant current research findings, had been (or were) involved in projects in several African countries; were leaders in the analysis of education development; and/or had experience working with multilateral development agencies in the region. In the initial go-round only three Africans responded.. With the assistance of the Harvard Graduate School of Education, where one of the authors was a visiting professor, the authors were able to get seven additional Africans to participate, including some who had recently completed academic work on education and development. The final groups of 23 included eleven Africans, three Europeans, four North Americans, and five Japanese.² While many of the respondents had at least some on the ground in-school experience, they were all mainly concerned with national and regional education policy issues. The names of the participants are listed on the title page. Individual scores are not reported in this report and the participants are not responsible for any of the conclusions in this report.

46 selected interventions were defined.. Most of the interventions have been used in previous attempts to reform basic education in Africa and elsewhere in the developing world.

Each of these interventions is described in Table 4. Each strategy is expressed in a simple and accurate way so that the comparison of estimations made by the panel of experts could be reliable (and error variance reduced). Interventions include “promising policy interventions” identified in previous research findings, such as those related to instructional time; textbooks and learning materials; increasing the learning capacity of students (food, health, and initial education); teacher training; and curriculum. . Some interventions were included which, because of their cost, did not seem yet appropriate to Africa; yet in other regions they have had an impact. Each expert reviewed the strategies and had the opportunity to add relevant strategies.

The research team identified the characteristics of a country, based on data from Ghana, Kenya, Malawi, Tanzania, Uganda, and Zambia. It was decided not to use the richer Southern African countries (e.g., Botswana, Namibia, Mauritius, South Africa) since these have somewhat different economic and educational profiles. The target “composite” country, is defined on the basis of averages of population, educational coverage, primary enrollments, unit primary cost, student-teacher ratio, rural sector, ethnic minorities and average test scores at the end of primary education, using data from the UIS as a guide. The \$110 unit cost is based on data on Malawi, Uganda, Kenya, and Zambia which were available to the authors at the time of writing this paper. The fact that there is a common "country" for all participants helps to make a meaningful comparison of answers, but it is an artificial construct with no history or context. English speaking Africa was selected because there seems to be major differences between Anglophone and Francophone Africa in funding and results.

² The Japanese experts were identified during the period of time that one of the authors was a visiting professor at Hiroshima University.

For example in Cameroon, which has a dual education system—Anglophone in two provinces, Francophone in eight, there are higher costs but much more dropout and repetition in Francophone provinces compared with Anglophone ones (Cacougnolle). This “composite” country is described below:

Table 3 Prototypical Country—English Speaking East and West Africa

- Population: 18 million. Rural population: 70 percent
- Completion rate in primary education (six years): 60 percent of each age group.
- Student teacher ratio: 40:1
- There are some 8000 primary schools
- Unit cost of primary education: \$110 (purchasing power parity (PPP) exchange rates, based on recently published information from UNESCO Institute of Statistics)
- Number of children in grades 1-6: 4.0 million
- Total cost of primary education system: \$440,000,000
- Percentage of budget going to teachers salaries: 90 percent
- Hours of schooling: 3 per day and 20 class periods of 45 minutes each per week
- Weeks of classes in the school year: 34 weeks (effective) equivalent to 170 class-days
- Half of children have basic textbook
- 50% of the population has access to electricity, and 10% has access to telephone.
- There are 50 TV sets per 1000 habitants.
- There is no assessment system in place. However a standardized test was given to a small sample at the end of 4th grade. The test was based on the official curriculum of both math and Language. The average score on the test was 50 out of 100. A score of 100 would indicate that a student had mastered what the official curriculum expects him/her to know.

Cost-effectiveness will vary significantly with the size of the country, its current stage of educational development, and its GNP per capita. For example, relative costs of inputs can be significantly

smaller in a country where average unit costs are \$200 or more, compared to the average used in this report of \$110. Annex 3 to this report provides the most recent data from the UIS on unit costs in primary education in English speaking Sub-Saharan Africa. There would also be some savings in larger countries where fixed costs are high and variable costs low (e.g., sample-based assessments and distance education). Therefore, a common educational context is critical for making these estimates.

For each intervention the experts estimated the impact on learning and the probability of its correct implementation. The average of their estimates was compared with unit costs estimated by the authors to create an index of estimated cost-effectiveness.

Learning achievement is defined as the score on a standard language and mathematics test given at the end of fourth grade. It is assumed that students on average answer about 50 percent of the items correctly (items being representative of the expectations of a common curriculum). These are “criterion” referenced” tests. We expect children to score 100 percent--which is what the curriculum demands. It is therefore possible, with appropriate interventions, for a large number of school children to get high scores. It is assumed that the curriculum is relevant and that the test content is taught, e.g., that there is an "opportunity-to-learn.”

The overall score on a fourth grade test is a simple but clear measure of current attempts to improve the quality of schooling in the region. Nonetheless it should be noted that a significant percentages of children are dropping out before reaching fourth grade, and this exercise does not capture interventions which could increase school retention. For example it is likely that school feeding would have a strong impact on school retention but a lower impact on learning achievement.

The economists and planners were then asked the following two questions (with respect to the average country) for each one of the 46 interventions:

- Estimate the average percentage increment in student achievement on a test in mathematics and reading, given to fourth graders, compared to a control population which did not receive the intervention, assuming the intervention is adequately implemented.
- Estimate the probability (in percentage) of adequate implementation of the intervention, based on both technical and political considerations. In many cases it was small given the limited amount of resources to implement strategies.

The authors then estimated the probable increment in annual operational unit cost for each of the selected interventions, including the annualized capital cost, in the context of the “typical country and based on their experience in the region and elsewhere.

The estimated cost per student of each intervention cost estimate was compared with the product of the previous two estimates to create an index of estimated cost-effectiveness for each intervention. This approach is somewhat similar to the development of “DALYS” (Disability Adjusted Life Years) in the health sector (see World Bank World Development Report of 1993) in which cost-effectiveness estimates were derived from expert opinion on the extent that illnesses would affect the productivity of individuals

The index is calculated as follows:

a = % of school population benefiting from the intervention

b = if fully implemented, expected % increase in the test score of the target population

c = % probability of full implementation of the intervention

d = % increase in annual operational cost for the benefited population

$I(\text{index}) = b*c/d$ for the target population; for the population as a whole, the costs and impact are reduced proportionally but the value of the index remains the same (e.g., $I = b*c*a/d*a$).

There are two ways to present cost effectiveness. One way is to simply divide the percentage increase in learning by the percentage increase in costs. Another way is to estimate the Dollar cost per student (taking into account that the annual cost per student is estimated at \$110) to increase a test score by one point. Both ratios are provided.

III. 46 Possible Interventions

A preliminary set of 40 interventions was sent to experts. They suggested to add eight strategies and to delete two strategies that would not be relevant for Sub-Saharan Africa

The initial list of interventions was based on: educational projects and programs, both successful and unsuccessful, implemented in Africa in the last twenty years;) educational policy recommendations and priorities proposed by international organizations and development banks (Lockheed and Verspoor, 1991; World Bank, 1994); and findings in regional diagnostic surveys carried out in the 1990s (World Bank web site). Below is the list 46 interventions:

Table 4: Forty Six Education Interventions in Sub-Saharan Africa

- | |
|---|
| <ol style="list-style-type: none">1. Enforce a policy not to switch classroom teachers during school year.2. Implement a policy to assign best teachers to first grade.3. Enforce regulations on official length of school year and instruct headmasters to enforce the teacher attendance policy.4. Extend daily schedule by one hour (40 minutes academic classes, 20 minute recreational) and pay teachers additional proportional salary.5. Extend length of school year by one week and pay teachers additional proportional salary.6. Pay teachers in rural schools salary increment of 20% to have better trained teachers and raise the percentage of certified teachers.7. Raise teachers' salaries by 10% in real terms, with no-strike agreement for two years.8. Raise teachers' salaries by 20% in real terms, with no-strike agreement for three years.9. Fire half the staff in the education bureaucracy (currently 5% of unit costs) and establish a new highly trained and motivated bureaucracy paid on average 2.1 times previous salary. |
|---|

10. Establish Management Information System (MIS) for identifying low performing schools and inform school supervisors.
11. Decentralization: give authority to school principals to manage funds and to hire and fire teachers with local council approval; with no efforts for strengthening the Ministry of Education (MOE) capacity for assessment and oversight.
12. Same as above, except MOE capacity for assessment and oversight is improved significantly.
13. Test a 10% sample of 4th graders in math and reading and provide numerical results to all 4th grade classroom teachers.
14. Test the same sample (as above), analyze results in terms of remedial strategies, and organize local follow-up seminars for all 4th grade teachers (one week).
15. Universe testing of 4th graders (in math and reading), analyze results in terms of remedial strategies, and organize local follow-up seminars for all 4th grade teachers (one week).
16. Provide classrooms with one standard textbook per student in math as well as in reading (100 pages each) and accompanying teacher guide, without training teachers to use them.
17. Provide same as above and also train teachers to use them (1 week per year).
18. Produce and provide to each student a set of learning materials for individualized instruction in reading and math, revised after evaluated with students for one year (400 pages per student, replaced every three years).
19. Suggest schools to establish a revolving textbook account (e.g., schools rent textbooks at 1/3 the replacement value over 3 years; then replace the books and repeats the process)
20. Provide a small library (60 books) to each classroom (renew every 5 years).
21. School feeding programs: free snack (cup of milk and bread) for everyone.
22. School feeding programs: free snack provided for 1/2 of the children, the rest pay.
23. School feeding programs: free lunch for everyone.
24. School feeding programs: free lunch for 1/2 of the children, the rest pay.
25. Yearly checkup and referral by nurse. Not including medical interventions (which come from the health system).
26. Vision test by school and referral. Not including treatment, but it is recommended that nearsighted students sit up in front.
27. Adapt and broadcast high quality pre-school TV programs such as Sesame Street (250 programs). For home viewing only.
28. Mass media campaigns for parents to provide early stimulation to children ("did you read one page last night to your children?"), 30 one-minute spots in one week (radio and TV).
29. One year of developmentally oriented pre-schooling for at-risk children (50%), at unit cost equal to one year of primary school.
30. Same as above at unit cost 0.5 times primary.
31. One year of care taking of pre-schoolers (provided to 50% of students) with no educational development content (unit cost 0.5 of primary school).
32. Provide general in-service training to teachers (upgrading), 4 weeks per year (without follow-up materials for students).
33. Targeted in-service hand-on training focusing on developing classroom strategies for cooperative learning (group work) and students' active use of time (one week per year).
34. Targeted training focusing on using "programmed learning" materials (one week).
35. Targeted training acquainting teachers with modern curriculum objectives and strategies (one week).

36. Grant program to improve the quality of pre-service training to meet the challenges of the 21st century. Government provides US\$20 additional for every teacher-trainee to teacher training institutions revising their programs to emphasize active learning, high standards, commitment and responsibility.
37. Revise curriculum in math and reading using local experts and send a copy to each teacher (without teacher in-service training and without field study of implemented curriculum).
38. Reduce class-size by four students (from 40 to 36 students per teacher).
39. Reduce class-size by ten students (from 40 to 30 students per teacher).
40. Recommend headmasters and communities to enforce student attendance policies.
41. Pay US\$1 per month (cash or kind) to families, or \$10 per year provided their children remain in school (e.g. conditional transfer or subsidy).
42. Rotate teachers and principals each 5 or 6 years among schools from same city or area to increase sharing of best professional practice (as in Japan).
43. Prepare and implement interactive radio instruction program for mathematics and language and broadcast by radio to all school children with accompanying teaching/learning materials.
44. Paying the teachers regularly (avoiding delays) or at least paying their salaries before other civil servants' salaries (including army's salaries).
45. Provide one hour per week of access to computers to all primary school children at which time they study LOGO.
46. Establish a national consensus on the importance of improving basic education. Then deliver a complete learning package to schools at risk (50% lowest performing schools): self-learning materials, training in active and cooperative learning, hands-on workshops, community involvement, school based management, formative evaluation and systematic testing and feedback.

Since there is an increasing consensus that combinations of interventions may have a cumulative impact, a number of the strategies combine two or more interventions. For example, in addition to strategy 11 "decentralization of authority to school principals," there is strategy 12 "same as 11 but improving capacity of the ministry for monitoring." Also, in addition to strategy 16, "provide two textbooks per student," there is strategy 17 "same as 16 plus one week training for teachers to use the textbooks". In these cases the unit cost corresponds to the addition of both unit costs.

These interventions can be grouped by operational area, as below.

Table 5. Education Interventions by Operational Area

Area of Intervention	Number of the intervention (strategy)*
Time on task (and available time for learning)	3, 4, 5, 40, 41
Academic management	1, 2, 38, 39, 42
Salaries	6, 7, 8
Management and decentralization	9, 10, 11,12, 19, 44
Testing	13,14,15,
Textbooks and (self) learning materials	16, 17,18,19, 20
Food and health	21, 22, 23, 24, 25, 26

Initial education (increasing learning capacity)	27, 28, 29, 30, 31
Teacher training	32,33,34,35, 36
Curriculum	37
Radio and computers	43,45
Package of interventions	46

IV. The Results of the Survey

Table 6 summarizes the estimates of potential impact, probability of effective implementation, probable impact, cost, and cost effectiveness.

Table 6. Estimates of Cost-Effectiveness of Forty Six possible Education Interventions

Presented in Order of Descending Cost-Effectiveness

Strategy #	A. Estimated Increase in Achievement (%)	B. Probability of Adequate Implementation (%)	C. Probable Impact (%) [A*B]	D. Estimated Increase in Cost (%)	E. Cost-Effectiveness [C/D]	Increase in unit cost in US\$ for 1% point increase in scores	
2	Assign best teachers to first grade	21.6	37.4	8.1	0.01	1184.23	0.1
3	Enforce official length of school year	13.4	45.7	6.1	0.01	898.44	0.1
40	Enforce student attendance policies (less truancy)	10.8	52.5	5.7	0.01	832.33	0.1
44	Pay teachers regularly (avoid delays)	11.5	34.0	3.9	0.01	573.08	0.2
1	Teachers do not rotate during school year	6.7	53.3	3.6	0.01	524.09	0.2
42	Rotate teachers & principals among schools	9.5	36.8	3.5	0.01	511.71	0.2
28	Mass media campaigns for parents to read to kids	11.8	51.8	6.1	0.05	134.63	0.8
37	Revise curriculum (math & reading) and distribute it	4.4	39.1	1.7	0.02	75.68	1.5
26	Vision test by school and referral	7.3	46.8	3.4	0.05	74.91	1.5
10	MIS for identifying low performing schools	12.8	48.6	6.2	0.09	68.39	1.6
13	Test 10% of 4th graders and report to teachers	7.7	60.0	4.6	0.09	48.98	2.2
11	Decentralization to school level	5.5	29.4	1.6	0.05	35.23	3.1
36	Grants (\$50/student) to improve pre-service	13.4	47.3	6.3	0.18	34.91	3.2
14	Same as 13 plus remedial strategies (1 week)	21.4	52.1	11.1	0.54	20.79	5.3
12	Decentralization with supervision of MOE	15.2	34.0	5.2	0.27	18.97	5.8
27	Broadcast excellent pre-school TV programs	4.5	42.3	1.9	0.13	15.22	7.2
19	Revolving textbook account (school rent textbooks)	15.0	37.1	5.6	0.55	10.05	10.9
15	Test all 4th graders (one week remedial seminar)	25.0	39.3	9.8	1.35	7.27	15.1
20	Small library for each classroom	11.2	38.3	4.3	0.82	5.22	21.1
25	Yearly checkup and referral by nurse	5.7	41.5	2.4	0.53	4.43	24.8
33	Interactive instruction by radio	17.3	38.2	6.6	2.09	3.17	34.7
43	Learning materials for individualized instruction	25.8	28.8	7.4	2.42	3.06	36.0
18	Train teachers on using cooperative learning	17.3	38.0	6.6	2.65	2.49	44.2

35	Acquaint teachers with modern curriculum	10.9	44.5	4.8	2.65	1.83	60.2
17	Same as 16 and train teacher (1 week)	28.6	37.0	10.6	6.28	1.68	65.4
16	Give each student 2 standard textbooks	14.4	41.0	5.9	3.64	1.62	67.8
34	Train teachers on using programmed learning	11.5	36.6	4.2	2.65	1.59	69.1
5	Extend length of school year by one week	7.0	44.4	3.1	2.65	1.17	94.4
9	Smaller bureaucracy, but well paid	8.9	14.1	1.3	1.25	1.00	109.9
30	Same as pre-school but half the cost	12.3	30.9	3.8	4.17	0.91	121.0
46	Multiple interventions (learning packages)	23.8	26.7	6.4	8.85	0.72	153.2
29	Cognitive oriented pre-schooling (one year)	15.2	27.4	4.2	8.33	0.50	220.5
29	Salary increment of 20% for rural teachers	18.8	31.0	5.8	12.60	0.46	238.8
6	Caretaking of pre-schoolers (no cognitive goal)	6.1	27.5	1.7	4.17	0.40	275.0
31	Raise teacher's salary by 10% (no strike)	10.6	33.3	3.5	9.00	0.39	280.2
32	In-service training to teachers (no materials)	12.0	36.6	4.4	11.65	0.38	291.8
8	Raise teacher's salary by 20% (no strike)	14.4	28.8	4.1	18.00	0.23	477.3
4	Extend daily schedule by one hour	17.0	29.1	4.9	22.50	0.22	501.0
38	Reduce class-size from 40 to 36 students	7.1	26.4	1.9	10.00	0.19	591.8
41	Pay US\$1.00/month if children attend school	7.6	21.9	1.7	9.09	0.18	604.1
21	Feeding program (50% receive free snack)	8.0	20.2	1.6	11.59	0.14	785.0
22	Feeding program (everyone receives free snack)	11.9	23.0	2.7	23.18	0.12	933.2
39	Reduce class-size from 40 to 30 students	12.3	20.0	2.5	25.00	0.10	1112.3
24	Feeding program (free lunch for 50%)	12.2	19.8	2.4	30.91	0.08	1405.1
23	Feeding program (free lunch for everyone)	16.7	18.1	3.0	61.82	0.05	2255.3
45	One hour per week of access to computers	6.0	14.9	0.9	18.85	0.05	2324.8
AVERAGE		12.8%	35.3%	4.5%	6.97%	0.6	170.4

(A) Estimated average percentage increment in student achievement on a standardized test in mathematics and reading, given to fourth graders, with an initial score of 50 out of 100, compared to a control population which did not receive the intervention.

(B) Probability (in percentage) of adequate implementation of the intervention, based on both technical and political considerations.

(D) Probable increment in annual operational unit cost from the intervention including the annualized capital cost.

(E and F) Both these columns show the estimated cost-effectiveness of each strategy. (E) shows the ratio of % increase in expenditure to % increase in scores. (F) estimates the dollar increase in expenditure per student to achieve a one point increase in scores

Potential Impact

On average the experts estimated that the various interventions, if adequately implemented, could increase learning achievement by over 6 points on a test where students answered 50% of questions correctly, or 12.8 percent over the base score (50 points). Table 7 lists the six interventions with the greatest possible impact if properly implemented..

Table 7. Six Interventions with Greatest Impact on Learning Achievement if Properly Implemented

Intervention	Expected Percentage Increase in Test Score
17. Give students 2 standard textbooks and train teachers for one week in their use	28.6
43. Learning materials for individualized instruction	25.8
15. Test all 4 th graders and provide one week seminar to teachers	25.0
46. Provide comprehensive learning package	23.8
2. Assign best teachers to first grade	21.6
14. Test 10% of fourth graders and train all teachers for one week on results	21.4

The intervention with the greatest possible estimated impact was “providing a textbook and training teachers one week (per year) to use them” (item #17). The other strategies that had an impact, if properly implemented, above 20 percent, were “testing of children and developing remedial training strategies (#15); “providing learning materials and revising them” (#18); “providing a package of multiple interventions” (#46); “assign the best teachers to first grade” (#2); and “providing learning materials for individualized instruction (#18). Clearly testing and instructional materials are considered of highest importance by the respondents.

The experts identified some interventions which would have little or no impact. For example, #37 “changing the curriculum” without training teachers was expected to have an impact of only 4 percent. Other interventions with low expected impact included #27 “pre-school TV programs like Sesame St,” “nurse examinations” (#25), and “access to computers” (#45).

Probability of Correct Implementation

Overall the education economists and planners were pessimistic about the probability of adequate implementation of these interventions, which had an average chance of only 35 percent of being implemented. This is undoubtedly the result of unfortunate but real experiences in the past. They estimated that the costliest interventions to have the lowest probability of adequate implementation, as, for example, one hour per week of access to computers (#45). Feeding programs (#21-24), as well as conditional cash transfers (\$1 per student) (#41), which are also

expensive, were not expected to be well implemented. Another intervention with a low probability of implementation the one in which the Ministry of Education would fire half its staff and nearly double salaries (#9).

The interventions with the best chance of being well implemented (over 50 percent) were simple ones, depending on procurement of a few items or, in one case, hiring a private firm. These included “mass media campaign for parents to read kids” (#28); “test 10% of 4th graders and report to teachers” or train teachers for one week (#13 and 14). Ensuring that “teachers do not rotate during school year” (#1) also appeared relatively easy to implement.

The pessimism about implementation is not simply a result of experience in Africa but also of experience around the world in education reform. Any change (even a small one) involves breaking traditions and affecting many social relationships which support a return to the old patterns. The analysis of major school reforms shows that "... even moderately complex changes take from three to five years, while major restructuring efforts can take five to ten years" (Fullan, 1991). Successful reforms require coherence and institutional capacity building (Chrispeels, 1997; Lockheed and Verspoor, 1991; Rondinelli et al, 1990).

In eventual replications of this approach (for example, in a single country) a more sophisticated approach could be used, which could separate out technical, fiscal and political problems of implementation.

Probable Impact

When the expected impact on achievement (average 12.8 percent) is combined with the 35.3 percent probability of implementation, then the average probable impact of all interventions is 4.5 percent (Table 7 Column C), which is very low. This may be a reflection of the overall pessimism about education reform in Africa, or perhaps a result of difficulties outside the education sector of political stability and governance. In fact, no intervention has more than an 11 percent probable impact on learning achievement.

Table 8 shows the seven interventions with the greatest impact on test scores, taking into account the probability of adequate implementation.

Table 8 Seven Interventions with Greatest Impact on Learning Achievement Taking into Account the Feasibility of Implementation

Intervention	Expected Percentage Increase in Test Score
14. Test 10% of fourth graders and train all teachers for one week on results	11.1
17. Give students 2 standard textbooks and train teachers for one week in their use 43.	10.6
15. Test all 4 th graders and provide one week seminar to teachers	9.8
2. Assign best teachers to first grade	8.1
Learning materials for individualized instruction	7.4
33. Interactive instruction by radio	6.6

The three interventions with the greatest probable impact were: (#14) --test 10% of 4th graders, report to teachers and train them in remedial strategies” (11.1 percent); and (#17) provide learning materials to students--2 standard textbooks per student--and training the teachers to use them (10.6 percent).

The interventions with the lowest potential impact (2 percent or less) are those which have a small effect on learning (less than 10 percent) , and have a probability of being implemented of between 10 percent and 30 percent. These include: one hour per week of access to computers (#45, with 0.9 percent); reducing the Ministry of Education's bureaucracy (#9, with 1.3 percent); revising the curriculum (#37, with 1.7 percent); caretaking of preschoolers (#31, with 1.7 percent), paying \$1 per month if children stay in school (#41 with 1.7%), and feeding program (#21, with 1.6%). The overall pessimism about the impact of education interventions is a cause for deep concern in the region.

Cost Estimates

The estimated costs of interventions are in themselves of great value since cost figures are seldom available for systematically assessing the cost of project components. The authors did their own estimates of costs, presented them to the experts for comments and, eventually, compared the increment in costs with the experts' estimates of the impact on learning weighted by the probability of implementation. It was inappropriate to ask the experts to estimate costs since this is a technical question which had a “right” answer (given the data available) and takes a long time to carry out. The cost estimates are based on costs in a typical lower-income, medium-size country in the region. The estimated increments in costs are presented in Table 7 (column D). Annex 1 provides the reasoning behind the cost estimates. Feedback from readers on the adequacy of these estimates would be useful and is encouraged. In addition each reader can revise the cost estimates himself and then re-calculate the cost effectiveness indicators. A field study would be necessary to confirm and/or revise these estimates.

The highest cost intervention is the provision of a free lunch to all school children (#23, involving a 62 percent unit cost increase). Other high-cost interventions (above 10 percent) include #45, “one hour per week of access to computers” (19 percent); #4, “extend daily schedule by one hour” (23 percent); reduce class-size from 40 to 30 students (31 percent). ; and #46 multiple interventions package” (20 percent). Other relatively expensive strategies are: increasing salaries by 20 percent in order to reduce strikes (#8, requires an 18 percent increment); and paying rural teachers 20 percent more (#6 at 13 percent),

Half of the selected interventions require increasing present annual unit costs by less than three percent and 14 strategies involve increasing the annual unit cost by less than one percent. The lowest costs refer to administrative decisions whose costs are nil or insignificant, such as enforcing regulations (#1, 3 and 40, with 0.07 percent); assigning good teachers to the first grade (#2, with 0.07 percent); rotating teachers and principals among schools (#42 with 0.07 percent); operating a revolving textbook fund (#19 with 0.07 percent); or paying teachers without delays (#44, with 0.07 percent).

Decentralization by itself is a very low cost intervention (#11, with 0.5 percent); but combining decentralization with better central government oversight is significantly more costly (#12, with 2.9 percent). One year of pre-schooling, which at first glance would be expensive, should be prorated over the six year primary school system (#29, with 8 percent, or #30, at 4 percent).

Differences between Groups of Experts

Table 9 summarizes the differences in estimates based on the region of birth of groups of economists and planners who participated in the survey.

Table 9. Estimates by Respondent's Region

Region	Number of Respondents	Potential Increment in Learning Achievement (%)	Probability of Adequate Implementation (%)
North American	4	12	34
Japan	5	12	35
Europe	3	6	46
Africa	11	14	37
Average of all	23	13	35

Overall there is a reasonable level of consistency among these groups. Europeans tend to be less enthusiastic about the potential increment in learning achievement, but more positive about the possibilities for implementation. Africans are slightly more optimistic about the proposed interventions. Overall there is a reasonably good consistency among the respondents. Annex 3 provides more detailed information on respondents' responses by intervention.

Potential Cost-Effectiveness of Interventions

The index of cost-effectiveness summarizes all the information gathered in this survey (Table 6, final two columns). Interventions with the highest cost-effectiveness would be expected to be those which cost very little but have at least some impact on learning. Table 10 summarizes the six interventions with the highest cost effectiveness:

Table 10. Six Interventions with Highest Cost Effectiveness

Intervention	Cost Ratio Effectiveness
2. Assign best teachers to first grade	1184
3. Enforce official length of school years	898
40. Enforce school attendance policies	832
44. Pay teachers regularly	573
1. teachers do not rotate during the year	524
42 Rotate teachers and principals among schools between years	511

These especially include inexpensive policies such as assigning the best teachers to first grade (#2); enforcing regulations on the number of days and hours in the school year (#3); enforcing students' attendance (#4); not switching teachers during the school year (#1); avoiding delays in paying teachers' salary (#44); and rotating teachers and principals among schools (#42). This suggests that authorities should pay attention to simple but fundamental management strategies.

Some interventions do have a significant but reasonable cost and a significant estimated impact, and therefore have a high cost-effectiveness ratio. These include: sample testing of fourth graders (#13); vision test and referral (#26); mass media campaigns to encourage parents to stimulate their children (#28); school decentralization (#11), and revising the curriculum (#37), and an MIS identifying low performing schools(#10).

Finally some interventions with significant costs as well as impact also have reasonable cost-effectiveness ratios. These include: testing students and developing remedial treatments (#13, 14 and 15); providing high quality preschool television programs (#27, with 1.6); grants to teacher training schools (#36), a revolving textbook account (#19), and testing and then training of teachers (#15).

The items with the lowest cost-effectiveness are those which are very costly and have little, or only a modest, impact on learning. These especially include school feeding (#21 through 24), and provision of computers (#45). Other interventions may not be costly but have not much of an impact on learning, such as reducing class-size from 40 students to 36 or 30 students (#38 and 39). Paying teachers more money (#6-8) is costly but the experts believe that it is not by itself a cost-effective intervention. Paying parents to keep the children in school (#41) does not appear to be cost effective in terms of learning.

The experts' estimates confirm the following:

- Undertake interventions which do not cost much but have an impact (e.g., enforcing school year regulations, or putting good teachers in first grade).
- Some interventions are of moderate to high cost but have a significant impact, especially those related to teaching materials and to hands-on teacher training. These interventions should be implemented.
- Some interventions are expensive and, at least by themselves, without ancillary activities, are not good investments. This is especially the case of increased salaries, traditional teacher training, computers and school feeding programs.

The ratings are quite consistent. For example "decentralization" as well as "sample testing" have lower (or similar) "impact" ratios than the same interventions with complementary activities such as "decentralization while also strengthening the ministry of education" (# 12) and testing while also providing feedback on tests (#14), but the differences in costs changes the value of the cost-effectiveness indicator. Decentralization without other elements has a lower impact on learning. The most comprehensive package of interventions (#46) --which is similar to projects

being implemented in several countries--, has a probable impact of 6.4 per cent, but a relatively low cost-effectiveness ratio.

Comparison with Latin America

Table 11 compares the overall results of the survey with that of Latin America:

Table 11. Comparison of Cost Effectiveness Estimates between Sub-Saharan Africa (six countries) and Latin America

Average for all Interventions	Sub Saharan Africa (composite of six countries)	Latin America (composite of all countries)
Increment in learning if adequately implemented	12.8%	10.3%
Possibility of adequate implementation	35.3%	62.8%
Probable impact	4.5%	6.5%
Incremental cost of intervention	7.0%	5.1%

Source for Latin America: Schiefelbein, Wolff, and Schiefelbein. 46 interventions in Africa and 40 interventions in Latin America

Compared with Latin America, experts in Africa think that, if adequately implemented, interventions could have a greater effect; but they are costly compared to the per student cost and significantly more difficult to implement. In fact the most striking difference between the two estimates is the pessimism about implementation in Africa; implementation is therefore clearly the critical issue in Africa..

V. Conclusions and Next Steps

The conclusions of the exercise are: undertake interventions which do not cost much but could have an impact (e.g., enforcing school year regulations, putting good teachers in first grade); some interventions of moderate cost and a significant impact, especially those related to teaching materials, should be undertaken; do not undertake large-scale expensive interventions which up to now have demonstrated low cost-effectiveness (increased salaries, conventional teacher training, etc.); focus on implementation, including taking into account the difficulties of implementing complex packages of interventions.

This index can help to make more transparent the assumptions of decision makers within governments, as well as external agencies funding education projects. It alerts policy-makers to the strategies they are actually selecting. Listing 46 interventions, as well as estimating their costs, in itself, is of great value. They can be used to assess, or at least to provide a benchmark, for estimates of the cost of project components made in various countries.

But estimating cost effectiveness is still a poor substitute for real cost-effectiveness research. To put it simply, planners and experts work under a large set of partially or un-tested assumptions. This is especially the case for currently favored interventions, such as decentralization and testing. There is now an increased opportunity in sub-Saharan Africa to undertake applied research, since international cooperation efforts such as SACMEQ are growing. Moreover, national assessments processes being developed in several countries could be linked to a strong applied research agenda.

A similar exercise can be undertaken in southern Africa as well as in French speaking West Africa, and also repeated five or ten years from now. Over time, new interventions will be identified, political and implementation constraints may be reduced, and costs may be reduced (for example, with computers), therefore allowing some interventions to become increasingly cost-effective.

Not only education practitioners, but also national political and business leaders, need to define their priorities in education. Perhaps, with this simple tool to explicitly define assumptions, national decision makers can begin to understand what works and what does not work in education, and help create a stronger social consensus on education investments.

This exercise may be refined and improved by contacting a larger number of experts. It could be undertaken in other regions, in order to compare similarities and differences in results. The cost parameters can be adjusted to individual countries or groups of countries. A new group of experts can estimate a new set of figures for a given country.

It has been shown in Latin America that the process of estimating cost effectiveness can be an effective teaching device for training policymakers and educational planners, since it forces them to clarify their own thinking. To work best, small groups could be assigned to discuss and then report on their deliberations with regard to a sub-set of the interventions. They would work together and then come up with conclusions which would be presented to a plenary session. The approach has already been adapted into the curriculum for training international education researchers at both Harvard Graduate School of Education and Stanford University.

In summary,

- an index (admittedly crude) of cost-effectiveness of interventions is now available for a group of sub-Saharan African countries
- this index can help to clarify assumptions about primary education interventions identified
- based on this index, an agenda for traditional (and time-consuming) cost-effectiveness studies can be developed to provide a more solid basis for objective decisions on education development
- last, but not least, an effective teaching and consensus-building tool has been devised.

Annex 1. Basis for Cost Estimates of 46 Interventions

Summary of Estimated Cost of Each Intervention

Intervention Number	Percentage Increase	Increase in US\$ PPP(based on unit cost of \$110)
1	0.007%	0.01
2	0.007%	0.01
3	0.007%	0.01
4	22.500%	24.75
5	2.647%	2.91
6	12.600%	13.86
7	9.000%	9.90
8	18.000%	19.80
9	1.250%	1.38
10	0.091%	0.10
11	0.045%	0.05
12	0.273%	0.30
13	0.094%	0.10
14	0.535%	0.59
15	1.350%	1.49
16	3.636%	4.00
17	6.283%	6.91
18	2.424%	2.67
19	0.552%	0.61
20	0.818%	0.90
21	23.182%	25.50
22	11.591%	12.75
23	61.818%	68.00
24	30.909%	34.00
25	0.535%	0.59
26	0.045%	0.05
27	0.125%	0.14
28	0.045%	0.05
29	8.333%	9.17
30	4.167%	4.58
31	4.167%	4.58
32	11.647%	12.81
33	2.647%	2.91
34	2.647%	2.91
35	2.647%	2.91
36	0.182%	0.20
37	0.023%	0.03
38	10.000%	11.00
39	25.000%	27.50
40	0.007%	0.01
41	9.091%	10.00
42	0.007%	0.01
43	2.091%	2.30

44	0.007%	0.01
45	18.848%	20.73
46	8.847%	9.73

BASIS OF COST CALCULATION FOR EACH of 46 INTERVENTIONS

(Costs are estimated in current US\$)

1. Nominal cost of \$30,000. This represents less than a 0.01% increase in unit cost.
2. Nominal cost of \$30,000 for information and control. This represents less than a 0.01% increase unit cost.
3. Nominal cost of \$30,000 for providing information and insuring enforcement. This represents less than a 0.01% increase in unit cost.
4. One more hour means a one third increase in hours, equivalent to a one third increase in salaries, which are estimated at 90% of total cost, or total 30% increase in unit costs.
5. One extra week of work means that the 34 weeks of schooling is increased by 1 week, which is a 2.9% increase. However teachers' salaries are equivalent to 90% of this figure, so the cost increase is 2.65%.
6. 70% of students are in rural areas. For this group teacher salary increase is 20% of 90% of unit cost or 18% for the target group. For the system as a whole this represents an increase of 12.6% in unit cost.
7. Increase in teachers salary is 10%. Since teachers account for 90% of costs, total increase in cost would be 9%.
8. Increase in teachers salary would be 20%. Since teachers account for 90% of costs, total increase in cost would be 18%.
9. Bureaucrats are 5% of the total budget. Firing half the bureaucrats would save 2.5%. Paying the remaining bureaucrats 2½ times their salary would result in an overall cost increase of 1.25%.
10. Management Information System (MIS) estimated at \$400,000 per year or 0.09% of unit cost, based on an overall estimated system cost of \$440 million.
11. Since there is no improvement in MOE capacity for oversight and assessment, the cost is estimated at \$200,000 This cost represents an increase of 0.05% in unit cost.
12. To improve flow of information and capacity for regulation and oversight, total cost is about \$1.2 million to strengthen testing, statistics and financial management, or 0.27% increase in unit cost.
13. It costs about \$6 per student to test them adequately. However only 10% of fourth graders are tested; and 4th graders are 1/6 of the total, so we are testing 1.67% of all students. Distributing the results to 4th grade teachers adds around \$15,000. This represents an increase of 0.09% in unit cost.
14. The cost of the follow up seminar is the same as one week of teacher's time which comes an increase of 2.65% (see the cost of strategy 5), which would be provided to all fourth grade teachers. The unit cost for the system is one sixth of this amount (based on six grades) is 0.44%. Added to strategy 13 the total incremental cost increase is 0.54%.
15. Universe testing for all fourth graders assumes that the cost per student is \$6 and the number of students is one sixth of the total of grades 1-6. The total cost is around \$4 million or 0.9%

- increase in costs. To this we add the cost of one week of training of all fourth grade teachers or 0.44% for a total increase in costs of 1.35%
16. Two textbooks are provided (Language and Math). Assumes \$2.00 for each book for a total of \$4 per student. This represents an increase of 3.64% in unit cost. Assumes textbooks last only one year.
 17. Teacher salary is assumed to be 90% of unit cost. Divided by 34 weeks, one week of teachers time comes to 2.65% (see the cost of strategy 5), If we add the cost of textbooks above, the increase in unit cost is 6.29%.
 18. Cost of each set of learning materials is the same as for textbooks (\$2).. However four books are provided, and they are expected to last for three years. The cost per student is $2 \times \frac{4}{3}$, or \$2.67. This represents an increase in costs of 2.42%
 19. It is assumed that there will be an annual loss of 10% of rented textbooks over three years, so the cost will be about US\$.60 and a nominal amount of \$30,000 will be needed for oversight. So the total increment in costs is 0.55%.
 20. Assume each book costs \$3 (in bulk), so one library costs \$180. Cost over five years is \$36. With 40 students per classroom unit cost is \$0.9. This represents an increase of 0.82% in unit cost.
 21. Estimate milk at \$.10 and bread (or any local staple food) at \$.05, for \$.15. Total is $$.15 \times 170$ days or \$8.5 per student. This represents an increase of 23.18% in unit cost.
 22. Same as above but given to half the students, so unit cost is \$4.25. This represents an increase of 11.59% in unit cost.
 23. Lunch is estimated at \$.40 per day, so cost is $$.40 \times 170$ or \$68 per student. This represents an increase of 61.82% in unit cost.
 24. Half of above or \$32. This represents an increase of 30.91% in unit cost.
 25. Detection only. Does not include medical interventions, which come from the health system. One nurse can check 30 students a day or, over 170 days, about 5000 per year. The salary is \$3,000 per year so the unit cost is \$.60. This represents an increase of 0.54% in unit cost.
 26. Detection only, but nearsighted students can sit up front. Can be done by teacher if materials and some extra money are provided. Cost is \$.05 per student. This represents an increase of 0.05% in unit cost.
 27. 250 television programs are provided for home viewing only. Royalty to Sesame street is \$500 per episode, and cost of transmitting is \$2000 per episode. Total absolute cost is \$550,000. This represents an increase of 0.13% in unit cost. Assumes that detailed adaptation to local culture is not undertaken.
 28. Estimate overall at \$200,000 for preparation and purchase of radio and TV time for mass campaign, which is \$.05 per student. This represents an increase of 0.05% in unit cost.
 29. Assumes that the cost of pre-schooling is the same as that of primary school. Since 50% of one year of at-risk students are pro-rated over 6 years, then the increase is 8.33%.
 30. Half the cost, or 4.17% in unit cost.
 31. Same as above or increase of 4.17% in unit cost.
 32. Four full weeks of teacher upgrading is estimated at 4 times the cost of strategy 5, plus an additional 10% for preparation and travel, for a total of 11.65%.
 33. Training for one week is estimated at the same as No. 5 above, or 2.65% in unit cost.
 34. Same as above.
 35. Same as above.
 36. Grant program is estimated at \$80 per graduate (20x4) who teach for 10 years so the cost is \$8 per year per teacher. Since there are 40 students per teacher the annual cost is $\frac{8}{40}$ or \$.50. This represents an increase of 0.18% in unit cost.
 37. Revision not based on detailed research but rather on contracting local experts and distributing curriculum guides. Cost estimated at \$100,000 mainly for local experts and a

very low cost of distributing curriculum guide. This represents an increase of 0.02% in unit cost.

38. 10% reduction in class size (from 40 to 36) represents an increase of 10% in unit cost.
39. 25% reduction in class size (from 40 to 30) represents an increase of 25% in unit cost.
40. Nominal cost of \$30,000 for providing information and insuring enforcement. This represents an increase of 0.01% in unit cost.
41. The cost per 10 months is \$10.0 per student. This represents an increase of 9.09% in unit cost.
42. Nominal cost of \$30,000 for providing information and insuring enforcement. This represents an increase of 0.01% in unit cost.
43. \$2 million for preparation, with outside technical assistance, pro-rated over 10 years. Radio cost of \$30 per classroom, lasting three years. Yearly cost of materials is about \$2 per student. Total increment in unit cost is 2.09%
44. Nominal cost of \$30,000 for providing information to stakeholders, representatives and mass media to obtain political support for this strategy. This represents an increase of 0.01% in unit cost.
45. \$1000 for the computer plus \$100 for other physical modifications. Computer lasts four years, so computer cost is \$275 a year. Maintenance is \$50 per year. Computer serves 30 students per week and teacher serves 400 students per week (once a week in class).. Total increase in costs is 18.85%.
46. Cost is based on above calculations as follows: strategy 16--textbooks; strategy 18--self-help learning materials; one week training \$0.53 (strategy 5); local school management (strategy 11); evaluation system (strategy 13). Total increase in cost is 8.85%..

Annex 2. Averages, Variances and Ranges of Estimates by Region of Respondent

. Average of estimates by groups of judges: Potential Increment in Achievement and Probability of implementation

Strategy Number	Probability of Implementation						Total for 23 judges	Potential Increment in Achievement (points on a test with a mean of 50)					Total for 23 judges
	Average by groups of judges							Average by groups of judges					
	USA	Japan	Europe	Africa 2004	Africa 2005			USA	Japan	Europe	Africa 2004	Africa 2005	
Teachers do not rotate during school year	1	51	53	58	59	51	53	5	3	3	6	2	3
Assign best teachers to first grade	2	31	37	45	45	31	37	14	8	8	17	9	11
Enforce official length of school year	3	49	46	80	53	49	46	10	7	5	10	4	7
Extend daily schedule by one hour	4	32	29	45	23	32	29	7	11	8	8	8	8
Extend length of school year by one week	5	38	44	58	39	38	44	2	4	2	6	3	3
Salary increment of 20% for rural teachers	6	30	31	30	41	30	31	10	9	4	15	9	9
Raise teacher's salary by 10% (no strike)	7	28	33	40	28	28	33	3	7	3	8	6	5
Raise teacher's salary by 20% (no strike)	8	29	29	23	25	29	29	3	9	5	10	8	7
Smaller bureaucracy, but well paid	9	16	14	25	15	16	14	5	6	2	5	4	4
MIS for identifying low performing schools	10	45	49	30	67	45	49	3	5	3	18	6	6
Decentralization to school level	11	23	29	25	36	23	29	3	1	4	8	1	3
Decentralization with supervision of MOE	12	36	34	23	38	36	34	6	6	6	15	7	8
Test 10% of 4th graders and report to teachers	13	56	60	65	78	56	60	1	3	2	6	5	4
Same as 13 plus remedial strategies (1 week)	14	49	52	53	68	49	52	10	9	5	15	12	11
Test all 4th graders (one week remedial seminar)	15	37	39	53	50	37	39	11	14	7	17	12	13
Give each student 2 standard textbooks	16	37	41	65	56	37	41	8	7	5	14	5	7
Same as 16 and train teacher (1 week)	17	37	37	63	54	37	37	15	14	8	24	12	14
Learning materials for individualized instruction	18	26	29	35	40	26	29	12	11	8	18	14	13
Revolving textbook account (school rent textbooks)	19	39	37	55	45	39	37	6	7	4	9	9	7

Small library for each classroom	20	34	38	68	34	34	38	6	2	5	8	7	6
Feeding program (everyone receives free snack)	21	23	23	30	37	23	23	6	7	2	9	6	6
Feeding program (50% receive free snack)	22	22	20	38	25	22	20	4	6	1	7	2	4
Feeding program (free lunch for everyone)	23	21	18	15	40	21	18	9	9	4	12	7	8
Feeding program (free lunch for 50%)	24	22	20	28	41	22	20	6	8	3	13	3	6
Yearly checkup and referral by nurse	25	39	42	73	59	39	42	2	3	1	6	3	3
Vision test by school and referral	26	51	47	78	54	51	47	4	2	2	4	5	4
Broadcast excellent pre-school TV programs	27	34	42	53	69	34	42	1	1	1	4	4	2
Mass media campaigns for parents to read to kids	28	48	52	55	81	48	52	2	2	3	17	7	6
Cognitive oriented pre-schooling (one year)	29	29	27	45	20	29	27	9	9	6	6	7	8
Same as above but half the cost	30	29	31	53	23	29	31	8	6	5	6	5	6
Caretaking of pre-schoolers (no cognitive goal)	31	17	28	53	34	17	28	2	3	2	6	3	3
In-service training to teachers (no materials)	32	25	37	45	64	25	37	4	9	4	5	6	6
Train teachers on using cooperative learning	33	37	38	45	54	37	38	7	8	2	14	10	9
Train teachers on using programmed learning	34	35	37	45	35	35	37	8	7	3	6	5	6
Acquaint teachers with modern curriculum	35	39	45	55	70	39	45	6	3	3	10	6	5
Grants (\$50/student) to improve pre-service	36	46	47	60	55	46	47	4	6	2	13	8	7
Revise curriculum (math & reading) and distribute it	37	31	39	63	48	31	39	1	2	0	4	2	2
Reduce class-size from 40 to 36 students	38	26	26	60	20	26	26	1	1	0	12	3	4
Reduce class-size from 40 to 30 students	39	22	20	35	34	22	20	5	5	3	17	4	6
Enforce student attendance policies (less truancy)	40	57	53	30	87	57	53	5	2	1	18	4	5
Pay US\$1.00 /month if children attend school	41	25	22	48	19	25	22	4	4	2	9	2	4
Rotate teachers & principals among schools	42	28	37	35	73	28	37	3	5	2	9	5	5
Interactive instruction by radio	43	39	38	50	58	39	38	9	10	5	13	7	9
Pay teachers regularly (avoid delays)	44	36	34	48	48	36	34	5	6	4	12	4	6
One hour per week of access to computers	45	20	15	10	31	20	15	1	1	1	3	6	3
Multiple interventions (learning packages)	46	31	27	18	56	31	27	16	9	7	15	12	12
Average		34	35	46	46	34	35	6	6	3	10	6	6
s.d.		8	9	14	15	8	9	3	3	2	4	2	2

Note: Africans in 2005 were those who were associated with or recently graduated from the Harvard Graduate School of Education

Variance and Ranges of Estimates by Groups

Strategy	Probability of implementation					Increment in achievement (points)				
	S.d. 23-cases	Range for 23 cases		Range for 5 group averages		S.d. 23-cases	Range 23 cases		Range for 5 group averages	
		Minim	Maxim	Minim	Maxim		Minim	Maxim	Minim	Maxim
1	21	10	90	40	63	3	0	10	2	6
2	20	0	80	28	46	7	0	40	8	17
3	23	5	100	29	80	5	0	20	4	10
4	23	0	80	21	45	5	1	30	7	11
5	24	0	90	38	58	2	0	10	2	6
6	17	0	80	25	41	4	2	20	4	15
7	19	0	80	26	53	4	0	30	3	8
8	16	0	80	21	43	6	0	35	3	10
9	12	0	51	9	25	4	0	20	2	6
10	24	1	99	30	67	5	0	40	3	18
11	16	2	70	23	39	4	-10	15	1	8
12	24	5	90	23	38	5	0	25	6	15
13	21	10	95	54	78	3	0	15	1	6
14	23	5	95	41	68	7	0	25	5	15
15	26	3	95	33	53	8	0	30	7	17
16	24	10	100	29	65	5	0	30	5	14
17	26	5	100	21	63	9	2	40	8	24
18	22	0	80	17	40	7	2	30	8	18
19	25	0	90	21	55	6	0	30	4	9
20	24	0	75	33	68	3	0	15	2	8
21	19	0	88	15	37	4	0	20	2	9
22	16	0	55	6	38	3	0	20	1	7
23	21	0	100	6	40	6	0	25	4	12
24	20	0	100	2	41	5	0	25	3	13
25	28	0	100	17	73	3	0	10	1	6
26	27	2	100	19	78	3	0	15	2	5
27	25	0	85	29	69	2	0	10	1	4
28	24	5	100	33	81	5	0	40	2	17
29	19	0	70	20	45	5	0	30	6	9
30	22	0	75	23	53	3	1	20	5	8
31	23	0	80	15	53	2	0	10	2	6
32	23	0	100	25	64	5	0	30	4	9
33	22	5	100	21	54	7	0	25	2	14
34	20	0	70	28	45	4	0	15	3	8
35	25	0	100	25	70	4	0	20	3	10
36	23	5	80	38	60	6	0	20	2	13
37	26	0	80	29	63	2	0	5	0	4
38	19	0	80	18	60	4	0	30	0	12
39	20	0	100	5	35	6	0	35	3	17
40	30	3	95	30	87	5	0	40	1	18
41	16	0	70	13	48	3	0	15	2	9
42	24	5	100	28	73	3	0	15	2	9
43	21	1	80	23	58	7	0	30	5	13
44	22	0	75	23	48	4	0	25	4	12
45	16	0	100	1	31	4	0	20	1	6

46	22	0	90	13	56	7	1	28	7	16
Average	22	2	87	23	55	5	0	24	3	11

Source: Analysis of the individual answers of the group of experts.

ANNEX 3. UNIT COST ESTIMATES IN English Speaking Africa

Expenditure per student US\$ PPP

	2000	2001	2002	2003	2004
Botswana	...	400.5	...	...	...
Eritrea	0	171.2	140.2	124.8	111.3
Ethiopia	...	...	...	...	...
Gambia	...	...	218.5	163.7	140.3
Ghana	...	...	...	...	...
Kenya	240.8	229.9	...	221.6	225.3
Lesotho	421.0	457.8	435.0	...	...
Liberia	...	...	...	...	...
Malawi	...	...	...	...	63.9
Mauritius	...	932.7	910.6	1428.7	1474.8
Mozambique	...	...	...	...	...
Namibia	1188.2	1212.5	1207.9	1279.0	...
Nigeria	...	...	...	...	...
Seychelles	...	...	2644.2	2621.7	2666.2
Sierra Leone	111.3	...	...	...	...
Somalia	...	...	...	...	...
South Africa	1269.8	1265.3	1244.5	1282.3	...
Swaziland	410.4	383.4	431.3	498.6	...
Tanzania	...	...	...	...	...
Uganda	...	...	...	...	156.0
Zambia	52.7	...	...	...	78.3

Expenditure per student US\$ (official exchange rates)

Botswana	...	159.5	...	...	...
Eritrea	0.0	27.0	20.2	20.5	21.5
Ethiopia	...	...	...	...	...
Gambia	...	...	33.0	22.8	20.0
Ghana	...	...	...	...	...
Kenya	83.5	82.3	...	95.9	101.8
Lesotho	96.0	85.9	71.3	...	...
Liberia	...	...	...	...	...
Malawi	...	...	...	...	16.4
Mauritius	...	323.9	316.5	556.2	603.7
Mozambique	...	...	...	...	...
Namibia	354.8	322.2	290.6	442.2	...
Nigeria	...	...	...	...	...
Seychelles	...	...	1205.0	1313.6	1355.3
Sierra Leone	30.4	...	...	...	...
Somalia	...	...	...	...	...
South Africa	404.0	338.6	297.3	436.9	...
Swaziland	124.0	107.2	100.8	176.8	...
Tanzania
Uganda	28.2
Zambia	22.2	43.5

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