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Background Paper

Reforms in Higher Education and the Use of Information Technology

Lessons from Higher Education Reforms in Africa

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INTRODUCTION

Rationale for Higher Education Reforms

This document draws from specific cases in Higher Education reforms to arrive at a format, which could be generalised as a "Best Practice" case or a series of lessons to be learnt and possibly applicable in other cases.

2. This paper uses a methodology that draws on a common set of variables, which are considered the most important for a general reform in Higher Education and the use of Information Technology. The challenges faced by developing countries in conceptualising and implementing reforms in higher education are obviously country-specific, but there are certain elements that act as common denominator to precisely the reforms in Higher Education. One of the reasons for this, is the historical context that is similar in most developing countries, particularly in Africa.

3. The 80s were the turning point for a number of countries, both developed as well as developing countries, with regards to education and education reforms. The reason for the re-thinking of the role and cost of Tertiary education was caused by a combination of external costs to the global economy-increases in oil prices and consequent increase in raw materials, and the political shift from demand side Keynesian macroeconomic to market oriented liberal policies. The privatisation of previously public services and the introduction of market forces to enhance efficiency and efficacy followed. The role of the State changed, or better still, shifted from provider of services to facilitator of market techniques. This was applied to some degree in all countries, especially in Europe where the welfare state was part of its post-II World War history.

4. In Africa the situation had a even larger impact because of the balance of payments imbalances and the consequent structural adjustment plans to alleviate their debt problem ensuing. Prior to this in the immediate post-colonial/independence period the investment in Tertiary Education in Africa was based on the need for Government officials, to replace ex-pat staff, and to achieve macroeconomic growth.

5. In so doing the educational system was heavily subsidised by governments, if not completely made free of charge for the society at large. Thus there was a consequent relative high increase in enrolment, without reaching at the continental aggregate level a comparable enrolment rate as Asia. The approximate figure for Africa is 2.5-3.3% of graduates from the age cohort group-a rather low figure for economic development. Consequently the investment in Tertiary education was based on the quantity aspect of supplying the State bureaucracy, in some way rent-seeking rather than productive employment. The perennial equity problems associated with

Tertiary education i.e. the pro-poor nature of primary education as against lower social returns on Universities or Higher Education Institutions, resulted in a small group of university graduates who where in the higher income quintiles and were eventually employed in the public sector.

6. As was stated above the crisis of the 80s brought about a rethinking of tertiary education, not as a separate area but as part of an efficient use of public resources. The external shock to the national economies was the catalyst in most cases to the ensuing reforms in Higher Education. This is indicative in itself since the Tertiary education system in general, although showing signs of fatigue prior to the 80s, was thought of as a means of "catching-up" with the developed world by producing high-skilled personnel.

7. Thus the shift was the link or match between national development strategy and educational policies, therefore again aiming at quantity and quality of human resources supply. The difference prior to 80s and post 80s was the concept of sustainability. The policies then faced a new criterion of fiscal rigour, or the non-deficit public resource expenditure. This obviously had repercussions on the quality and quantity of education in developing countries, and a more pronounced emphasis on the cost of such exercises.

8. Besides the sustainability of the educational policies, the developing countries also faced the poverty reduction strategies as an aftermath of the economic crisis. The decrease in poverty became an integral part of a sustainable development, and this further complicated the education sub-sector within the national development strategy. Every policy was filtered through the criteria of its poverty alleviation impact prior to its implementation.

9. Thus on the micro-level a cost-benefit analysis together with a macro-level strategy to poverty reduction led to the rates of return to educational investment as a criteria for the quantity of investment as well as allocation to the level of investment-primary, secondary and tertiary. In general one can say that the result was an emphasis on lower levels of education, because of their higher social rates of return, and a diminishing allocation to Higher Education. The concept of cost-sharing followed in terms of increasing access to post-primary education, without at the same time increasing public resources. The obvious limits of such a system will be discussed later, but the main point that emerges is the supply of basic skilled students (primary graduates) in an economy, which was and is introducing market-oriented reforms.

10. The skills required by the market in a competitive framework, nationally and internationally, rather than Government sponsored jobs, became performance indicators of the educational system. This was further complicated by the growth rate of the use of Information Technology at a global level in productive activities. This caused a shift towards a knowledge-based economy, wherein the comparative advantage is now not

natural endowment, but man-made engineered knowledge. The developing countries have had a series of repercussions on the use of It-due to its high development cost; its strategic infrastructure necessity; its need for high skilled labour.

Methodology

11. Within the framework outlined above a number of African countries were visited to assess their reforms in Higher Education and their use of IT. The countries chosen were Egypt, Ghana, Kenya, Korea, Mozambique, Nigeria, South Africa, Uganda, U.K., U.S.A

12. The countries can be divided into developing countries; a middle-income country (Korea); and two developed countries that have a major influence on educational policies worldwide. As was said above, although the countries' socio-economic performance differs greatly the aim is to arrive at a common denominator of areas in some way common to all. In so doing the lessons to be learnt from a particular country on a particular area becomes a basis for the construction of "Best Practice."

13. The areas chosen are the outcome of country-specific variables, which became in our study common to all, and a series of variables resulting from the broader framework of the link between economic growth and education. The areas thus selected are:

- Quality
- Quantity
- Access and equity
- Funding
- Curriculum
- Information Technology
- Private/public partnerships.

14. A close glance at most Higher Education Strategies place emphasis on the above points. The different GDP per capita of the countries and their allocation to education does not suffice to arrive at a common platform for Reforms in Higher Education.

Table 1: Indicators on education cost, GDP and public expenditure

Countries	GNP per capita (PPP $) 1997	Current Expenditure per student as % of GNP per capita 1996	Public current expenditure on tertiary level as % of total expenditure
Egypt	3080	68	33.3
Ghana	1610	n.a.	n.a
Kenya	1160	n.a	n.a
Korea	13430	6	8.0
Mozambique	690	n.a	n.a
Nigeria	860	n.a	n.a
South Africa	7190	54	14.3
Uganda	1160	n.a	n.a
U.K.	20710	40	23.7
U.S.A.	29080	25.2	25

Source: World Education Indicators-UNESCO 2000

15. Although Table 1 shows a lack of data, a perennial problem in Africa a number of tendencies could be found. Firstly there seems to be no relation between GNP per capita and amount spent on Tertiary education. Rather, more precisely the higher the GNP per capita does not necessarily correlate with current expenditure spent per student. This is interesting in that the production of University graduates except for Korea seems to have a high price with the added disadvantage in Africa of severe public resources.

16. When Table 1 is compared to the following Tables then the efficient and efficacious production of University Graduates becomes more apparent. These will give some indication on the quantity and equity of the Tertiary level of education.

Table 2: Indicators on Gross Tertiary enrolment Rate, % Male and female division

Countries	Gross Enrolment Rate[1] 1996	% Male	% Female
Egypt	20.2	24.2	15.9
Ghana	1.4 (1990)	2.0	0.6
Kenya	1.6 (1990)	2.3	0.9
Korea	67.7	82.0	52.4
Mozambique	0.5	0.7	0.2
Nigeria	n.a	n.a	n.a
South Africa	17.2	18.0	16.5
Uganda	1.9	2.6	1.3
U.K.	52.3	48.6	56.3
U.S.A.	80.9	70.6	91.8

Source: World Education Indicators-UNESCO 2000

17. The quantity of Tertiary graduates in the developing countries seems to be low, if one takes into consideration the necessity of the modern knowledge-based economy for highly skilled labour. The data for net enrolment and therefore one cannot compute an indicator for quality of Tertiary Education. Yet the gross enrolment rates already give a picture of potential low enrolment at high cost (see above) and if one takes a 20% deduction for repetition and drop out rate across the countries, then the enrolment rate would be even lower.

18. The second point that one can observe from Table 2 is the fact that the countries with low gross enrolment have a male bias in Tertiary level graduates, while high enrolment rates have even higher female participation. There seems to be a GDP per capita above which the gender bias is less prominent, except for Korea, thus pointing towards a possible combination of GDP per capita and cultural variables as explanatory of female participation.

African countries

Quality ,Quantity, Access and equity

19. The African countries visited had similar characteristics in dealing with access. There are two seemingly contradictory thrusts on access in African countries in that they pull in opposite directions in terms of strategies. Access to Tertiary education in Africa has changed from the "open door" policy of the 60s and 70s, wherein the replacement of foreign public officers

[1] Gross enrolment rate is total enrolment in tertiary education expressed as a percentage of the population in the five-year period following on from secondary-school leaving age, regardless of age.

was the main purpose, to the crisis situation of supplying sufficient graduates to the market and reducing the cost of such delivery.

20. Access and equity are usually corollaries of the same problem. The low rate of graduates in the economy and the need to replenish supply has been the mainstay of all the African countries strategy. The main problem is that the average unit cost of tertiary education in Africa is 657% of GNP per capita (World Bank 2000) and that to increase access would require the public expenditure allocation to the tertiary sector to increase. The general tendency for the African countries under study have shown a decrease in tertiary allocation, one of the reasons being the high unit cost and the need for public spending rigour.

Table 3: Indicators on Expenditure on Tertiary Education

Countries	% distribution of current expenditure 1990	% distribution of current expenditure 1996	Current Expenditure as % of GNP per capita 1990	Current Expenditure as % of GNP per capita 1996
Egypt	36.0	33.3	82	68
Ghana	11.0	n.a	250	n.a
Kenya	18.9	28.7	475	780
Mozambique	9.9	n.a	998	n.a
Nigeria	n.a	n.a	n.a	n.a
South Africa	21.5	14.3	96	54
Uganda	n.a	n.a	n.a	n.a

Source: World Education Indicators-UNESCO 2000

21. Table 3 shows that in general allocation to Tertiary level has decreased, but the unit cost has not decreased by as much showing that there is some form of inefficiency in costing, yet the need for graduates as said above is mentioned in all the country plans on Higher Education.

22. Another problem is the equity of such access. There has been an attempt by most countries to increase equity by various measures loan schemes (Kenya); positive discrimination for low-income and regional imbalances and gender (Uganda). This is due to the need to rectify the pro-rich nature of Higher Education. Although the equity nature of schooling is based one way or another on rates of return, which is still questionable, the imbalances in access to Tertiary education is an empirical reality.

23. Egypt is an interesting example, which can give some insights on enrolment, access and equity. The university system has expanded rapidly in the past years. Between 1998/99 to 1999/2000 the total enrolment increased by almost 1% and at the same time female % to male went from 85.7 to 87.5. This took place with a diminishing unit cost (see Table 3) as well as a reduction in Higher Education as a percentage of public expenditure.

These results are even further interesting since the Government of Egypt provides free education at all levels.

24. Firstly this points to the fact that public provision of Tertiary education in Egypt can achieve improvements in its cost, access and equity. Obviously this cannot be generalised for Pareto optimality through public provision, but even within the public system some improvements on efficiency and equality can be reached.

African countries

Curriculum

25. The curriculum relevance for Africa's needs has also been considered as important by the public educational authorities. This has become part and parcel of any reform process for a number of reasons, namely:

- Graduate unemployment
- Indigenous knowledge
- Technology-based economies.

26. The graduate unemployment, which is becoming a serious problem with the "downfall" of Government secured jobs, has caused a reassessment of whether the skill-content of the graduates themselves matches the demand of skills by the market. An interesting note is that the gap between students in Natural Sciences and Social Sciences is for example 15% to 41% respectively in Egypt, while the gap drops to 29% to 36% for female students (Source: World Education Indicators-UNESCO 2000). There is a general lack of Science students and therefore graduates and this is causing a mismatch between supply and demand. It must be said that most countries have recognised this problem and have come out with a series of policy recommendations.

27. For example Kenya's Higher Education Loan Board readily loans to Science students, because of the more likely return on the investment made. In Uganda the National Higher Council conducts manpower surveys to identify the requirements of the market and inputs the data for Government sponsored students. In both cases the institutional capacity to monitor performance and act, as an input organisation is not the most efficient. Although it must be said that this has been identified as a lacuna in the system there are difficulties in ameliorating the institutional aspect, a point we will return to later.

28. Indigenous knowledge is a relatively new area in which the relevance of curriculum is questioned by its applicability to the African reality. This is so much the more so since knowledge has become the backbone of economies world-wide and the property of that knowledge becomes extremely important. There is a move towards cognitive development

globally, wherein the education system becomes instrumental rather than incremental. This phenomena is further developed by the use of IT, in that Knowledge now is world-wide, and the user of IT creates or can create new knowledge or adapt information. Besides the research capacity, which most countries have seen as crucial to their development strategy, identified as one of the priorities in Tertiary education outputs there are some interesting developments in the countries visited. For example the creation learning network between Kenyan, Ugandan and Zimbabwean teachers of mathematics and science to achieve regional co-operation exchange information adapt it to the local reality at a lower cost.

29. The use of IT will be a separate paragraph of this report. Yet the need for students/graduates in Science subjects has been recognised by all the countries visited. The policies adopted for resolving this problem have differed, but the common denominator is to "catch up" with the developed world and in some way decrease the 'digital divide' as well as match what the market demands.

30. For example in Uganda the Government sponsored students are those whose course content has a higher probability of matching market demand. There seems to be a "numerus clausus" for every course with affirmative action, among other variables, for science and technology courses. Also in Uganda every course whether in humanities or sciences has a computer literacy course again to endow students with marketable skills. Again in Uganda the involvement of the private sector in the National Commission on Higher Education is a method chosen for curriculum improvement towards what is demanded by the market. In Kenya the Higher Education Loans Board uses a bias of science and technology courses for loan disbursement. In Mozambique there is an on-going process of consultation with the private sector by Universities of curriculum development.

31. In South Africa found that the focus on humanities (49% of enrolment) is too high, but even more it does not match market demand. Hence it is stressed in the National Planning for Higher Education that a shift for enrolments between humanities, business and commerce and science, engineering and technology shift from the current ratio of 49%: 26%: 25% to a ratio of 40%: 30%: 30% should take place and the funding mechanism which will be discussed later should adapt to the new ratio over a 5 to 10 year period.

African countries

Funding

32. As is evident throughout this paper the funds for Higher Education in Africa are decreasing and this is caused by a number of factors. Since the crisis of the 80s Government spending evolved taking into consideration the impact of public spending on alleviating poverty and the efficient and efficacious use of public funds. In so doing in general one can say that

Tertiary education, being the most costly, started to receive less funds. This set off a particularly politically sensitive issue of private consumption of tertiary education. The cost-sharing schemes started in most African countries, with the exception of Egypt and to some extent Ghana, and the cost-sharing schemes varied in intensity and amount.

33. There is also a problem of inefficiency in the use of dwindling resources. These range from low student-staff ratios, high drop-out and repetition rates, non optimal use of physical capacity, increase of non-tuition fees, duplicative programmes. Thus the total sub-sector of Tertiary education came under scrutiny by the education authorities.

34. The general thrust of the reforms in funding are :

1. Diversification of financial basis through non-academic services
2. Introduction of targeted fees
3. Optimal utilisation of physical resources
4. Optimal utilisation of human resources
5. Consultancy and alternative income generating activities.

35. Again going through the countries visited there are many different policies that attempted to come to terms with the soaring cost of Tertiary education.

36. On the supply side Kenya has the HELB which has had a managerial overhaul in terms of its efficient running. The HELB is now directly linked to the income tax department to ensure repayment of loans automatically and turn the HELB into a form of revolving fund. The criteria for loan disbursements will be made more transparent and accountable. Secondly the physical capacity in Kenya was enhanced through the totally private evening classes. These seem to be a success in terms of a better utilisation of University resources-physical and human- and have, although data is not available, high enrolments. This extra source of income for the University and University staff is one of the success stories of Kenya's funding mechanism.

37. The Master Plan for Education goes on to stipulate the necessity of audited accounts for Universities to achieve certain criteria for performance evaluation and set standards for monitoring. The alternative sources of Finance, besides evening courses, have been identified within the enhancement of research by Tertiary institutions. In this context consultancy for private sector requirements were identified as one of the areas of interest. Here a point must be made about the legal implications of consultancy in terms of individual research of university professors,

departmental research and in what proportion should the amount paid be divided between University/department and individual. There is a clear case, in Italy, where there are fixed proportions between researchers and institutions which has the added effect of rendering University staff some form of hybrid between public employees and private consultants.

38. Referring to the institutional arrangement of funding an important development in South Africa which allows planning and monitoring is by 2003 funding will be through institutional 'rolling plans' based on student averages over a certain period. This is because of large variability of funds presently earmarked on year to year student enrolment, which does not allow planning by the Institutions. Because of its particular history South Africa had institutions for socially defined demographic groups with repetition of courses and high cost to the whole system. Post-independent South Africa is merging certain Institutions to achieve lower fixed costs and better equity.

39. Most of the countries visited have private universities that have increased access for Tertiary education and introduced a form of competitive market. There are general problems of accreditation and quality control, which have been overcome in some cases through subsidiaries of known Universities, American University in Egypt and Kenya. The presence of private universities has also brought about the private consumption of Tertiary education within public institutions.

40. A micro application of private students in public institutions, which could be taken as a "Best Practice" is Makerere University. Until 1991 Makerere University was underfunded and facing a serious breakdown of its physical and human resources. The option of cost-sharing was considered inapplicable because of its negative political consequences.

41. Thus the choice of private students within the public university was started in 1991-92 with 300 out of a total of 2,418 students. The obvious bias towards low-income students was not considered, since the criteria for Government sponsored students included inadequate income level. In other words Makerere tried to tap the rich family markets, competing with foreign Universities and at the same time drawing on private funding. This had an effect on the physical capacity of the university and thus evening courses and distance learning were taken into consideration. This was stipulated contractually, between the central administration getting 40% and the rest left to the faculty that ran the courses (A mechanism close to the Italian model mentioned above).

42. Once this innovative system got under way the question of more financial/administrative autonomy emerged. There is no doubt that the Universities Act 2001, which among other clauses mentions the semi-autonomous role of the Vice -Chancellor was an input by the rather successful management of Makerere. This is because the private student scheme started within a public governance system, with the university

expressing the need to go beyond the Vice- Chancellor as Chief Executive, but a corporate management model based on the Vice- Chancellor as Chief Accounting Officer, although this would require further amendments to the Act.

African countries

Information Technology

43. The use of Information Technology in Tertiary education in Africa has been associated with distance learning and because of this one of the methods to reduce cost. In a way Information technology is complimentary to Tertiary education delivery methods. There are only a few of the countries visited that have made IT a strategic choice, that is how IT not only can decrease unit cost, but also how this could be useful in curriculum development, research possibilities, access, exchange of indigenous knowledge, regional co-operation, etc.

44. A general overview of the use of IT in Africa shows that The gap between rich and poor countries-the "digital divide" is growing with 14 million telephone lines for a population of 739 million and generates only 0.4% of internet content all with a severe urban bias. (Wheeler 2000)

45. Notwithstanding this during in Africa in the last few years a more liberal policy was put into place, namely:

- A total of 20 countries have established independent regulatory agencies in Telecommunications, compared to 2 in 1990.
- A total of 17 African telecom operators have allowed some degree of privatisation(only 8 in 1995)
- The African mobile cellular market has shown an interesting growth rate of 11.3% between 1996 and 1997 (ADF 1999)

46. Only a few countries in Africa, among which Ghana, Guinea-Bissau and Mali, have made progress in laying the foundations for national information and communication infrastructure. In most cases there has been a tendency to focus on a specific area/activity and this process falls short of social considerations. The most appropriate way to view IT is the total impact it has on the economy, using IT as a tool which shifts from given to produced information. (Snyder, Kuglin, Philp and Beatty 2000) In other words in an endeavour to harness the development process, Africa should aim at the ownership of its own development through extensible explanation networks through IT.

47. In terms of education, or more specifically Tertiary education problems of regional disparities inadequate funding and inefficient use of available resources and low quality. Again IT can be used to establish decentralised systems of management and monitoring of outcomes. Besides the

organisational aspects which should not be understated the use of IT in education is frequently associated with Distance Learning.

48. The analysis of IT use in education must be broader based for a number of reasons, namely:

- Education as an aspect of Human Capital accumulation is closely tied with economic growth thus it is within this framework that IT and education must be seen
- IT use in agricultural productivity, as in the example above of Kenya's crop forecasting creates firstly a learning environment and secondly a shift towards productive information.
- IT allows a paradigm shift from passive acceptance to active production of information, and thus as with the productivity councils in China mentioned above it is a shift towards "ownership" of the developmental process.

49. To exemplify these points in Benin an agricultural NGO operates three community learning centres in 3 regions. To promote community access to its internet based business "Cyber Songhai" offered training first to its staff and then to the community at large which now include entrepreneurs university students and a course for women on "Internet for Women". Being within the community it is not only a course in "digital literacy" but has: an effect on gender disparities a frequent distortion in Africa, University students' research, entrepreneurs who adapt information on the web to local conditions –all this becomes a spillover of distance learning on the growth of a community. (World Employment Report 2001, I.L.O.)

50. In the countries visited the possible "Best Practice" cases are South Africa and Egypt, and these were chosen because of this strategic choice of IT in terms not only for Distance learning, but also how to achieve maximum externalities through the use of IT.

51. For example in South Africa there is a Regulatory Authority (SATRA), separated from executive ministerial level, which has two tasks:

1. Stimulating industry to deliver internationally competitive products; and

2. Redress imbalances by providing services for under-served area.

52. In strict Distance learning terms in Manguzi, South Africa the Government started a Telecentre. Telecentres are an extremely interesting policy option, both in the developing as well as the developed world. In fact the IT infrastructure is physically in one place for the benefit of all and this has been used for teleworking, marketing education, etc and can be considered as the new "virtual" meeting place. In this way costs are spread over various users within a social context. In Manguzitwo rural schools 5

kilometres from the Telecentre asked to be connected to use the available link-ups. Eventually a radio link was chosen for the uplink path and satellite is used for downloading Web content directly to the PC at schools (Total cost was $2300 for Telecentre and $3000 for rural unit recurrent cost $40 per month). (Kagami,Tsuji 2001).

53. At the University level the use of IT is also closely connected to the Distance education module, where the open University of South Africa, founded in 1873, has over 130,000 students 10,000 graduates per year at a unit cost 50% lower than traditional delivery methods and where students fees cover 39% of the budget.

54. In Egypt the situation is not that complex in terms of enhancing IT in the national information technology framework. Though the choice is strategic rather than complimentary. The Government plans to use IT in a restructuring process for autonomy, intellectual freedom as well as network the Universities (presently there are 12 Universities networked with the Supreme Council of Universities as a hub).

55. The Government also plans to provide University students with individual computers and agreements have entered with IT companies for the supply of software packets at reduced rates. Another point is to utilise the satellite owned by Egypt for educational purposes. In this context the idea of the equivalent of an Arab Open University is taking place. That would result in some form of course curriculum development, but this would require more resources.

African countries

Private-public partnerships

56. One of the most striking aspect of African Tertiary Education is the variety of roles that the private sector play. These range from private Universities, showing some positive form of rate of return to investment in Higher Education, to institutional representation e.g. Uganda, in policy making bodies, to also bursaries in South Africa.

57. The strategic role of the private sector on the receiving end of Tertiary graduates is not a coherent input in the educational system in Africa. The inputs of the private sector seem to be ad-hoc and the particular role (private university, policy partner, etc) depend on the country involved. This could be caused by a historical heritage by Government and private sector that Tertiary education is a public good in terms of its core content to supply personnel for national development. Although this seems to be changing slightly there should be more involvement on the crucial role of Tertiary Education.

African countries

Institutional Development

58. The institutional framework for Africa's Tertiary education sector is frequently a side issue, yet because of its importance could be crucial in the implementation of reforms in High Education.

59. The institutional capacity of African countries has been mentioned time and time again as a lacuna, which could stifle growth. The institutional capability is not only the norms and the organisation but also the timely nature of the very institutions themselves.

60. An example is the Uganda National Council for Higher Education whose task of conducting manpower surveys and input the results to policy orientation in Tertiary education. Besides the NCHE has 3 representatives of the private sector and hence a strategic role of the private sector has been recognised. Yet the problem is that this institution was formed this year 4 years after the Education Strategic Investment Plan 1997-2003 was issued. The institutional capacity that should have monitored a key area of
Private sector involvement and labour demand, because of the time factor, caused seroius problems not only on the delivery of its key tasks but also to the whole system.

61. In this context an interesting model of institutional capacity of Tertiary Education and the economy is from East Asia. The heavy investment in education and how this linked to economic growth was one of the aspects considered in the high growth rate of the Asian economies.

62. The Asian model of science and technology education and its relationship with the labor market is an interesting case of how all three above-mentioned points are linked.

63. The "Asian miracle" emphasizes that all of the Asian Newly Industrialized Countries (NICs) have experienced rapid growth through high investments in human capital and physical capital.

64. The analysis of the Asian model can be divided into two main schools of thought. The first is the "accumulation" model, which sees both the ability to hold off diminishing returns to capital as well as high economic returns to education, both in terms of the parameters of a conventionally defined production function.

65. On the other hand the "assimilation" model stresses that entrepreneurship, innovation and learning are all key aspects to master new technologies. Moreover, much of the successful absorption effort is attributed to efforts by firms to learn new opportunities, and undertake minor by cumulatively significant changes in the production process (Nelson & Pack)

66. This was tied in on the institutional front with the productivity centers: The Productivity Councils (Hong Kong); Productivity Center (China); Medium and Small Business Administration (Taiwan) – different names but serving the same purpose. Their main tasks were:

(i) provision of specialized technical services
(ii) identification of problems facing enterprises and devising appropriate remedies and training packages
(iii) transferring "production-ready technology" that the government imported and adapted to local firms.

67. The outcome of such a system resulted in high economic growth and also the production of "owned" technology. (Out of a total 27,281 patents in 1991 in Taiwan, 13,555 were national whilst they were 2,897 out of 6,265 in 1981; in addition, the R&D/GDP ratio increased from 0.95 in 1984 to1.65 in 199 (Taiwan Statistical Data Book)).

68. Thus the link between education, science and technology education in particular on the labor market is evident. The application of technology and the eventual production of technology was based and fed into an educational system with a high emphasis on science and technology curriculum.

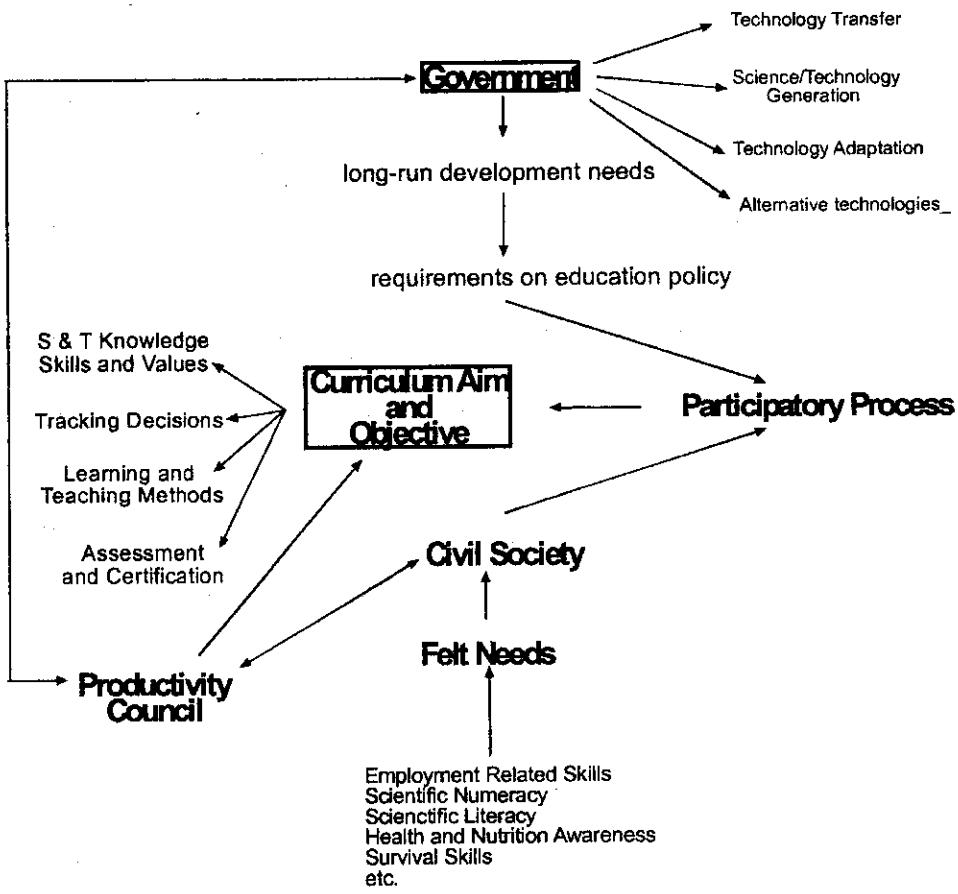
69. African economies continue to be heavily dependent on agricultural production and the export of natural resources. So seemingly the "assimilation" Asian model is not exportable. Yet there are a number of important points to keep in mind:

- The link between the labor market and the educational system
- Emphasis of science and technology across all three levels of education (primary, secondary, and tertiary)
- The strategy towards ownership of technology.
- The application of skills, concepts of science and technology to production problems.
- A global vision of education emphasizing Science and technology education even by a incentive scheme, to go beyond numeracy and literacy and aim at what OECD call Level 3.

70. The African educational system as said above suffers from low quality and/or is non-relevance to employment opportunities. The present enrolment and attainment rates in Africa are predominantly primary schooling. The emphasis should become not only numeracy and literacy skills, but to achieve Science and Technology cognitive skills for problem-solving techniques. This should be set at all levels of education, probably the most effective would be at upper secondary and tertiary levels. Since digital literacy is the pre-condition for participating in the global economy, the shift from incremental to instrumental education should be the global vision, thus the focus of resources and probably additional resources, should be invested in SET. This does not mean that the SET curriculum development should not deal with the traditional sectors of African economies, for

example agriculture but SET is a methodological approach to problems. For example farmers in Ecuador were able to get advice on how to eradicate a pest that was destroying their potato crop because a field worker was able to post a question to several email news groups. This shows that it is not the information, which is necessary but the skills for its access and the know-how to adapt to local conditions.

71. In graphic form the above can be shown as:



Some notes on Asian economies:

The Asian Miracle

72. East Asia has experienced dramatic growth over the last three decades, which can be accredited to the political decisions that were taken.

73. Policymakers in Asia realised at an early state that to become competitive, large investments in physical as well as human capital would have to be made. Thus, no surprise that in nearly all the rapidly growing East Asian economies the transformation of education and training in the period 1960-1990 was dramatically good.

74. As noted earlier, between 1970 and 1989, real expenditures per pupil at the primary level rose by 355% in Korea. The comparable figure in e.g. Kenya was a mere 34%.

75. In 1987 Korea moved rapidly from primary to secondary education: whereas enrolment rates in the latter were 35% in 1970, they had increased to 88% in 1987. Yet, not only was the quantity of schooling increased but particular emphasis was laid on providing *quality* education. In a test designed by the National Assessment of Educational Progress, the percentage of 13-year old students who attempted the mathematics test composed of ascending complexity (adding, subtracting, solving simple problems, two-step problems, understanding concepts, interpreting data, etc.), Korean students ranked *first* in each category. In fact, the performance gap between Korean students and others from high-income countries was greater for higher-order skills (source: WB).

76. A typically Asian feature of the Korean take-off was that industrial policy was such as to enhance feedback mechanisms to the educational system in general and technical education in particular through productivity councils. In addition, the government directly supported private R&D through tax incentives, tax credits etc.

77. All in all, there is a lot to learn for Africa from Korea's past achievements in supplying the labour market for technical skills with highly qualified workers.

78. The major points that emerge from the Asian Model are:

- State involvement in educational inputs closely linked to labour market demands.
- Monitoring of educational attainment as shown by test results above to achieve quality
- Emphasis on Science and Technology across all levels of education
- Linking Technological inputs into industry as inputs into schooling structures in general, curriculum development in particular.