International Institute for Capacity Building in Africa

Learning Assessment Integral to Measurement of the Quality of Education

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The assessment of learning plays an important part in measuring the quality of education. We know that one of the main reasons for school dropouts and low enrolments is the pupils' and parents' perception of what the school offers as both irrelevant to their lives and of low quality. Whilst school grades should not be the be all and end all of education, nevertheless they play a critical role in enabling every stake holder: the children, the parents, the community, the government, to gauge whether the education system they have in the country and in their own individual school, measures up to their expectations.

How would we define the quality of education? Quality is defined differently in different contexts and by different groups. Some aspects of quality would include the physical aspects such as whether the school includes environmentally friendly characteristics, such as many trees and plants, and a clean and hygienic environment which does not help the spread of disease through having good aeration, sunlight and comfort in the classroom. A clean water supply and separate clean toilets for boys and girls are accepted as necessities for a good school. However educationalists generally agree that the physical aspects are only a small part of what comprises "quality education". More important are the knowledge, values and skills that the child learns in the school.

Examinations have been devised for centuries as a means of objectively measuring the type and levels of learning in the school. Examinations were used to select the best candidates for various positions in society, for example for the selection of government officials or for appointment to high paying jobs in society. Examinations were seen as objectively fair ways of selecting candidates irrespective of their families' social background.

In Africa where secondary and higher education have been and are still restricted to a very small minority, examinations have played a critical role in selecting the minority who would be allowed to continue with their education, and in so doing improving their economic and social status in life.

One of the inherited problems in the African examination systems is the emphasis placed on the re-gurgitation of facts, i.e. on rote learning divorced from application to the realities of life. Ugandan President Yoweri Museveni once recalled his school days and how he was discouraged from learning science subjects:

> "In Chemistry, teachers would teach badly, introducing new concepts without explaining their genesis and expecting students just to "cram" things without understanding them. They would say "the symbol for Sodium is "Na". When asked why it is not "SO" if it is Sodium, the reply was you must just take it as it is. Much later I came to learn that symbols were taken from Latin and were internationally

recognized. It was really incredible the way some teachers were turning students against Science. "If you want to pass your examination and get a good job, you take any concept as it is and memorize it.""

President Museveni's experience is sadly the experience of many African students not only in science, but in other subjects as well. His experience touches on a number of aspects related to the quality of education: the quality and relevance of the curriculum to the present and future lives and careers of the learners; the selection, level of education, training and motivation of the teachers; the teaching and learning methodologies utilized in the classroom, and finally the way the learning was measured. Apparently rote learning was all that was required to pass the examinations and go on your way to a good job.

Whilst rote learning remains an important part of education, an education system which fails to develop higher level cognitive processes will obviously lead to the failure of its students in a global market where more than rote learning is required. It is within this context that IICBA has placed emphasis on the way teaching and learning are assessed. This issue focuses on the measurement of learning, with particular emphasis on science and mathematics.

Primary School leaving Science Examinations in Africa - some realities

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Assessment policy and practice in most countries in anglophone africa has always been subjected to international influences. Most national examination and assessment systems owe their origins to colonial governments that has mixed motives for the introduction of the first national assessment systems. These motives included the need to select the highest achieving students for the next level of education and for public sector jobs and the need to have some control over the curriculum and what was learned. Of much less historical importance were needs to monitor achievement to provide formative feedback that might be used to improve teaching and learning. in the last two decades, curriculum reform in africa (led in many cases by changes in science and mathematics) had replaced colonial material with nationally determined content and learning objectives. assessment systems have also changed. National examination boards have been established and different methods of assessment

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have been introduced. Concern has been given to links between science education and the labour markets that receive school leavers (lewin 1995). Questions of gender and urban bias have been addressed to promoted participation and equity. Science has become an established subject in the primary curriculum throughout africa and in most cases has become part of the core curriculum (Bajah and Lewin 1990, Ware 1992, Lewin 1992, Caillods, Gottelman-Duret and Lewin 1997). In parallel with current aspirations for change in the curriculum and the way science is learned, public systems of assessment have been subject to pressure for change.

Along with others (*Dore 1976, Oxenham 1984, Lewin and Little 1981, Somerset 1982, Heyneman 1987, Lewin 1992, Harlen 1997*) *Eisemon* argued strongly for the need to use examination reform actively to improve the curriculum in action. several african regional workshops have discussed assessment in science education in the 1990s[2] . *The German Foundation for Internal Development (DSE) supported workshops in Kenya (1994) and Berlin (1998) on Assessment of Science and Agriculture (Bude and Lewin (ed) 1997, Lewin 1998). The International Institute for Educational Planning and the Centre for Educational Policy Development, South Africa organized a regional forum at Magaliesburg in 1995 on science education based on the outcomes of its multi-country research programme (Caillods, Gottelmann-duret, Lewin 1997).*

Most recently the African Forum for Children's Literacy in Science held a meeting in Zimbabwe (1999) to review developments and discuss ways forward (Dunne and Lewin 1999). Three problem areas emerge from discussions by participants at these workshops which are relevant. These are first, links between the curriculum and patterns of assessment; second, the assessment of practical work; and third, the importance of science as a subject used for selection and the backwash this generates on the curriculum.

The first group of questions concern links between assessment strategies and the curriculum. Historically, there is much evidence that curriculum development in science in Africa has often proceeded independently from the development of related examinations *(Ogguniyi 1986, Eisemon 1990, Wallberg 1991, Lewin 1993).*

New programmes with different pedagogy and learning objectives, have been devised and implemented before appropriate assessment strategies have been developed. Weak links have often existed between curriculum development bodies and the examining authorities, especially where the latter have had strong links with overseas examining bodies. Problems have arisen when what is tested has a different emphasis from that which is intended to be taught and where some desired outcomes cannot be assessed by the methods of testing available. As noted above it is widely argued that too many assessment tasks remain at the level of recall and relate loosely, if at all, to what is known about cognitive development. Analysis suggests that often it is possible to achieve pass grades without demonstrating achievement at higher cognitive levels.

Secondly, assessing practical work is widely seen as problematic. Practical examinations are expensive to organize, logistically complex to arrange, time consuming and difficult to administer (Haddad and Za' rour 1986, Sibanda 1990).

Thirdly, in all the Anglophone African countries, Science is one of the subjects that contributes to primary school leaving examination scores. These determine who is selected for secondary schools. Where the number of selection subjects is small, the weighting for Science is relatively high (e.g in Mauritius where Science is one of four subjects assessed for selection to secondary school). Where the number of subjects is large, the significance of Science results is much less (e.g. Kenya where it has been one of 13 subjects tested in 7 papers). The significance of Science assessment for selection depends on its level of difficulty and its power to discriminate between candidates. In some countries pass rates can be as low as 15%. It is the range of Science scores and the extent to which they contribute to the variance of the aggregate score across all subjects which actually determines how much influence Science results have on selection decisions.

[2] *The participating countries varied between the workshops. They include the majority of Anglophone Sub-Saharan African countries.*

Whilst the actual significance of the Science result is not known in most countries, it is often believed to be next in significance to language and Mathematics. This is important because of the effects assessments has on what is learned and taught (Oxenham 1984, Dore 1976). Discussions in various meetings have noted that in many countries examinations continued to encourage rote learning of Science concepts and that only a minority of items were directed towards higher order cognitive outcomes (Bude and Lewin 1997:8). It has been often suggested that teachers were concentrating only on what was assessed and ignoring that which was not.

In most of the countries involved in various meeting the only data fed back to schools from examinations is that candidates have passed or failed. Usually the grade of pass is indicated but in some countries the information available at school level is limited to pass/fail. Teachers generally have little indication about which skills their students have mastered and which they have not. Kenya has one of the most developed systems of monitoring and feedback of data on performance (Somerset 1982, Kyalo 1997, Wasanga 1997). Some other countries e.g. Lesotho and Uganda also produce follow up reports indicating aspects of performance (Bude and Lewin 1997). The absence of detailed formative feedback seems to encourage "backwash" from examinations that often appears to undermine broader educational objectives and stifle interest and curiosity by restricting what is taught to what can be externally examined.

When an empirical analysis was undertaken of the Science elements of Primary Science leaving Examinations in nine countries - Botswana, Kenya, Lesotho, Malawi, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe (Dunne and Lewin 1999), it was discovered that for example in 1997, four of the nine countries had a paper called Science or General/Integrated Science (Botswana, Lesotho, Malawi and Swaziland). Four other countries had variations that included other subject areas - Kenya (Science and Agriculture); Uganda (Basic Science and Health); Zambia (Environmental Science); Tanzania (two papers - Science and Agriculture and Environmental Education/Science).

Zimbabwe includes Science-related items within a General Paper undifferentiated by subject that includes questions on Social Studies and Religion. In all cases no practical examinations were used, Neither were results from continuous assessment or other school based examinations used in constructing final scores. All these Science examinations contribute to aggregate scores used to select students for secondary school education.

When all the papers from the above countries were analysed for content, biologically based questions were most common (27%), followed by Physics (21%), Integrated Science (18%), Agriculture (14%), Health Science (13%) and Chemistry (8%).When the same papers were analysed for cognitive skills using the Bloom's taxonomy, they fell into three levels - application, comprehension and knowledge[3]. Knowledge type items predominantly requiring recall constituted up to 70% of the items. Over 25% of items were classified as comprehension and only 4% appeared to be at the level of application and above.

Analysis of items by context indicated that the questions fell into specialist (experimental, laboratory type setting), everyday real life (domestic and familial settings) and theoretical settings (theory based). In 1997 on average of 24% of items were specialist, 19% everyday life and 56% theoretically based.

Analysis of the way the item were presented in 1997 showed that 21% of items included diagrams, 3% flowcharts and figures, 3% graphs and 3% tables. The majority of items (70%) consisted of only text. Most illustrations were diagrams and there was a wide range on this between countries (4% to 44%, Tanzania: Zimbabwe).

When the papers were analysed for bias in terms of rural verses urban and gender, it was revealed that rural bias was more common than urban bias and that gender bias only marginally favoured males. This was reflected in a very small portion of the items.

From this analysis a number of tentative conclusions could be drawn. First, tensions between assessment strategies and curriculum are

[3] *This classification was used since it is the most widely familiar and is used in the construction of Tables of Specification for examinations in many of the countries.*

apparent. None of the countries use anything but externally set, close book, fixed time examinations for primary school leaving assessments. The range of assessment techniques used is narrow. Most countries use multiple choice items only. Where short answer questions are used they are accompanied by multiple choice items except in Uganda. Most of what is tested remains heavily biased towards recall. It is therefore clearly true that passes, and even good passes, can be obtained on these examinations through good performance on recall items alone. Moreover, items are disproportionately set in theoretical contexts and are mainly text based.

Learning designed to promote concept acquisition and thinking skills should logically be accompanied by assessment that tests intellectual capabilities above the level of recall. It should also include some elements which evaluate performance in more, rather than less, authentic conditions that are located in the world of real everyday problems with a science dimension. Given that most African learners are working in a language which is not their mother tongue a continued dependence on text based questions seems unwise and likely to affect reliability and validity.

The analysis revealed that practical examinations are not attempted in any of the countries in question at primary level. The main defence for this is the proposition that most of the thinking skills associated with practical work can be assessed using conventional written tests. If so the case for external practical assessment is weak given their cost and administrative complexity.

It is clear that in most of the countries selection to secondary school is very important and that science paper performance plays a significant role in determining success. Several countries where larger numbers of subjects are included in primary school leaving examinations are considering reducing the number to a core of language, Mathematics and Science. This is consistent with recent trends in advice from donors and the World Bank. In most African countries it is a minority who proceed to secondary school (Lewin and Caillods 2000).

In most of Anglophone Africa, primary schools leaving examinations remain "***high stakes***". Selection ratios into secondary school remain low. Moreover the quality of secondary schools is highly differentiated and choice is rationed by examination performance. Thus assessment scores on primary leaving examinations determine whether students continue in school and if they do, which secondary school they can attend. Science scores are important in deriving aggregate scores for selection. This means that the selection function of assessment still remains dominant. Objectivity, reliability, validity, discrimination, and some form of norm referencing are therefore all likely to be placed in the foreground in preference to diagnosis, more subjective assessments (especially those which are teacher based and those of non-cognitive outcomes).

There are more contentious reasons why examination reform to improve quality, relevance, reliability and validity may not be occurring as much as some advocate is necessary. Four speculations are provocative. First it may be that reform is unwelcome simply because stasis is comfortable and less troublesome than change. If Anglophone African Examination Boards are not structured to be developmental, have weak relationships with curriculum development and are organized primarily in terms of their administrative rather than professional functions, conservatism may take precedence over innovation. African Examination Boards are highly politically visible and as a result are more, rather than less, likely to be risk averse.

They are often closely coupled to the politics of selection that can have complex ethnic and class dimensions which professionals engage with at their peril.

It may be that the technical and administrative capacity to design, develop and undertake broader based assessment strategies with higher quality instruments remains lacking. Though some countries actually spend as much or more on examining candidates than they do on teaching them for a year, this may still be an insufficient level of resources to guarantee quality assessment instruments depending on how resources are deployed. Many primary school leaving examination system now do not pre-test items and most undertake limited post test analysis before becoming preoccupied with the construction of the next year's papers. There may only be one or two trained item writers in each subject on the core staff

of boards responsible for constructing tests at several different levels. The pool of competent and trusted markers may be small and very difficult to moderate.

Some reforms in assessment may simply be ill-conceived. Not all changes are for the better. Some innovations in assessment prove unworkable though technically attractive. Others promise benefits that are believed in by their advocates but not their critics. And whatever the benefits turn out to be they have to be judged against the costs (e.g. in money, time, training, supervision) of their implementation.

Despite nearly three decades of advocacy related to primary science and its assessment there is still a gulf between the aspirations for reform and the realities. If external influences at this level are powerful and external assistance definitive, this is difficult to explain.

The fact that reform has proved so difficult does not lead to conclusion that the enterprise should be abandoned. Consistency between curricula and assessment strategies is not a problem that can be wished away. Assessment policy should generate assessment instruments that reinforce valued learning outcomes. Selection based on tasks that do not reflect Science competencies that are more than the accumulation of recalled information is unlikely to improve learning and teaching.

Statements of policy on curriculum and assessment clearly do not necessarily lead to changed practice. Policy documents in many of the countries contain statements of intent that resonate with the aspirations of the professional assessment debate in Anglophone Africa. This strongly suggests that rational policy analysis should start with an enquiry into what has been tried before and why it has not been realized. If this question is not pursued then more of the same will in all probability lead to similar lack of sustained reform.

The most likely reasons why optimistic hopes for a wider range of assessment strategies for primary Science have not been realized are endogenous rather than exogenous.

Structural context may be definitive. Thus, where the number of candidates is large, administrative infrastructure is poor, and security and moderation problematic, it is attractive to deploy multiple choice instruments. Most of the alternatives depend on antecedent conditions that are not met. No matter what the aspirations of individuals, structure may saturate agency in attempts to develop new assessment strategies.

Though context may be a constraint, it is not a sufficient condition to explain away all the inconsistencies between curricula goals and the balance of assessment tasks. Better matches can be achieved than those that appear to exist. The "high stakes" nature of primary school leaving examinations is both a limitation and an opportunity. It restricts the room to maneuver in assessment policy but it also guarantees that the tasks that are included and the competencies they assess will be the ones that shape learning. This is especially so for Science and Mathematics.

References

Bajah, S. and Lewin, K, 1990 *Evaluation of Environmental and Agricultural Science in Action in Zimbabwe.* Report for Deutsche Stiftung fur Internationale Entwicklung, Bonn.

Bude U and Lewin K M (eds) 1997 Improving Test Design: Vol.1 *Constructing Test Instruments Analysing results, Improving Assessment Quality in Primary Schools in Africa.* Deutsche Stiftung fur Internationale Entwicklung, Bonn.

Bude U and Lewin K M (eds) 1997 Improving Test Design: Vol.2 *Assessment of Science and Agriculture in Primary Schools in Africa: 12 Country Cases Reviewed.* Deutsche Stiftung fur Internationale Entwicklung, Bonn.

Caillods F, Gottlemann-Duret G, Lewin K M, 1997 *Science Education and Development; Planning and Policy Issues at Secondary Level.* Pergamon 242 pp.

Dore R P 1976 *The Diploma Disease, Unwin Education.*

Dune M Lewin K M, 1999 *Assessment and African Science: An Analysis of Patterns and Practice in the 1990s.* African Forum for Children's Literacy in Science, Regional Conference on Assessment, Harare, November.

Eisemon T O 1990 *Examination Policies in African Countries.* IJED Vol.10 No. 1:69 - 82.

Haddad W with Za'rour G 1986 *Role and Educational Effects of Practical Activities in Science Education.* Discussion Paper, Education and Training Series EDT 51. World bank Washington.

Kyalo K 1997 *Primary School Examinations in Kenya with Special Reference to Item Construction for Science and Agriculture: The Use of Examinations Results for Monitoring the Performance of Schools, Districts and*

Provinces in Bude and Lewin. 1997 (op cit).

Lewin K M 1998 *International Development in Assessment: Issues for Africa.* Key Note Address Conference on Assessment in Africa. Deutsche Stiftung fur Internationale Berlin April.

Lewin K M 1995 *Development Policy and Science Education in South Africa; Reflections on Post Fordism and Praxis.* Comparative Education 31:2 203-222.

Lewin K M. 1993 *Planning Policy on Science Education in Developing Countries; A Research Agenda.* International Institute for Educational Planning, Paris.

Lewin K M 1992 *Science Education in Developing Countries; Issues and Perspectives for Planners.* International Institute for Educational Planning, Paris.

Oxenham J C P (ed) 1984 *Education vs Qualifications Unwin Education.*

Ogunniyi MB, 1986, *Two Decades of Science Education in Africa*, Science Education 70(2) 111 - 122.

Sibanda, I, 1990 *The Assessment of Science Practical Work in Zimbabwe in Innovations in Science and Technology Education.* Volume III, Layton, D (ed) UNESCO, Paris.

Somerset H C A 1982 *Examination Reform: The Kenya Experience* IDS/World Bank.

Torrance H (ed) 1995 *Evaluating Authentic Assessment* Open University Press 1995.

Wallberg H 1991 *Improving School Science in Advanced and Developing Countries.* Review of Educational Research 61: 25:69.

Ware S 1992 *Secondary School Science in Developing Countries: Status and Issues.* Education and Employment Division Population and human Resources Department, PHREE Background Paper Series, Doc PHREE/92/53.

Wasanga P 1997 *Testing and Monitoring Procedures Developed for Primary School in bude and Lewin* 1997 op cit.

Assessing Mathematical Abilities

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What do we mean by ability?

We can contrast ***ability*** with ***aptitude or achievement***. The American literature is full of wrangles over this terminology (Green 1974; Anastasi, 1980). ***Aptitude*** has historically carried the connotation of innate capacity to perform in some arena, independent of learning, but its meaning seems to be shifting to ability to learn. ***Achievement*** is more dependent on learning. It looks back at past accomplishment, whereas ***aptitude*** looks forward to future attainment and ***ability*** sort of floats in between.

In this article, ***ability*** is used in the singular, but one should refer to mathematical abilities rather than mathematical ability, if possible, to emphasize that proficiency in mathematics can be exhibited in a variety of ways. There are many facets of mathematics, however you define it, and no one is equally good or equally poor at learning or doing all of them. Furthermore, mathematical abilities somehow connote things that teachers might influence, whereas mathematical ability seems more fixed and permanent.

It is sometimes useful, to distinguish between an ability to do something in mathematic and an ability to learn something in mathematics. Ability to do mathematics is essentially a ***power*** concept; ability to learn mathematics is essentially a ***rate*** concept.

What is mathematical about mathematical abilities?

If one examines carefully the list of mathematical abilities put forth by Krutetkskii (1976), one may be led to ask the above question. For example, Krutetskii lists "***the ability for rapid and broad generalization of mathematical objects, relations and operations***" (p 350) and one can ask whether this is not simply the ability to generalize that is being applied to mathematical material.

The investigation of mathematical abilities seems to depend on having a task or a set of tasks to give people to do. We cannot decide what is mathematical about mathematical abilities unless we can decide what is mathematical about a mathematical task. Wheeler (1970) points out that, although we expect almost everyone to learn to speak his or her native language, we do not have the same sort of expectation with respect to the learning

of mathematics - primarily because we have, until recently, had a rather narrow view of what mathematics is.

We need to enlarge our definition of mathematics so as to incorporate into our concept of mathematical abilities the inventive powers children have developed before anyone starts to teach them mathematics. Our attention should not be so heavily focused on the mathematics of the tasks we give to people to do. It should be focused on the mathematics of the situations in which they find themselves and of their responses to those situations.

What is the structure of mathematical abilities?

This question is wrongly posed. Mathematical abilities do not have a unique structure. The work of Krutetskii, like that of the factor analytic researchers before him, shows that the structure of mathematical abilities one obtains through empirical means is nothing more than the structure of the mathematical tasks one has used in the investigation. As Wesman (1968) observed in talking about intelligence, "***such structure as we perceive is structure which we have imposed***" (p. 273). It is a fiction … although probably a useful fiction… to ask about the structure of mathematical abilities. We should not delude ourselves about the answers we will find.

How can we measure mathematical abilities?

To measure something, we need to know where to look for it. Mathematical abilities are not objects or entities; they are attributes. They are inferred from behavior. We tend to think of them as being located somewhere inside a person, but it would be more reasonable to think of them as social constructions that appear in the behavior negotiated in a situation between someone whose abilities are being assessed and someone else … a teacher, a tester, an observer, ... who is making the assessment. Attending to the social dimension of the measurement of mathematical abilities helps us see how narrow our assessment practices have been. Krutetskii's scolding of Western researchers for their dependence on tests as measures of abilities is richly deserved.

We need to extend the measurement of mathematical abilities in two directions. The first, and the more difficult, is to move from task to situations, from short bits of behavior to extended samples of behavior over time and from obtrusive intervention to unobtrusive observation. The second direction is to analyze more thoroughly the behavior we obtain through the tasks we are using now. Information processing models of cognition hold more promise in helping to characterize the cognitive process used by capable students. We need to become better acquainted with this work… overcoming our perhaps natural aversion to the repetitive tasks and response - latency measures that are so commonly used. Although we should be wary of the cognitive psychologists' assumption that a complex task can always be decomposed into a set of simple tasks, we should also recognize that this assumption is not unreasonable as a first approximation.

How can we measure mathematical abilities? There is no good answer except to say that we do not know because we have taken such a limited view of the measurement process.

References

Anastasi, A. *Harassing a Dead Horse*. Review of D. R. Green (Ed.), the Aptitude - Achievement Distinction: Proceedings of the Second CTB/McGRaw-Hill Conference on Issues in Educational Measurement. Review of Education. 1975, 1, 356 - 362.

Green, D. R. (Ed.). T*he Aptitude-Achievement Distinction.* Monterey, CA: CTB/McGraw-Hill. 1974.

Krutetskii, V. A. *The Psychology of Mathematical Abilities in School Children.* Chicago: university of Chicago Press. 1976.

Wesman, A. G. *Intelligent Testing.* American Psychologist, 1968, 23, 267 - 274.

Wheeler, D. *Curriculum Reform in the Seventies ..... Mathematics.* Journal of Curriculum Studies. 1970, 2, 144 - 151.

Assessment of Mathematics in University Examinations

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University examinations like any other examinations in the education system are essentially achievement tests and for them to be able to classify students adequately, their quality should be ensured through procedures that would enhance their ability to discriminate student's abilities. Any measuring procedure that does not show individuals' differences cannot be said to be useful. Because scholars man universities, it is assumed that the achievement tests given in these institutions meet the quality standards that are necessary for good tests. The question is, do university tests meet the qualities of good tests? A study of 37 examination papers in the 1999/2000 academic year of egerton university that included mathematics courses showed that 43.2%, 21.6% and 35.2% of the examinations in that year were good, acceptable and bad respectively. In terms of their ability to discriminate students abilities, three out of the four mathematics examinations were among the bad ones (kithuka, 2001).

Quite often, because of the misuse of the so called "***academic freedom***" in the universities, the lecturer is the authority in the way his/ her course will be examined.

While it is true that many university lecturers and professors are specialists in their disciplines, it is also true that many of them are untrained teachers.

Even among those who are trained, many are not specialists in psychometrics. Many of the lecturers will even argue that they don't need any skills in preparing a test because anybody can do that. Maybe this is why teaching is not a profession but an occupation. Where professions are professions not anybody can do anything and everything. In the university, many lecturers will not take any criticism on their examinations kindly even when a specialist in tests and measurements offers it. This is different from a case in information technology where a professor who is not computer literate will forget his long -standing degrees and seek to learn computer literacy with all humility from a technician or a craftsman. There are, therefore, as many examination standards in the university as there are faculties and as many standards in the faculties as there are lecturers. Lecturers will use different formats for their examinations.

Some will use essay questions only. Others will use multiple choice and others a combination of essay, objective and short answer questions. Some will set a short paper while others will set a long paper. Some will ask candidates to answer all questions and others will give candidates a choice to answer three or four out of a total of several questions. Some will even give open book examinations. Worse still, some will mark the scripts subjectively without a marking scheme while others will prepare comprehensive model answers to enhance objectivity.

All the raw scores obtained in these varied examinations will be used to determine grades to be used for classifying the degrees either as First Class, Second Class or Pass. One can imagine the comparability of such grades!

Performance in Mathematics at all levels of education in Kenya has been generally lower than in other subjects. Learners, especially females, have expressed fear of the study of Mathematics as a subject. Perhaps this is so because Mathematics is a subject in its own special class. Studying this subject involves sequential problem solving techniques while studying most of the other subjects may involve straight reading that may have nothing to do with solving a problem. To develop mathematical skills, therefore, would require that a student tenaciously practices solving problems of one kind repeatedly in order to perfect the skill. Apparently very few students, and especially girls, have this tenacity.

Until 1995, all students admitted to Egerton University were required to do a University core course called MATH 100. Passing all university core courses in the first two years of study was a prerequisite for all students before proceeding to

their next year of study. MATH 100 was such a big problem to the majority of students that Senate had to make a decision to exempt all students except those taking science related courses from it. Performance in this course in the non- science related groups is still very low.

One of the reasons given by the Mathematics Department is that the numbers in these classes are still too large to allow the lecturer to give personalized attention to the students. Performance in the Mathematics course for those taking it as a major is relatively higher than those taking it as a requirement. This is so, perhaps because Mathematics majors have the aptitude for the course. Similarly, in the third and fourth year classes where students are more specialized and the classes are smaller, performance is reasonably high.

Given the importance of Mathematics as explained above, the format of the examinations given should enable the examination to discriminate the learners effectively. However, all the Mathematics examinations in the department have adopted a format of a two- hour paper that requires the students to answer question one and any other two questions. Essentially what this means is that candidates do not end up doing the same test. This practice violates the principles of psychometrics especially when norm- referenced score interpretation is going to be used to compare students' performance.

Analysis of the formats used in assessing all papers studied in the 1999/2000 academic year in Egerton University Laikipia Campus revealed that papers that required candidates to answer all questions discriminated the candidates abilities effectively. In reference to Mathematics four courses were analysed which candidates had been given options to choose 3 out of 5 questions or 3 out of 6 questions.

When the discrimination indices in the four courses of Mathematics were compared to those of other courses in the university where candidates were required to answer all the questions, the discrimination power for the Mathematics courses was significantly lower. This is shown in the table below.

Table: Comparison of the Discrimination Power of the Courses analysed in the Study

	No. of Courses	*Discriminating High from Low Achievers*	*Discriminating High only*	*Discriminating all students*	*Discriminating average students*	*Not Discriminating at all*
Other Courses Answer all Qs.	8	____	1	7	____	____
Other Courses Answer 21 /23 Qs.	1	____	____	1	____	____
Other Courses Answer 4/5 Qs.	2	____	____	1	1	____
Other Courses Answer 4/7 Qs.	1	____	____	1	____	____
Maths and other Courses Answer 3/5 Qs.	11	2	____	4	4	1
Other Courses Answer 4/9 Qs.	1	____	____	____	____	1
Other Courses Answer 4/6 Qs.	2	____	____	1	1	____
Maths and other Courses Answer 3/6 Qs.	10	1	____	2	5	2
Other Courses Answer 3/7 Qs.	1	____	____	____	____	1

From the table above, it can be seen that out of the eight courses where students were required to answer all questions, seven of them discriminated all the candidates well. As the latitude of options increased, the number of courses discriminating candidates decreased significantly.

From this simple research, it can be observed that in a norm reference achievement test, allowing options in the test reduces the ability of the test to effectively discriminate between the weak and the talented examinees.

Reference

KITHUKA, M. (2001). *Canonical Standard Setting in University Examinations*. Paper presented in a Symposium at Thomson Falls, Nyahururu, Kenya.

Factors Affecting Performance of Girls in Science and Mathematics

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Research findings have consistently shown that girls have been performing significantly poorer than boys in science and mathematics for a long time. Many factors have been attributed to this trend. In kenya some of the factors that have been found to contribute to this poor performance include the following:-

Lack of role models

Women are consistently under-represented in science and mathematics based institutions at the national level. For example, in 1998, female practising teachers represented 42% of the total number of teachers in primary and 35% in secondary schools. The number of women, relative to men, who teach science and mathematics at the primary and secondary levels, reveals a worse situation. At the primary level, the majority of female teachers are assigned to teach lower primary classes, while at upper primary classes, science and mathematics are mostly given to male teachers. This situation tends to stereotype the female pupils against science and mathematics which adversely affects the performance of girls in these key subjects because they have no role models to relate to at this level.

Teaching and learning resources

Well-equipped laboratories enhance the teaching and learning of science and mathematics. However, most schools do not have adequate facilities and equipment for the effective teaching of science subjects. Teachers strive to improvise experimental equipment and learning materials whenever possible. However, this has proved to be difficult for most schools. Where equipment is available, both male and female students view them as male dominate and so students and teachers expect boys to work with the equipment while girls watch.

It has been observed that at the secondary school level, girls schools are relatively less endowed with the facilities needed for teaching science subjects. This leads to poor female performance in science and mathematics and lower representation at post secondary technical and science educational institutions (FEMSA report no.2).

Teaching methods

The school syllabus in Kenya is considered to be too long and gender biased. In an effort to cover the syllabus, teachers have no time to deploy teaching methods that may captivate the imagination or develop critical thinking in young people. in the case of girls, it is known that they learn mathematics best when it is related to real life situations. Burdened with the lack of adequate laboratories and equipment, teachers resort to teacher-centred learning approaches such as lecture methods. The students are therefore passive learners who are expected to listen and only observe. This diminishes the interest of students in the subject because the content is too abstract, and, in many situations, has no relevance to their daily lives.

Gender bias has also been observed in the teaching of science and mathematics. Teachers tend to use positive reinforcement more on boys

than on girls. Teachers tend to ask boys more difficult questions than girls. They also tend to give boys more time to answer questions and are more likely to openly make negative remarks about girls' abilities. Despite this observation, research findings indicate that teachers do not think that the teaching approach has an adverse effect on girls' performance in science and mathematics (FEMSA Report No.8).

The cost of education

High dropout rates have been found to be due to school fees and levies. The parents are expected to provide school uniforms, textbooks and other learning materials especially for the practical oriented subjects like sciences. The school levies are a financial burden on parents, some of who in choose to pay for their sons only (FEMSA Report No. 5). The cost-sharing strategy requires that parents take responsibility for the construction of buildings, including laboratories and Home Science rooms. This has led to increased dropouts especially for girls because of parents' inability to contribute to these additional costs. If parents have a choice they tend to pay for the boys and not the girls. Girls therefore miss many lessons and when they eventually return to school they cannot perform well especially in Science and Mathematics because they are already behind schedule.

Teachers' attitudes

Both male and female teachers have negative attitudes towards girls' abilities to perform well in Mathematics and Sciences. Among the reasons given by the teachers for gender differences in performances in these subjects include girls' fear of the subjects, lower determination and intelligence in girls than in boys. The teachers report that girls do not ask questions and often cannot solve problems on their own. They believe that girls suffer from an inferiority complex when it comes to academic achievement and are therefore incapable of excelling. Bali (1997) found that the majority of teachers believed that boys would join the universities to train as doctors, engineers and architects, while girls are only capable of being teachers, tailors and secretaries. This has been proved false; for example the medicine class at the University of Nairobi usually has more girls than boys. This appears to be due to the clarity that the girls have regarding the usefulness of medicine in life. That is what enhances their motivation to do the science subjects needed for this highly competitive course and perform well in that Science. Teachers' attitudes regarding girls' ability are critical factors since teachers often advise or force students to enroll for those subjects they feel the student is likely to succeed in (FEMSA Report No. 7).

Stereotyped attitudes about what subjects are appropriate and proper for female and males lead to the channeling of girls and boys into specific and often limited fields of study. This denies girls and women access to a wide choice of science-base field as they are concentrated in arts-based subjects.

Parental attitudes

Low enrollment and high dropout rates in schools have been identified as some of the reasons for the low number of girls enrolling in science and mathematics (FEMSA, Report No. 6). Negative attitudes from parents have been cited as a major cause of low enrollment and high dropout rates for girls. Because traditional beliefs segregated roles along gender lines, most parents have not accepted the need to equip girls with skills and knowledge through education to enable them to function effectively in the modern world. Negative parental attitudes based on perceived gender roles lead to biased socialization of girls at home and in the community. Such practices deny girls the opportunity to explore and experiment to the same extent, as boys are encouraged to do. Lateness and skipping of classes due to household chores hinder the mastery of schoolwork. In various ethnic groups, parents arrange early marriages for their daughters instead of taking them to school, in order to get dowry. Studies have also shown that parents hold the view that girls are academically less capable than boys (FEMSA, Report No. 6).

Girls' attitudes towards science and mathematics

Studies have shown that females have more negative attitudes towards science and mathematics. Wasanga (1997) reported that the majority of girls found science subjects difficult and that most girls perceived science subjects to be more useful to boys. For girls, usefulness was directly related to domestic purposes, while

usefulness for boys was more a function of future career development. This finding portrays the negative effects of perceived gender roles.

Misconceptions about gender appropriate careers also adversely affects girls participation and performance in Science and Mathematics. Studies show that girls perceive engineering professions as only appropriate for boys and not girls (Mugenda, 1997). It should also be noted that Science and Mathematics teachers do not encourage a perceived relevance-based approach when teaching girls.

Other factors that affect participation and performance are a negative self-image and eroded self-confidence. Self-image is a major determinant of the choices that people make. Bali (1997) found that girls had a low self-image relative to boys. In addition, girls were more self-critical and lacked self-confidence, which would undoubtedly diminish the choice and performance of Science and Mathematics courses.

In addition, low self-esteem hinders girls from asking questions and attempting to solve problems on their own. These are some of the problems, which make the perceived relevance-based approach in teaching more appropriate.

The factors discussed above are not sacrosanct to Kenya only but should be applicable to most of the developing countries especially in Sub-Saharan Africa and need to be addressed if girls are to improve their performance in Science and Mathematics. Sufficient research has been carried to prove the effects of these factors on performance of girls in Mathematics and Sciences. Perhaps it is time action needs to be taken by employing interventions to address the situation.

Reference

Bali S. K. (1997). *A Comparative Study of Antecedents of Gender-Specific School Wastage Rates in Kenya.* Academy of Science Publishers, Nairobi.
Report No. 39.

FEMSA Report No. 5: *Extra-curricular and Out of School Factors Affecting Girls' Participation and Performance in Science, Mathematics Subjects.*

FEMSA Report No. 6: *Parents' and Community Attitudes towards Girls Participation in and Access to Education in Science, Mathematics and Technology subjects.*

FEMSA Report No. 8: *Teacher Training, Qualification and Working Conditions.*

Mugenda A. G. (1997) *Relationships among Freshman Background Characteristics Variables, Misconception about Major and Satisfaction with Major.* Unpublished Masters thesis. Lowa State University.

Wasanga C. M. (1997). *The Attitude towards Science among Primary and Secondary School Students in Kenya.* Academy of Science Publishers, Nairobi. Report No. 23.

More Appropriate Primary Science Examinations

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Countries of Sub Saharan Africa see science and technology as a tool for economic development. The impact that knowledge of good agricultural and health practices and appropriate technologies can bear on the quality of life of their citizens is undisputed.

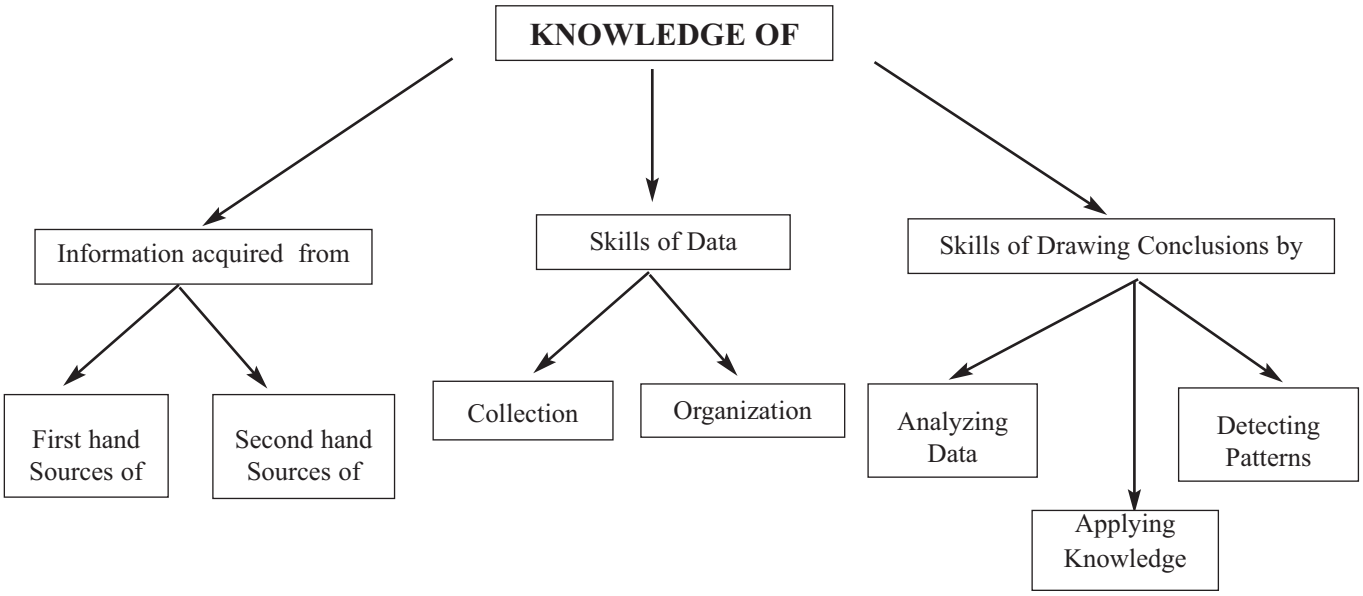
For example, a knowledge of crop and animal husbandry, of ways to conserve friable soils and of the long-term dangers of destructive environmental practices is vital in a continent where most economies depend on subsistence farming and cash crops. When access to medical facilities is limited, knowledge of what causes disease, of how to prevent them, and of simple curative practices such as the need for dehydration fluids saves countless lives and ensures a more healthy citizenry.

Probably all primary Science syllabuses in Africa also stress the value of the problem solving skills of Science and Technology in preparing future citizens to engage in the informal economy and to actively participate in the democratic process. The mass of young people must solve their own problems, using the scarce resources that economically stressed governments make available such as pamphlets, extension services, and the media.

They must be observant and knowledgeable of their immediate environment and such knowledge must be sharpened by an ability to classify and measure. Young people must be prepared to look for explanations for what they observe and to test their explanations. And they must be prepared to be open-minded and to listen critically to the explanation of others.

Such an understanding of causality, basic scientific concepts, and the ability to solve problems and continue to learn also provides a sound basis for selection of the minority of students who will benefit from further education as well as for an active participation in the democratic process. Suitable syllabuses, curricula materials, teacher development, and examinations are required to achieve the goals of Science teaching in primary schools throughout Africa. Though policy makers see primary education as a vehicle to provide students with the skills for engagement in the rural and informal sectors of the economy, parents and students view curriculum content only in reference to how it affects chances of selection for secondary school. Examination bodies, therefore, must ensure that examinations not only reinforce educational goals, but are also equitable in that they do not jeorpardize the chances of selection of children from particular socio-economic groups. If examinations do not do so, two educational systems will co-exist, one in the minds of planners and curriculum developers, the other in the reality of classrooms.

Devising ways to examine information-based curricula is relatively easy. Examiners can use recall items in a simple checklist to ensure adequate syllabus coverage as shown schematically below. More sophisticated techniques, however, are needed to examine curricula that promote higher order thinking skills, especially in Science and Technological based subjects.



Most primary science syllabuses in africa stress that pupils should be curious and observant of their surroundings. any leaving examination therefore, must test these skills indirectly through items that examine whether pupils can remember information most likely to have been learned using them.

A basic knowledge of agriculture, health science and appropriate technology is vital to learners' well being and productivity, and is most likely to have been learned at school and out of school and must therefore be examined.

Collecting information in a systematic and purposeful way through careful observation and experimentation are key skills that a primary science examination must test. Examinations can test pupils' ability to observe carefully but it is more difficult to test their ability to conduct experiments in a multiple choice, paper and pencil test.

However, collected information must be organized to detect patterns, and gain insight and understanding. though this skills can be tested by asking pupils to re-organise information presented in one way such as words into other forms such as tables or histograms. science examinations can also test how well pupils can analyze and apply in the stem to detect patterns and draw conclusions.

Efforts should be made to ensure that examinations test knowledge relevant to the needs of primary school leavers by directly making it part of the stem of items. there is no such thing as a culture free item. most items that claim to be culturally neutral are generally phrased in the school culture, a familiarity with which children from the elite are probably most comfortable. therefore primary science examinations should ensure a balance of the cultures within which items are phrased, such as nomadic, farming and female cultures.

Despite the stated goals of teaching primary school science, examinations in most countries of sub saharan africa largely test pupils' ability to memorize isolated facts selected because they are deemed necessary for an understanding of science taught in secondary schools. can examinations be set that do more? i suggest that they can.

Conferences and Workshops on the Assessment of Learning

The 1st National Conference on Assessment in Education,

organized by

Uganda National Examinations Board, P. O. Box 7066, Kampala, Uganda.
Tel: 256 (0) 41286173/41286635/78
E-mail:Uneb@swiftuganda.com
Website: www.uneb.co.ug
February 25th-March 1st, 2002
Nile Hotel Conference Centre, Kampala, Uganda.

Conference theme: ***Students Assessment in Primary Education.***
Conference Sub-themes:

i) the role of assessment-related data in educational policy making;
ii) defining and monitoring national and international education standards;
iii) using assessment-related data for improving teaching and learning in the primary education phase;
iv) assessment in primary education classrooms in developing countries: challenges and possibilities.

Regional Capacity-Building Workshop (Kampala-Uganda, 29th April - 3rd May, 2002) on Monitoring and Assessing the Quality of Secondary Education (MLA II) Survey of Mathematics and Science with Life Skills in Grade 8 (8 years of Schooling).

Organized by

United Nations Educational, Scientific and Cultural Organisation Organisation

des Nations Unies pour I'Education, la Science et la Culture

7, Place de Fontenoy; 75352 Paris 07 SP
Tel: +33(1) 45 68 09 93 /1134/ 1083;
Fax: +33(1) 45 68 56 37
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Objective of the workshop:

to share and to strengthen the African expertise and national capacities in developing educational quality monitoring instruments (tests and questionnaires) for assessing learning outcomes and factors influencing them in respective participating countries of the MLA II survey. Mathematics and Science with life skills being the focus of the surveys at Grade 8 level (i.e. 8 years of formal schooling altogether).

Association for the Study of Evaluations in Education in Southern Africa (ASEESA) International Conference 2002.

Polytechnic of Namibia,
Auditorium Centre,
Cnr Brahms/Hayda Streets, Windhoek
10th - 12th July 2002

Theme: ***Optimising the Role and function of Educational Assessment***

SUB-THEMES

- Assessment can improve teaching and learning: Why are the successes so few?
- Assessment and measurement of the effectiveness of teaching and learning in an inequitable system: Is it possible?
- Assessment and the reliable measurement of competence.
- Are there shortcoming in traditional assessment that prohibit the optimization of the role of educational assessment?
- Assessment relevant for both school exit and selection for tertiary education: achievable or not?
- The Curriculum and Assessment: What is the relationship?
- Assessment and the formulation of Educational Policies: What are the effects?
- Assessment as a monitoring and evaluation tool for the enhancement of quality assurance.
- Assessment innovations and new techniques to optimize the role and function of educational assessment.

Contact: aseesa2002@polytechnic.edu.na
for the attention of:
Mr. Corneels Jafta or Yvonne Tjizumaues or by snail mail to:
ASEESA 2002 Secretariat,
Polytechnic of Namibia,
Private Bag 13388, Windhoek, Namibia.

28th Conference of the International Association for Educational Assessment Reforming Educational Assessment to Meet Changing Needs.

1 - 6 September 2002,
Hong Kong SAR, China.

Conference theme: ***Reforming Educational Assessment to Meet Changing Needs***

Suggested topics for presentations:-

- The role of information technology in assessment,
- Assessment certification and selection functions,
- The assessment of students' values and attitudes,
- Providing students and schools with useful feedback on assessment results, the relationship between assessment and teaching and learning,
- Equity and equality issues in assessment,
- Monitoring student achievement and school performance,
- Standards setting,
- Value-added assessment,
- Other topics relevant to the Conference Theme

Abstracts contact: iaea2002@hkea.edu.hk.

Associations for Educational Assessment in Africa (AEAA)

The 20th Annual Conference,
AICC Arusha - Tanzania
October 7th-11th 2002
organised by

The National Examinations Council of Tanzania,
Ali Hassan Mwinyi Road, P. O. Box 2624,
Dar es Salaam - Tanzania

Tel: +255 22 2700493 - 6,
+255 22 2700499,
+255 22 2772423
Fax: +255 22 2775966;
E-mail: esnecta@ud.tz.

Theme: ***The Management and Administration of Public Examinations Systems in Africa. "Experiences on Examinations Irregularities"***

Sub-Themes:

i) Policy Issues related to the Management and Administration of Public Examinations,
ii) Influence of high-staked Examinations on Examination irregularities,
iii) The use of new technologies and their effect in Examinations irregularities,
iv) Experiences of Examination Authorities in controlling Examination irregularities,
v) Curriculum content, delivery and Examination irregularities,
vi) Factors associated with Economic policies in the Management and Administration of Public Examinations.

NEWS IN BRIEF

UNESCO Director General Visits Ethiopia, 6 - 9 January 2002

The UNESCO Director General, Mr. Koichiiro Matsuura, paid his second visit to Ethiopia in January 2002, focusing on the importance of Africa within UNESCO's brief. In addition to meetings with the President of Ethiopia, Mr. Girma W/Giorgis and the Minister of Education Mme. Gennet Zewdie, the DG also met with heads of Government departments of relevant Ministries as well as with the representatives of the United Nations system and with non-governmental organizations.

The UNESCO Director General during his visit to Ethiopia

He paid two visits to IICBA, during which he delved into the details of the work being done by IICBA. He was particularly impressed by the innovative programme initiated by IICBA on linking educational planning to economic development. One of the important outcomes of the visit was that IICBA was able to gain some additional funds from the Japanese Governments Funds-in-Trust for important UNESCO programmes.

Visits to Ethiopian Regional Universities

IICBA staff made study visits to a number of regional universities in Ethiopia, including Mekele, Alemayu, Bahir Dar and Debub Universities. The objective of these visits was to enable IICBA to have first hand contact with the universities with a view to incorporating the Indira Gandhi National Open University (IGNOU) programme on distance education, which is now entering its fourth phase, into a national university. It also enabled IICBA to gauge the staff development and capacity building needs of these universities in science, mathematics and school management, areas of focus for IICBA.

It was found that these universities are vibrant, young institutions with many young and brilliant staff, and that ambitious capacity building development are urgently required.

OAU Decade of Education Workshop for Southern Africa, Maputo, 12 - 15 March 2002

The Organization of African Unity (OAU) held a very successful workshop to discuss progress in Southern Africa in implementing the Decade of Education goals. Southern Africa is one of the most successful regions in terms of fulfilling the Education for All goals. The meeting included permanent secretaries and directors from Ministries

of Education from Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. The SADC Education Secretariat was well represented by its Director, Dr. J. Kunene, who presented a paper on the development of the SADC planning and management of education capacity building initiative which will focus on three regional institutions, viz, the University of the Witswatersrand in South Africa, the Pedagogical University in Mozambique, and the University of Dar Es Salaam in Tanzania.

Workshop on the Use of Virtual Reality Technology for Secondary School Science Teaching

IICBA had organized a competition for science teachers and specialists for lesson plans which could be turned into Virtual Reality lessons. The five winners from Ethiopia and Uganda, together with some IICBA staff and with Prof. Sam Bajah, a well-known science specialist from Nigeria, attended an introductory workshop on how to utilize Virtual Reality technology for developing science modules for secondary school use. As computers, videos and televisions are becoming cheaper, it is possible today to utilize Virtual Reality in place of or in addition to science laboratories and science kits for teaching and learning at secondary school level. Actually the technology is suitable for all subjects and all levels of learning, but IICBA has decided to begin with secondary school science as many secondary schools in Africa find laboratories too expensive, and are unable to access science kits. The programme seeks to provide exciting interactive teaching and learning modules following the secondary science curriculum of schools in Africa.

The Naledi3D Company, a technology company located at the Government run Technology Hub in Pretoria, was responsible for judging the competition and for developing the 5 winning entries into possible Virtual Reality lessons. In addition participants had hands-on work on how to utilize the technology and software. However a five day workshop can only be an introduction, as several months' training is needed to specialize.

IICBA is following up this workshop with a second workshop to be held in Addis Ababa, Ethiopia, later this year.

Participants of Virtual Reality Workshop, South Africa