

**Final Report of a Research Project to
explore the use of ICT as a means of
ways of developing the expertise of
Science Teachers in developing
countries.**

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Report author: Peter Wilson

**Centre for Science Education,
Sheffield Hallam University
City Campus
Howard St.
Sheffield
S1 1WB**

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Abstract

In this study, the current challenges facing education administrators, teacher trainers and science teachers in two contrasting countries – The Gambia and Jamaica – were explored in an effort to identify ways in which ICT could be utilised to improve the quality and effectiveness of science teaching in similarly developing countries. Whilst teachers in these countries are universally in favour of employing ICT based methodology in their classrooms and laboratories, a difficult mix of politics, bureaucracy, financial uncertainty and under-developed support infrastructures combine to make progress in these aims rather slower than all interested parties would hope for. There are very encouraging signs, however, that the vision for improved access to and use of ICT in support of teaching is beginning to take shape in these countries as the potential benefits become clearer to the various stakeholders.

Executive summary

The project team was originally tasked with exploring ways of supporting science teachers in developing countries to use ICT in support of their teaching and learning approaches in the classroom. What was originally envisaged as a project to develop CD ROM and on-line, web-based resources and environments for science teachers to use in and in support of science lessons quite quickly became deflected from its primary purpose because of a large number of practical and logistical problems on the ground within the main target country, Gambia. Intermittent and unreliable power supplies and internet connections, the painstakingly slow release of earmarked funds for new PC hardware and PC suite building, and the low ICT skill base of many existing secondary teachers all conspired against the “quick-start” approach we had been hoped might be possible.

In the event, we opted to employ a far more hands-on and hands-held approach to the situation we found in existence in The Gambia. Following two very fruitful scoping visits to Gambia to meet the policy makers, managers, administrators and classroom teachers, we joined forces with the newly formed Department for Science and Technology Education in Banjul in order to support their thrust to identify and mobilize a series of “Champion Teachers” - a group of Gambian nationals who would receive intensive and developmental training, first in basic ICT skills and then, with our specific workshop support, in the practical applications and pedagogic value of ICT in the teaching and learning of science. Our own contributions are now being built upon by the DSTE team in Banjul as they seek to encourage those so trained to cascade their developing expertise within their own science departments and schools. A 5 year development plan is now being enacted which seeks to establish ICT competence, both in practical and pedagogic terms, throughout the entire Upper Secondary school sector in the Gambia.

We concluded our study with a comparative look at the current situation in another developing country in which the necessary infrastructure for the exploitation of ICT-based teaching and learning was said to be more

developed – Jamaica. Whilst the Education Ministry in Kingston was already encouraging schools to engage with ICT supported learning, successes were spread in a fairly fragmented way across the entire school system – both in primary and secondary schools. Financial expediency had seemingly led to a culture of ICT educational policy being developed on a complex and multi-stranded basis, being driven by short term funding opportunities as much as longer term strategic planning. More encouragingly there were many pockets of excellent practice, particularly in primary schools and it is hard to dispute the feeling that it is this particular school sector which would benefit the most from the introduction of ICT based teaching and learning strategies more generally.

In addition to the preceding comments, our major conclusions from the study were that:

- 1) The “Champion Teachers” approach used in The Gambia seemed a very effective model for the identification, development and growth of an ICT literate teaching community within a developing country.
- 2) Developing countries need to invest heavily in improving the pedagogic skills and ICT capability of their own teaching nationals and then find ways of encouraging those teachers to remain within the teaching profession. Over-reliance on highly qualified immigrants from neighbouring countries has led to the fear that The Gambia might lose its newly found momentum in this area should these staff return home and take their ICT skills with them.
- 3) The feared “brain drain” of overseas expertise from Gambia’s school and college system – be it Sierra Leonean or Ghanaian science teachers – needs to be resolved in the medium to longer term by a restructuring of the initial teacher training system – allowing Gambian trainees to obtain an up-rated teaching certificate for upper secondary schools. At present they can only qualify easily for an award which entitles them to teach in a primary or lower secondary school only. The requirement for prospective Upper Secondary teachers to study for a degree on top of and subsequent to several years of science teacher training seems designed to militate against home-grown talent ever becoming sufficiently qualified to teach in the Upper secondary schools
- 4) Greater efforts must be made to ensure that the ICT and pedagogic expertise brought to countries such as The Gambia by VSO/Peace Corps volunteers is transferred to appropriate agents within the country before the volunteer returns home. At present too many projects and developments flounder because a key volunteer worker has reached the end of their stay in the country.
- 5) The use of ICT to support teaching and learning – and science teaching and learning in particular – has been a fairly low priority for many schools. What ICT facilities exist in schools have too often been used either to perpetuate “computer studies” – what is an operating

system, etc – or support office skills e.g. word-processing – or have been used to promote community activity and fund raising e.g. use of a school computer suite as an internet café for locals. This rather old-fashioned view of the limited potential of ICT needs to be challenged forcefully.

- 6) With suitable training, ordinary classroom teachers can quickly become confident in handling an array of ICT resources and peripherals in support of their own teaching and learning strategies. They quickly recognise the benefits that ICT-based solutions can confer in the classroom and, assuming that those resources and suitable technical support are provided within their own school, are enthusiastic about sharing this new-found expertise with their own colleagues.
- 7) ICT policy for the improvement of teaching and learning needs to be coherent, driven and supported “from the top” and needs to take into account the sustainability features alluded to already. Experience from the UK suggests that the best place to begin the necessary revolution in practice and pedagogy is within the initial teacher training regime – not with “long-in-the-tooth” or disillusioned practitioners within the school system.

Introduction and rationale for study

The Centre for Science Education at Sheffield Hallam University is a nationally renowned centre for expertise in the utilisation of ICT in improving the quality and effectiveness of science teaching. It has been involved in a number of key UK schools' projects such as “Schools on Line” and the DFES/NOF (New Opportunity Fund) “Science Consortium” training schemes for UK science teachers, in association with partners such as ASE (Association for Science Education) and New Media.

Following the successful implementation of ICT training regimes for science teachers in UK, the Project Team at SHU were tasked with exploring how well placed certain developing countries were to benefit from the wealth of rapidly developing ICT tools and implementation strategies which are now available to UK schools, and to science teachers in particular.

Initial Project Aims:

- encouraging the development of science teaching expertise in developing countries - through the use of ICT
- encouraging the development of self-sustaining science teaching communities and networks

- encouraging the development of curriculum, resources and teaching strategies for science by teachers in developing countries
- assessing the suitability of the Internet, CD ROM and other ICT-based resources in enhancing the range and effectiveness of science teaching skills of teachers in developing countries - as evidenced by student achievement & motivation to learn / study science

The study's working aims and objectives necessarily went through a series of revisions and iterations as the local circumstances in each of the target countries changed and these developments will be explained as each phase of the work is reported. It is suggested that the reader refers to any appendix as it is referred to in the text of this report given the complex and iterative nature of the action-planning process that was required throughout the duration of the project in order to maintain an overall sense of coherence and momentum in our work. It is hoped that these appendices will provide the glue that will help make sense of the rapidly shifting priorities that emerged during our study.

Project Timeline

Year 0:	
May 1999 – Feb 2000	Attempt to set up research activity in Zambia and, secondly, Mozambique
Year 1:	
May 2000	Scoping visit to The Gambia to review education system
Year 2:	
May 2001	Further scoping and preparation for ICT training venture
Year 3:	
July 2002	Training the Gambian “Champion teachers” – Workshop 1
2002	Training the Gambian “Champion teachers” – Workshop 2
March 2003	Scoping visit and comparative study of Jamaica’s preparedness for ICT developments and training

Project methodology

Rationale and issues for years 0 and 1

- **Identifying a suitable focus country**

In deciding a suitable focus area for the first year of the study, the Project Team thought it important to consider a range of factors in relation to the possible target country(ies) including:

- ◆ political stability
- ◆ economic and technical infrastructure
- ◆ existing educational projects and developments
- ◆ existing networking arrangements between teachers
- ◆ the degree of interest locally in engaging in such a project with us
- ◆ support of DfID

- **Establishing a local community / partnership network**

We felt that it was vital to secure the wholehearted endorsement and support of the country's educational management hierarchy (i.e. Government, local authorities, etc.) if we were to make real progress in securing the cooperation and commitment of local teachers to the project. We took a direct steer from DFID itself on this point as being best placed to advise us on this aspect of the project and we certainly valued having access to and support from knowledgeable DFID officers who provided us with the necessary introductions and authority in relation to the country(ies) of interest.

We also exploited the networking potential of organisations such VSO and the Peace Corps - using their local representatives as the main means of establishing relationships with and between local science teachers. For example, VSO staff have e-mail connections which could be used to help maintain contact with and between local teachers.

Unfortunately, a number of practical and logistical problems arose in year 0 of the study which resulted in our attempts to explore Zambia and then Mozambique as suitable target countries becoming thwarted before any visitation could be organised there. The details of these difficulties is fully documented in our initial report to DFID of the on-going work in *Appendix A*. Gambia was therefore chosen as the best country in which to conduct our study.

Outcomes of 1st and 2nd scoping visits to Gambia – (May 2000/July 2001)

This first visit to Gambia enabled us to speak to the key players in science education including six school principals and science teachers and advisers, principal education officers of the Ministry of Education (DoSE) and key staff in Gambia College. This intensive visit enabled us to gain a good understanding of the educational system, the current situation relating to school science & ICT education science teacher training, the equipment and resources levels, and a good indication of what support is needed and would be welcomed. (See *Appendix A* for the full report on our findings and our revised development plan for the research study).

The provision of ICT facilities in Gambian Schools was generally very poor in the majority of the 20 upper secondary schools in May 2000. Although some schools' headteachers had developed skilful strategies for income generation, which had afforded them the opportunity to develop some ICT facilities within their own schools, many schools had limited facilities and would certainly have benefited from further in-service training. The extent of practical work in school science was also very limited as a result of poor laboratory, chemical and apparatus provision combined with the need for updating in teachers' skills and of providing some on-going technical support for teachers.

Within the resources available to this project we could not tackle the fundamental problems of laboratory and apparatus requirements nor the provision of ICT hardware. This is a medium to long term issue which is being addressed currently through the DoSE's current five year development plan and the aid of a World Bank loan. However, we were convinced that we could make a significant and immediate contribution to the in-service training of science teachers which would help to raise the quality of students' learning experiences in science & ICT. We identified 4 key priorities for the next phase of our work in The Gambia:

1. To introduce science teachers to a broader range of teaching approaches including the use of ICT and thus shift the balance away from the essentially exclusive use of didactic teaching and resultant passive learning on the part of the students.
2. To suggest strategies and resources to enable more basic practical and investigative science activities to take place within the existing constraints of accommodation and equipment.
3. To offer specific ICT training to those schools/colleges which currently had some ICT facilities and so that there could be some immediate benefit
4. To identify :
 - a group of science teachers, principals, education officers, Gambia College representative(s), 6 regional training officers who would form a first cohort for training and thereafter be "trained as trainers" of other teachers

- forge a close working relationship with Gambia College/Regional in-service providers to (i) help with training and development (ii) create a partnership for effective roll out and the development of a substitute country-led continuous professional development programme.

We believed that this model would have the best chance of success and impact in both the immediate and longer terms. It would hopefully help broaden the range of science teachers' skills and utilise ICT to extend learning opportunities for both teachers and students, and teacher-trainers.

In the event, our ambition to support the Initial Teacher Training enterprise at Gambia College during this project was not seen as an immediate priority by the Gambian authorities, and thus sadly was not to be enacted. (See *Appendix B* for a report on the 2nd scoping visit to Gambia). However, our project intervention in The Gambia happily coincided with the establishment of a new Directorate for Science and Technology Education (DSTE) within the Education ministry. The newly appointed head of this Department was Mr Ebrahim Kah, the former Headteacher of the Muslim Senior Secondary School in Banjul. His visionary and energetic approach to all things educational were to prove an important turning point for the outcomes of our project and, more importantly, for the health of the science education enterprise in the whole of The Gambia.

DoSE had already identified a group of 20 - 30 "champion teachers" who were of Gambian origin. This group of professionals, chosen for their outstanding classroom practice, had already attended a Summer School ICT training event in the Summer of 2001 at which they had engaged in a crash course of activities designed to improve their basic ICT skills and ICT literacy. It was this group of teachers who quite naturally were to become the primary target for our own training input.

Negotiations with DoSE led to the setting up of a 2nd scoping visit in May 2001 and the development of a possible training plan for our next visit in September 2001. The setting up of the new DSTE allowed for our training plans to become woven into and shaped by the DSTE plans and priorities for developing the skills of the "Champion Teachers".

Rationale for and outcomes of two training visits to The Gambia: (Sept 2001) and (November 2002)

The full report of our planning, and of the content and outcomes of our first training visit to the Gambia is detailed fully in *Appendix C*. Interestingly, the venue chosen for this training was the YMCA near Banjul by virtue of its networked computer suite facility. At this time, there was no suitable computer facility available for the event within a public upper secondary school – a further illustration of the particular challenges of conducting what we had hoped would be a school-based training programme within the country. A further unfortunate limitation was that schools found it difficult to release science teachers for such an event in term-time. Additionally, not many of the

Gambian “Champion Teachers” who had attended the basic ICT skills workshops in the summer school of 2001 was able to attend this event. Instead, many attendees were actually computer-literate overseas teachers from Sierra Leone and Ghana who, whilst ready for this more advanced input on ICT, were not the ideal target constituency as far as we or the DoSE were concerned.

We were kindly invited by DSTE to participate in a further training event in November 2002. This workshop based at the Kindersdorf Bottrop High School attracted a large number of teachers who had attended the 1st set of workshops we had conducted in Sept 2001 and afforded us an ideal opportunity to review the progress with the use of ICT they had made since our last visit and then consolidate and build upon their expertise by developing those skills and pedagogic awareness further. *Appendix D* gives a concise summary of the programme of training for this 2nd series of workshops. Our training experiences in 2001 had led us to assume that there would probably be a wide range of expertise within the target group who attended this 2nd event. As a result, we planned for workshop participants to engage with a differentiated series of activities on the same themes – so that everyone who came on the course would attempt an Excel spreadsheet task, for example, appropriate to their level of confidence and experience with spreadsheet use. This proved to be a useful and fruitful strategy as can be seen by the analysis of participant feedback from the event. (*Appendix D*)

By this time, the Director of DSTE, Mr Ebrahim Kah, and his Assistant Director, Mrs Christine Tacchi, had formulated a series of policy statements and work plans spelling out the Directorate’s plan for the further roll out of ICT training across the country’s Upper Secondary Schools. (*See Appendices E, F and G*). Following discussions with our Project Team, DSTE formulated a proposed syllabus for ICT literacy in Senior Secondary schools (*Appendix H*) which helpfully spells out some simple ideas for teachers to trial using fairly simple ICT-based tasks in support of their teaching and learning objectives – and across the whole school curriculum. Hopefully, these extensive and ambitious plans are now well on the way to being implemented successfully across Upper secondary schools within The Gambia. Certainly, by the end of our involvement in The Gambia, there were far more encouraging signs that the promised redevelopment and provision of dedicated ICT facilities within these schools through the support of the World Bank was beginning to become more fully realised.

Our involvement with two one-week training workshops for science teachers in The Gambia has helped to equip a sizeable group of designated “expert” teachers with a number of key skills and insights into the broad possibilities and role of ICT within the classroom environment. They have now been charged with the responsibility of disseminating this practical expertise in the use of ICT to support science teaching within a number of secondary schools by a cascade process.

Outcomes of comparative scoping visit to Jamaica (Feb 2003)

The project team visited Kingston, Jamaica in February 2003 where we met with the Minister of Education, the Chief Education Officer, Mr Wesley Barratt and with the academic team which formed the Core Curriculum team in the Ministry – Winston Forrest, the Director and his colleagues, Cheryl Gardiner and Joan Higgins. Our purpose was to conduct a series of school visits and speak with the key policy makers and practitioners in order to determine the extent to which ICT was finding its way into the schools as a tool to support teaching and learning.

We found the Core Curriculum team to be an energetic and very dedicated group of people. They are busy throughout the year organising training workshops for practicing teachers and visiting schools across the entire country to conduct the progress assessment of trainee teachers. In between times they are formulating and managing policy developments and overseeing a vast array of educational projects often funded by external agencies such as The International Development bank, DFID, countries such as China and USA and conducted by Universities such as Canterbury and Kentucky State. Such is the complexity and diversity of this collection of active projects that it is difficult to see quite how all of these disparate strands of activity can be coalesced into a coherent and manageable educational strategy for the country as a whole. The need to raise a constant stream of external funding means that the Core Curriculum team cheerfully accept this challenge and seem unflustered by the sheer number of developments taking place across the country's schools at any one time.

A question remains about the extent to which short-term projects and interventions can deliver sustainable long-term improvements to the quality on educational experience of all pupils within the schools sectors. Clearly the lessons learnt from these interventions need to be disseminated and supported throughout the school sector for this to be so.

Nevertheless, we were extremely impressed by some of the examples of ICT-based initiatives and practices in schools which we visited. Interestingly, the majority of these developments in the use of ICT to support science and whole-curriculum teaching and learning were based in primary schools, in complete contrast to the approach used in The Gambia. Our feeling is that this is a very useful approach in that it permits children to grow up gaining increasing familiarity with the power and usefulness of ICT in supporting their own learning throughout their time in schools. The evidence suggests that experienced secondary teachers find it much more difficult to move from a teacher-centred approach to one giving more autonomy to the learner. Primary teachers seem, on average, more at ease with embracing the more pupil-centred approaches that ICT-based resources and strategies suggest.

The Ministry of Education in Kingston was about to develop a national policy for ICT and Education and we trust that our discussions with the team of policy makers will have helped to inform the debate that was on-going within that Department as to the future development of expertise in ICT amongst

teachers and teacher trainers. We discussed a number of potential avenues for further collaboration with the Core Curriculum team, one of which appears later in this report.

Discussion and analysis of major findings

The tension between the need for ICT skills and the use of ICT as a vehicle for learning across the curriculum

Our findings illustrated the very real disagreement that still exists about exactly what ICT should be used for in schools. We came across very many examples where schools and colleges were concentrating on "computer studies" rather than using ICT to support their teaching and learning approaches across the curriculum. In consequence, we found classes copying copious amounts of notes from the board on what an operating system was, or how to use a keyboard or mouse or even, how to type. Computer facilities remain in the hands of a few teachers in a school and there appear to be few opportunities for science, maths or English teachers to utilise these facilities in support of their own lessons.

Our experiences of conducting dedicated training sessions for science teachers in the use of ICT to enhance their teaching and learning approaches showed that subject teachers are certainly ready and capable of developing the necessary skills and strategies in order to benefit from a more long term drive to improve the nature and quality of ICT resources in schools.

Where should ICT training resources be concentrated?

The Gambian short to medium term strategy was to concentrate any new funding for ICT within the upper secondary schools in the country, given that the number of these schools – approx. 18 – 20 across the country – was manageable and appropriate given the level of funding available from the World Bank loan. Our view is that whilst secondary schools should certainly benefit from such developments of facilities, this should not come at the expense of excluding or sidelining primary schools or the initial teacher training system from such important investment and development.

It is our view that the long term health of education in developing countries would be best served by investment of funding and specialised training within the Initial Teacher Training system in that country. In Gambia, in particular, the main hope for increasing the proportion of highly qualified Gambian teachers within the schools system who could embed the use of ICT across the school curriculum would be to ensure that those who train as teachers necessarily have to display a degree of personal competence in the pedagogic value and practical applications of ICT before they qualify. This

would mirror the sort of developments in approach to this problem that have been taken by successive UK Governments in respect of our own teacher training regime in the last 5 – 7yrs. (DfEE, 1998)

In fairness to our friends at the DSTE in The Gambia, our visits and advice have partly inspired the publication of a number policy documents and the setting up of a 5 year work-plan to improve further the ICT skills and pedagogy of all Upper Secondary school teachers. This could also be logically and usefully extended to cover those who are currently training as teachers.

One of the particular problems in Gambia has been the fairly small proportion of Gambian teachers who currently make up the teaching staff in Upper Secondary schools. The majority of staff in these schools have migrated from neighbouring and sometimes, war-torn countries such as Sierra Leone. Whilst these staff are very well qualified as teachers and are very effective in the classroom, there is a real fear that, once they have secured a stable financial footing for themselves, and once the political climate within their own countries has stabilised, many of these staff will return home, taking their expertise with them. Another fear is that those so trained will choose to exploit their new knowledge by changing career pathways to one which would require a working competence with ICT systems.

Similarly, Gambia benefits greatly from the influence and support of very dedicated volunteers from the Peace Corp and VSO. These volunteers often have particularly crucial roles in the development and maintenance of ICT facilities within a given institution. Further thought needs to be given by all those countries and organisations which host and come to rely on these volunteers as to the need to develop mechanisms for that expertise to be transferred to appropriate agents within the developing country. Too often we came across examples of ICT facilities and developments whose viability and longevity were being threatened by the impending departure of a volunteer.

How should a strategy for the introduction and use of ICT within schools be developed?

ICT policy for the improvement of teaching and learning needs to be coherent, driven and supported “from the top” and needs to take into account the sustainability features alluded to already earlier. Experience from the UK suggests that the best place to begin the necessary revolution in practice and pedagogy is within the initial teacher training regime – not necessarily with “long-in-the-tooth”, tired or disillusioned practitioners within the school system.

Jamaica’s experience seems to suggest too that primary schools rather than secondary might be a good place to introduce new ideas and methods, such as ICT-based teaching and learning.

The “Champion Teachers” approach used in The Gambia seemed a very effective model for the identification, development and growth of an ICT literate teaching community within a developing country. The setting up of the

DSTE within the DoSE has proved a crucial and far-sighted development in The Gambia. This new agency has the authority and funding to inspire and drive on-going developments throughout the country in science and technical education and is making rapid progress in doing so due to the dynamic leadership and personal influence of its director, Mr Kah.

A role for ICT in support of teaching and learning? - Some possible ways forward

The introduction of ICT into teaching can make significant changes to the learning taking place. These changes may affect the methodologies and strategies employed by the teachers, for example, by shifting the emphasis of teaching from teacher-led to a more pupil-centred approach. They can also have an effect on the learning capability of the pupils, by giving them access to information and tools for supporting learning. Bringing ICT into the learning environment must therefore be focused on planning, structuring and managing this change and not just based on technological requirements and capability.

Lessons learnt from the introduction of ICT into UK schools over the last two decades highlight the complexity and scale of the challenge to bring about positive changes. Whole scale adoption of ICT into the curriculum and incorporation into teacher methodology is an elusive goal for teachers in many schools. What are needed are strategies that build on and enhance current teaching practice. Given that in the developing countries class sizes are large and teaching is often based on a teacher-centred, didactic model, the implementation of ICT should initially integrate with this preferred and familiar model of teaching. It is hoped that this would not only be a more effective way of bringing about change but also be a cost effective solution in the short term.

We have considerable evidence from recent training initiatives of the effectiveness of using a single computer in a teaching situation, for example. The teacher can explain, and illustrate concepts by using simulations, animations and video clips; experiments can be demonstrated with live data capture and analysis through data logging apparatus and software. Pupils can be involved in their learning by making predictions and suggesting and testing hypotheses with computer models. There are a number of advantages of this interactive demonstration approach compared to teaching a pupil-led lesson in a network room, for example:

- the teacher is in direct control of the learning
- the number of variables of computer technology are reduced
- the cost of the hardware and software is reduced
- teachers gain confidence and competence in their own skills

The approach is not exclusive. The ultimate aim would be for teachers and schools to adopt a variety of teaching methods. The above strategy would be a starting point for the development of teaching and learning strategies with ICT. By gaining confidence in their own abilities and by seeing positive effects on learning, teachers will hopefully be encouraged to move to increased pupil autonomy and involvement with ICT.

Again, where funding and the availability of technical expertise is a limiting factor, it may be more appropriate to provide schools with a laptop and digital projector – together with a package of suitable educational software and associated peripherals – rather than invest heavily in computer suites and large numbers of networked computers. Such a package could be made mobile and be used to benefit a much wider proportion of classes in schools than can a computer suite. Admittedly, security issues and the robustness of hardware then become an issue for schools, but with suitable training and management, there is no reason why these potential problems should not be planned out of the picture. Experience from the UK suggests that computer suites can easily become hijacked by whichever subject departments have greatest existing ICT expertise or greatest curricular relationship with ICT, leaving other departments without regular access to computers.

We have in mind the possibility of providing schools with an “ICT Science Suitcase” or “crate” containing:

- a robust “plug & play” lap-top PC with suitable windows-based office software (Word, Excel, PowerPoint) and equipped with modem and
- a robust digital projector
- a selection of cross-curricular CD ROM based teaching resources (e.g encyclopaedia, simulations, models, etc)
- a data-logging device and set of appropriate sensors

This resource could allow for the wholesale introduction of ICT based approaches into schools without the possibly threatening changes in teaching approaches, as far as some teachers are concerned, that are required by the use of a computer network.

Summary of some suggestions for possible further work

- 1) Research the effectiveness of using “*science ICT crates*” to introduce ICT into science teaching in a small number of schools, for example working with some of the schools whose teachers who attended the September 2002 workshop in The Gambia. The purpose of using the crates is to familiarise a school with a range of different software tools and teaching approaches, so that they are then in a position to develop skills and resources for themselves using a distance learning and distance supported approach.

A '*science crate*' could be provided for each upper secondary school in The Gambia containing the items listed in the previous section of this report. Additionally, it would be important to provide each school with access to a reliable and affordable ISP account. It is estimated that each '*science crate*' might cost £4-5000 at current UK prices.

Ideally, there should be one science crate in each Upper Secondary school, and one available in each regional education office. All science crates should contain identical equipment to allow ease of learning and ease of repair. A technician in the Science and Technology Directorate could manage and service them. The technician may need to be a volunteer from an NGO initially since there is currently very little "home grown" technical support available in the country. The volunteer technician should endeavour to train at least one other member of staff to take over the role in their absence or following their departure.

Clearly, this plan would require the identification and provision of an additional funding stream which is not covered by the current World Bank / World Links funding arrangements

- 2) Apply the "train the trainers" or "Champion teachers" model for cascading ICT practical and pedagogic expertise within other developing countries, as used in The Gambia during this study.
- 3) Develop and deliver a training programme for Gambia College, in association with VSO, DfID/INFUNDO and World Links, to introduce the use of ICT into their teaching programmes, which may then lead to the production and electronic dissemination of effective distance learning resources for their placement students and hold open the possibility of distance support.

We would also be happy to provide consultative advice on the possible future development of initial teacher training at Gambia College, in line with some of the recommendations that we have made concerning the importance of ICT based pedagogic skills for all newly qualified teachers.

- 4) Develop a web-site based on the UK "**Science Consortium**" model for distance learning and communication with science teachers in developing countries. Such a project would require the trialling of the concept with a country having a reasonably well developed infrastructure e.g. Jamaica

Sheffield Hallam University has recently developed and coordinated the successful Science Consortium New Opportunities Fund training programme in ICT for Science Teachers within the UK. We have considerable expertise in initial teacher training in science, the pedagogic use of ICT in science classrooms and in the use of online

technology to provide teacher training. The resources developed as part of the Science Consortium programme have equal application to science teachers throughout the world. The aim of this proposal would be to promote science teaching and learning in Jamaican pupils by enabling Jamaican science teachers to make use of the resources and experiences gained by the Science Consortium in the UK.

This could involve:

- creating a database of Jamaican teachers and schools
- editing lesson materials to reflect the Jamaican curriculum
- training a web site administrator

- Running a face-to-face training course with a small group of trainers identified by the Ministry of Education, Youth and Culture in Jamaica. These trainers would become induction trainers and tutors for the scheme in Jamaica.
- Identifying, say, up to 20 secondary schools and all-age schools in Jamaica to become part of the pilot project
- Organising induction training with the pilot teachers and their trainers under the supervision of Sheffield Hallam staff.
- Monitoring the progress of the pilot teachers and supervising the tutoring role of the trainer's through the web site from the UK.

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- The Principal and staff of St Peter's, Muslim High, Kinderdorf Bottrop secondary schools in The Gambia. Special thanks to Mr Samateh, Principal of Kindersdorf for hosting the 2nd training event
- Jodi Lys, Head of the Centre for Educational Technology (CET) in Banjul, The Gambia
- The Ministry of Education and Core Curriculum unit in Kingston, Jamaica with special thanks to Joan Higgins and Jean Beaumont

Appendix A

**Revised report on an exploratory
visit to Gambia for the DFID
(July 9th – 14th 2000)**

Submitted by Peter Wilson
Centre for Science Education
Sheffield Hallam University
December 2000

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Revised report on an exploratory visit to Gambia for the DFID (July 9th – 14th 2000)

Overview:

This five-day visit on behalf of DFID took the form of a fact-finding and scoping mission which was based in the city of Banjul, Gambia. Its purposes were:

- to examine the educational system in Gambia – with special regard to secondary science teaching and the secondary teacher training system
- to speak to experienced school principals and teachers to determine what are the most pressing in-service training needs of science teachers in Gambia currently
- to survey the facilities for and the current use made of ICT (Information & Communication Technology) in Gambian Secondary schools
- to determine what form of in-service support might be most appropriate for SHU to prepare and how this support might be made available to Gambian science teachers

Schedule:

Sunday 9th July - Arrival and informal discussions with Mohammed Jallow, Head of ITHRD

Monday 10th July – Discussions with:

Mr Mike Ratcliffe – Development Adviser, ITHRD

Mr Salifu Jarsey – Principal Education Officer (Region 1), Human Resources, ITHRD

Mr Sarjo Jobe – Science teacher, Crabb Island School, Banjul

Mr Burama Jammel – i/c In-Service Teacher Training, Gambia College

Mr Kakai Sanyang – Principal Education Officer and his team (Region 2)

Tuesday 11th July – Discussions with:

Mr Celestine Mendee – Headteacher and staff of St. Peter's Secondary School

Mr Momodou Samateh, Principal, Kinderdorf Technical Senior Secondary School, Brikama.

Mr Lamin Darboa, Senior Teacher and Mr Musacesay – Brikama Upper Basic School, Brikama

Wednesday 12th July - Discussions with:

Mr Joof – Principal of St Augustine's Upper-Basic Secondary School, Banjul

Mr Alpha Khan – Principal of Charles Jow Memorial School, Banjul

Mr Ebou Kah – Principal, Muslim Senior Secondary School, Banjul

Thursday 13th July - Discussions with:

Mrs Phillott – Head of School of Education (i/c Initial Teacher Training), Gambia College

Mr Lamin Conteh - i/c Science Teacher Training, Gambia College

Mr Aboubacarr Jallow – Science Tutor, Gambia College

Mr Momodon K. Toway – Principal Education Officer, Region 5

Notes on the Gambian Education System

The office of ITHRD (Information Technology and Human Resources Directorate) is a division of the Department of State for Education which was set up in 1998 and is headed by Mr. Mohammed Jallow, who helped to arrange and hosted my visit to Gambia.

Gambia is currently in the throes of a “15 year plan” (1988 – 2003) to reorganize and update its educational system. A recent review and revision of the original plan has led to the publication of “The Education Masterplan” (1998 – 2006) which now forms the basis of the developments currently taking place throughout the education system.

ITHRD priorities currently include:

- The development of distance learning materials for teachers in training to use whilst on school practice.
- Setting up ICT suites in junior secondary schools
- A pilot project with selected secondary schools to setup an ICT-enabled base for pupils, teachers and the community to use
- Reducing the proportion of unqualified teachers in the field
- Retraining about 25 qualified junior secondary teachers to become upper secondary teachers

The school system currently consists of:

Primary Schools (7–12yrs) – Grades 1-6

Junior Secondary Schools (12-15yrs) - Grades 7-9

Upper Secondary (16-18yrs) – Grades 10-12

Primary education should be compulsory but funding problems and family considerations mean that, in practice, there is not a 100% take up. Primary school classes might typically contain around 45 pupils. Primary teachers are expected to be multi-subject – i.e. teach all the required curriculum elements (Mathematics, Integrated Science, English, Social and Environmental Studies [humanities].) The formal examinations which currently take place in grade 6 are

being phased out. A high proportion of primary teachers have no formal qualification as teachers (20% of all teachers in Gambia are unqualified) but the primary sector does employ a higher proportion of Gambians to non-Gambians than does the secondary sector. There are no immediate plans to “RESET” i.e. train all of these unqualified teachers given the logistical and financial problems that this would cause.

Junior Secondary schools have the same curriculum as the Primary schools with the addition of Agricultural Science. Class sizes are again around 45 in number and some of these schools have some form of dedicated laboratory space available for science lessons – although they lack basic equipment, chemicals and laboratory support staff. Formal examinations take place at the end of Grade 9 and (Grade 12 in Upper Secondary schools) which are organised by the West African Examinations Council (WAEC). All Gambian schools follow the WAEC examination syllabuses.

Junior Secondary teachers are trained to teach two subjects – typically, Science & Maths with Environmental Studies, for example. Many secondary school teachers in Gambia have emigrated from other English-speaking countries in West Africa – e.g. Ghana, Nigeria, Liberia and Sierra Leone (the countries that, with Gambia, make up the membership of WAEC.) This influx of foreign workers has been fuelled by political instability in those countries and by the lack of Gambian nationals who have traditionally been willing and suitably qualified to be employed as teachers. One of the most important aims of the revised education “masterplan” is to ensure that a greater number of Gambian nationals are trained as lower and upper secondary teachers, so that the country will not be as reliant on the skills of non-Gambians in the future.

Currently, foreign teachers make up less than 1% of primary teachers, over 50% of junior secondary and around 80% of upper secondary teachers in Gambia.

Upper Secondary schools

About 50% of students progress from basic secondary to the upper secondary schools. The upper secondary system would not cope with a greater number of students currently and so there are no plans to increase this proportion in the near future. Science is taught as three separate strands in Upper Secondary schools.

The upper secondary system would not cope with a greater number of students currently and so there aren't plans to increase this proportion in the near future. Science is taught as three separate strands in upper secondary schools. Grade 12 i.e. Upper Secondary WAEC passes are deemed to be higher qualifications than “O” levels but not as high as “A” levels, which are largely being phased out.

Notes on the Gambian teacher training system

All formal initial teacher training (ITT) in Gambia takes place at Gambia College which is based at Brikama in Administration Region 2 about 20 miles from the capital, Banjul. ITT courses are organised at two separate levels although neither of these awards is classed as a degree-level qualification:

- The Primary Teaching Certificate (PTC)
- The Higher Teaching Certificate (HTC) – normally for secondary teachers. (It is possible for primary trainees to do an HTC if they include a programme of training in the administration of education.)

From September 1999 the PTC was re-organised as a three-year programme entailing one year in college and two years in the field. (Prior to Sept. 1999, primary courses were run in a two-year format in college with no associated school experience.) Printed distance learning materials are being developed to support students in years two and three although it is hoped eventually to use the Internet and other media to support this venture. PTC holders who wish to transfer to the secondary sector to work must currently also complete the HTC in full – in other words, they are not given any credit or exceptions in respect of their PTC qualification.

The 1st year of the PTC entails the study of Chemistry, Biology and Physics, Maths, English, Social and Environmental Studies (i.e. humanities), Physical Education, Art & Craft and Home Science. The distance learning material used in year 2 covers all of these subjects except the last two.

The HTC involves 2 years subject training at College and 1 year in the field. Science trainees study Chemistry, Biology & Physics – and their associated teaching methodologies - together with Educational & Professional Studies (EPS). EPS includes study of assessment & evaluation, learning theories, philosophy of education, classroom management, lesson planning, pastoral care and special needs and educational record keeping.

In the latter year trainees are paid as unqualified teachers from a College stipend.

Entry qualifications for the primary course (typically 4 GCE passes or 3 WAEC passes) are lower than for the secondary course (4 credits at WAEC including the two core teaching subjects) and graduates in science are usually directed towards the “tertiary” or upper secondary schools. Applicants for ITT courses have traditionally been in their 30’s but more recently younger students have been attracted into training.

Admission to the PTC is dependent upon an entrance examination and interview whilst for the HTC an interview suffices. Interviews normally take place in early

summer. The expected intake in September 2000 is 241 on the PTC and 333 on the HTC - a large increase in numbers on previous years given the current resource situation. The Science Department, for example, has two relatively modern but small and ill-equipped laboratories which it has to use for class sizes of around 40 students. The "Masterplan" does include provision of a further 3 science laboratories using World Bank finance and, though building has yet to begin, a firm date has officially been agreed.

As a result of this severe overcrowding, teaching necessarily focuses on teacher demonstrations rather than class practical work and this clearly has knock-on effects on the nature and breadth of teaching strategies employed by these trainees in schools. There has been little replacement of exhausted chemical stocks or broken apparatus over the last 10 years and what chemical stocks exist are nearing the end of their useful shelf lives.

Although the College always aims to modernise its teacher training provision and methodological approaches, staff feel that the under-funded expansion of student numbers and the attendant increase in teaching loads – 22 hours of teaching per week, typically, plus work on designing distance-learning materials, tend to militate against such developments.

Trainees are assessed in college by a variety of methods including continual assessment and examinations. School-based practice is assessed by school-mentors – who will be experienced senior teachers selected for the role by the Regional Education Office – and by inspectors from the regional office who combine their trainee inspection role with that of more general school standards inspection. Additionally, college staff are involved in the assessment of the pedagogical aspects of the trainees' performance in school.

Notes on the Gambian schools visited:

Kinderdorf Technical Secondary School, Brikama - Region 2

Kinderdorf School is a combined junior and senior secondary school with 602 pupils in junior and 492 pupils in Upper School. In the technical disciplines teachers teach across both age ranges. Senior school is held in the morning and junior in the afternoon. Class sizes are typically 45 to 48 in junior school but numbers tend to fall off in senior. 85% of students come from the local area. Mixed ability groupings are the norm here as it is believed that this methodology encourages everyone to do well. The more able students are encouraged to support and help the less able ones.

Parents of junior students pay 150 Dalasi per term: 100 to cover tuition and 50 for books. Senior students pay 200 Dalasi per term which covers tuition only -

the school sells books to these students at cost price, making use of the supply of cheaper textbooks sourced from Nigeria.

The junior school curriculum consists of English, Maths, General Science and Social and Environmental Education. [i.e. History and Geography]. The Senior Curriculum comprises eight or nine subjects including English, Maths, Chemistry, Biology, Physics plus other options. Technical Drawing is a compulsory subject due to the availability of technical equipment provided by a secondary school in Essen, West Germany.

Few laboratory classes take place, partly as a result of there being too few chemical and apparatus resources. At one time, the school received £10,000 from VSO to spend on Philip Harris Supplies but these are now largely used up. The school can no longer afford paid appropriate assistants - in common with most schools - and tends, therefore, to ask the more able science students to help set up experiments.

Successful students may go on to study at the School of Nursing or School of Public Health at Gambia College or begin a university programme at the fledgling University of Gambia.

Teaching staff report that they would value even more opportunities for externally funded INSET than are currently available. Some schools supplement externally funded INSET programmes by organising internal staff development workshops held at weekends or during the holidays within their own schools.

The Principal has arranged for a classroom to be modified to make into a computer suite but has been awaiting the setting up of a stable electricity supply in the school - currently, the school have to rely on a generator. He expects that some staff will receive training in the use of IT (at the GTTI - Gambia Technical Training Institute) although the school currently has no facilities for staff computing.

The Principal has been very active in promoting links with interested partners in developed countries over recent years including the University of Bristol and St George's Community School in Bristol, a University in Nova Scotia and the school in Essen, West Germany mentioned earlier. These links have enabled him to secure a level of external funding and support for the school which is no doubt the envy of many other schools in the country. The result is a well-ordered, well-run and relatively attractive environment for learning for his pupils.

St Peter's Secondary School, Brikama – Region 2

In common with Kindersdorf School, this is a combined Junior and Senior Secondary school – Senior pupils attend between 8am and 1.30pm and junior pupils between 2.00pm and 6.40pm. The school follows the standard teaching syllabuses and divides the morning into 10 periods of 30 minutes which are blocked into doubles for the Sciences. The afternoon consists of eight periods of study on Monday to Thursday night and ten on Friday. The school arranges extra lessons for senior pupils preparing for examinations on some afternoons.

At Senior school a mixture of continuous assessment (30%) and examination (70%) is used to determine promotion to the next year level. Students must pass each level before passing to the next. Fees of 600 Dalasi are payable for Senior schooling. In addition to the core subject classes, students study either RE or IRK (Islamic Religious Knowledge).

The school possesses a computer laboratory for 35 pupils. Pupils from grades 7 -10 have compulsory lessons in computing. This has led to enthusiastic interest, particularly in the use of e-mail and Internet, which unfortunately has meant that pupils' time on the Internet and has had to be rationed. The school hopes that a more affordable connection will eventually be provided by GAMTEL. The room is not normally available for science lessons because it is preferentially used for other subjects e.g. typing and financial management. In addition, the school hires out the room to external groups in order to raise more income for itself.

Science teachers cite a number of factors which reduce the effectiveness of their teaching including:

- A lack of materials (chemicals and apparatus)
- The cost of materials
- Class sizes of 30 to 40 (in Senior school)
- A lack of a technical support - though some help may be sought from more able senior pupils

As a result, more emphasis is placed on the theoretical aspects of the Science Curriculum as this is seen as providing a better preparation for the external examinations. In common with many other schools St. Peter's has a number of science teachers from outside the Gambia e.g. from Sierra Leone. Typically, these teachers possess high-level qualifications (including first and second degrees) in science and tend to approach the teaching of Advanced level topics in a most rigorous fashion. Indeed, some of the topics taught might well also have found a place in many university science courses.

As in Britain, science teachers prefer to teach their specialism. In this school pupils are thought to have similar IQ's and therefore streaming is not felt to be necessary.

Science teachers admit a lack of experience using ICT and would value some training in this area. Although INSET could theoretically take place on an afternoon in senior schools and on a morning in junior schools, most teachers here would prefer not to disrupt the school during term time and would rather attend INSET at weekends or during the holidays.

St Augustine's Upper Basic Secondary School (Region 1- Banjul)

This school is based in the centre of Banjul and has 1172 pupils on roll. The principal, Mr. Joof, and his colleague, Mr Khan, from Charles Jow Memorial School, expounded a very detailed analysis of the problems currently facing this sector of the education system in the Gambia.

Staffing is a particular cause for concern for these schools. There is in particular a dearth of well-qualified Science, Maths and technical subject teachers in this sector. Many move on quickly to work in the upper secondary sector as soon as they can. There are no dedicated rooms for science lessons and class sizes of 45 to 50, together with a lack of experimental apparatus generally (the school has the only 2 microscopes, for example), make it very difficult to avoid an over theoretical approach to teaching science.

Teachers understand that pupils' need to see, to feel and to experience science. However, although some believe that the development of this approach should start in the Primary schools, class sizes of 60 to 70 and even worse resourcing problems make this unrealistic. Some teachers believe that the theoretical base of the upper Basic School is itself responsible for many of the problems. The feeling is that there was not enough consultation or trialling/testing of the curriculum or examination syllabuses before their introduction.

The Principals recognise that some teachers are more imaginative and resourceful. However, the majority need further encouragement, perhaps from the reintroduction of INSET/RESET activities. In addition, the subject teacher associations in need to be revived and junior secondary schools, in particular, should be given access to at one least one central science laboratory.

Muslim Senior Secondary School (Region 1- Banjul)

Mr Kah, the school principal at this grant-assisted school, was a science teacher in school and college for many years and is well placed to provide an insightful overview of the principal issues and challenges facing science teachers in the Gambia. In his view the major problem in Gambian schools is teaching methodology. However, because school laboratories are dilapidated and the appropriate materials lacking, teachers understandably rely on didactic teaching methods.

Mr Kah reported that the Education Ministry has targeted eight schools for ICT training. GTTI trained two teachers for his school for September 2000 to enable the introduction of computer studies this academic year but some of these costs have had to be borne by the school. Eight of his staff have already trained in the use of computers, at their own expense, and the two most proficient are to be used to teach computer studies within the school. However, this development has left vacancies for two science teachers within his school. The intention at this school is to develop a science laboratory with a ICT facilities.

In his opinion, ploughing new resources for ICT into schools is likely to be a waste of time and money unless appropriate training is provided at the same time. A long-term programme of continuous help and support involving constant encouragement, supervision and monitoring will be necessary if the initiative is to succeed. Mr. Kah cited the environmental education project, CEDA, which was seen by some teachers as a waste of money, as a case in point. This initiative was felt by some to embody too many plans, programmes and projects and perhaps lacked the clear focal point necessary. In contrast, the NSGA Peer Help Guidance and Counselling initiative was well received by teachers.

Mr Kah believes that what is needed is an approach which involves the schools and teacher organisations, which looks at what is meant by Computer Education and Computer Literacy and which attempts to illustrate the wide range of uses to which ICT may be put in the classroom. Such support for ICT needs to start from the general and then move to the specific. Where possible, the ICT skills of teachers who have come from banking or administrative employment backgrounds need to be harnessed. Once the issue of computer hardware has been settled, the provision of appropriate software (e.g. educational CD ROMs) and associated hardware (e.g. Data loggers) needs to be tackled. The major challenge then is how teachers might apply learning, understanding and Principles of IT in individual schools.

Brikama Upper Basic School (Region 2)

This junior secondary school organises its pupils into two groups on the basis of Primary School test scores - the Upper ability range have lessons in the morning and the remainder in the afternoon. Slow learners are offered extra classes, normally Saturday or Sunday, taught by teachers on a voluntary basis. The core subjects are again, English, Maths, General Science and Social and Environmental Education. There is a feeling amongst teachers that Agricultural Science should also be a core subject rather than a subsidiary one.

At the end of the ninth grade and dependant on their academic performance, they may choose to study at a range of establishments including upper secondary schools or a technical or vocational training centre based usually in an urban centre e.g. GTTI, VTCU.

The science curriculum at this level is fairly elementary e.g. health, the digestive system, etc. Development of the separate strands of science takes place at senior secondary school. Science lessons occupy five 35-minute sessions per week, in common with English and Maths.

Teachers believe that their greatest need currently is for INSET. At the moment teacher training tends to be a "once in a lifetime" experience. Teachers would value some retraining and the provision of more on going support. Many teachers in this sector have been trained in Social and Environmental Education and there is consequently an acute shortage of science-trained teachers. In the broader context of the whole country, teachers here believe that technological skills are the most important priority for the Gambian population. They believe that too few Gambians have the skills necessary for the manufacturing industries, and that this leads to far greater reliance on skilled foreign workers than is healthy for the country.

Three old computers donated to the school several years ago by the U.S. Embassy have now been scrapped and computing facilities at the school are currently non-existent.

Notes on the discussions held with other Gambian teachers and educational administrators

Salifu Jarsey, Principal Education Officer – Region 1 / Sarjo Jobe, Science Teacher, Crabb Island School :

There is a great sense of dissatisfaction amongst some teachers with the current system of teaching. Teachers lack access to modern teaching materials and resources – including chemicals, apparatus, models and other teaching aids, computers, Internet access, etc. They would value refresher courses and greater on-going guidance in developing their range of teaching skills and approaches, post qualification. They accept that they need to improvise more, make their teaching more relevant to the natural environment and to rely less on "chalk and talk". There is a genuine desire to encourage teachers to make more use of learning by discovery and exploration. Although the syllabus encourages teachers to make reference to the practical applications of science e.g. visits to a soap factory or water treatment plant and visits from family planning professionals, in common with Britain it is the examination syllabus which tends

to drive the way in which teaching is done. It is felt that parents need to be encouraged to value science more.

Mr Jobe is currently organizing the reintroduction of a science teacher association in the Gambia which he hopes will act as an important catalyst for science teachers' professional development. In addition to publishing a regular newsletter, he hopes to organise teacher workshops and a conference to be held in Banjul. Once established it is hoped that the Gambia ASE will be able to exploit working links with similar organisations, for example, in Britain, Australia and USA.

Mr Kakai Sanyang, Principal Education Officer – Region 2

Mr Kakai provided a detailed overview of the roles and responsibilities of a Regional Education Office. Three key issues provide the platform for much of the work of the REO:

- Quality of education
- Relevance of education
- Access to education

The Education Masterplan specifies a range of expectations of the education service including:

- The building of more classrooms - normally by expansion of existing schools together with some new school building projects
- The establishment of regional/district educational committees
- The evaluation of teacher and student performance

School inspections are carried out by Regional Officers. The inspection schedule involves not only the quality of teaching and learning in the classroom but also more generic issues such as school management and administration, the condition of buildings and associated services and facilities, parent-teacher associations and school development plans. The Regional Office also inspects private schools.

In addition to its statutory duties, this regional office has instigated a number of initiatives designed to promote pupils' enthusiasm for and interest in school Science and Mathematics. Two examples of these are a scholarship scheme designed to encourage girls to study Science and Maths at upper senior school level and regional science competitions in which schools produce a display of work for a public exhibition. Attempts are being made to attract sponsorship for the latter idea.

Mr Kakai feels that there is a need for workshops - perhaps arranged at cluster level in the regions-in order to update Teachers' skills. The region 2 site itself has a well appointed room which could be used for such events. One of the major challenges for the PEO is the need to enhance the teaching skills of staff from such wide variety of backgrounds and qualifications.

Burama Jammah, Head of INSET, Gambia College

In addition to Initial Teacher Training, Gambia College designs training programmes for practicing teachers in conjunction with the Ministry of Education. This involves action research in order to identify specific training needs. From April 1999 this unit has also had responsibility for overseeing school curriculum development.

Gambia College also oversees the work of six regional training officers who are based in Education Resource Centres sited in each of the six regional areas. These centres provide a base for the decentralised INSET system and are currently used for meetings, seminars and other training activities. It has also been suggested that the local community might one day be allowed to make use of these modern ICT facilities.

It is further hoped that these facilities will allow the dissemination of training materials to teachers and provide another means of interaction between teachers and students. Obviously, one of the key requirements is the development of a syllabus that links science with ICT.

Gambia College have previously been involved with an ODA-managed project whose impact was evaluated by David Johnson and a team of colleagues from Bristol University. This RESETT programme (Regional Strategy for the Education and Training of Teachers) trained 800 "resource teachers" in the four core curriculum areas between 1993 and 1996. 32 of these teachers were chosen and trained as trainers in the Ministry of Education "training of trainers" programme. Eight of these visited Ghana to see a similar programme before becoming appointed as regional trainers who now oversee the regional centres.

Summary of findings and proposals for further action

This first visit to Gambia has enabled us to speak to the key players in science education including six school principals and a broad range of science teachers and advisers, Principal Education Officers of the Ministry and key staff in Gambia College. This intensive visit has enabled us to gain a good understanding of the Gambian educational system, the current situation relating to school science & ICT education, science teacher training, the equipment and resource levels, and

a good indication of what support is needed and would be welcomed by practicing teachers.

It was fairly evident from my observations and discussions with key staff that, whilst the overall policy documents and statements of intent are quite clear on the timetable for the development of improved ICT facilities in upper secondary schools, a majority of these 20 schools were still awaiting the arrival and commissioning of such equipment. In these circumstances, proposals for a purely ICT-focussed project strategy would currently be unworkable, except perhaps with a small cohort of schools who are already reasonably well-resourced in this area. However, my discussions with science teachers revealed that, in addition to the need for greater ICT awareness and expertise, many teachers would value some in-service retraining designed to broaden their current repertoire of teaching skills and approaches.

However, the project team do recognise that ICT rather than “active teaching and learning” was the original intended focus for our work and may remain the preferred one for the medium term as far as DFID and the Ministry of Education in the Gambia are concerned. We also recognize that the Education Ministry in Banjul has already implemented training for some secondary teachers in the use of basic software packages such as word-processing, spreadsheet and databases. We propose therefore, that as more of the new ICT infrastructure is put in place in these sixteen schools, it should be possible, in conjunction with Gambia College and GTTI, to provide on-going support and encouragement for upper secondary science teachers as they get to grips with this new technology and its applications in the classroom.

The extent of practical work in school science is also currently very limited, partly due to poor laboratory and apparatus provision and partly to the need for updating teachers' skills in this area. Interestingly, Lower Secondary teachers expressed great enthusiasm for on-going professional development, perhaps as a result of the particularly acute lack of equipment and laboratory facilities in this school sector.

Additionally, it became clear that the vast majority of science teachers in the secondary school sector are non-Gambians. It may be helpful therefore for us to endeavour to support and extend the subject and pedagogic expertise of the new wave of Gambian science teachers who are being encouraged to enter the teaching profession. This would obviously suggest that we should work closely with Gambia College as the primary agency responsible for pre-service and in-service training, during the next phase of our work in the Gambia.

We believe that Gambia College staff (under the authority of DoSE and ITHRD) are best placed to act as our working partners and primary link with local schools, teachers and, of course, student teachers. The College has the additional advantages of having a well-run regional education office near by and

two relatively well-resourced upper secondary schools which could act as a test-bed for some of the ideas we would hope to share with teachers.

Within the resources available to this project we cannot tackle the fundamental problems of laboratory and apparatus requirements nor the provision of ICT hardware. This is a medium to long-term issue which is hopefully being addressed soon. However, in spite of these difficulties, we remain convinced that we can make a significant and immediate contribution to the in-service training of science teachers which would help to raise the quality of students' learning experiences in science and ICT. We believe there are 4 key priorities:

1. To forge a close working relationship with DoSE/ITHRD and Gambia College initial and in-service teacher training providers in order to:
 - Plan and conduct a programme of appropriate in-service training and development for science teachers
 - Identify a group of science teachers, principals, education officers, Gambia College representatives and regional training officers who would form a first cohort for training and thereafter be trained as trainers of other teachers
1. To introduce science teachers to a broader range of teaching approaches, including the use of ICT, and thus shift the balance away from the predominant use of didactic teaching and resultant passive learning on the part of the students.
2. To provide teachers with strategies and resources to enable more basic practical and investigative science activities to take place within the existing constraints of accommodation and equipment.
3. To offer specific ICT training to those schools/colleges which currently have some ICT facilities and would therefore have immediate benefit

This model for future action, we believe, would have the best chance of success and impact in both the immediate and longer term. It would help broaden the range of science teachers' skills and utilise ICT to extend learning opportunities for both teachers and students.

Suggested Programme of Activity: November 2000 – October 2001

Nov – Dec 2000	Negotiate with representatives of DoSE/ITHRD and Gambia College in order to develop plans for initial training programme and identify initial cohort for training
Feb 2001	Conduct 1 st training workshop for Gambia College staff, students and local secondary school teachers
February – July 2001	Workshop participants trial and evaluate a range of teaching approaches in their institutions using some basic “action research” techniques.
July 2001	Conduct follow up (2 nd) training workshop – Review of trialing and action research. Writing workshop to produce materials appropriate to Gambian schools and curriculum (to place on a web-site.)
July – Oct 2001	Training cohort carry out further trialing, evaluation and action research.
Oct 2001	Conduct final training visit – focusing on training and dissemination of the work and outcomes of the project.
Late October 2001	Evaluation and report to DFID on progress and impact of this training model, including outcomes of action research and recommendations for the future direction of the project. (At this point, we would be reviewing the prospects of developing this work and developmental model more extensively in the Gambia and moving onto a 2 nd and later, 3 rd country).

Please note also that as World Bank-financed ICT equipment arrives in schools, we would hope to establish on-going e-mail and web-based support for those teachers who are participating in the training programme.

Peter Wilson

Centre for Science Education
Sheffield Hallam University
December 2000

Appendix B

Update report for Dr Digby Swift, DFID on
the outcomes of our 2nd scoping visit to
Gambia – May 2001

Peter Wilson & Richard Needham
Sheffield Hallam University,

June 2001

Update Report on the Sheffield Hallam University/DFID/Gambia Research Project

This report is just to update you on the outcomes of our recent visit to The Gambia (18th – 25th May 2001). We spent a week out in Banjul and visited Gambia College, GTTI and a range of schools. (St Peter's and Marina - the private school.) We had fruitful talks with Mohammed Jallow and his colleagues, including Mr Njie, about their preferences for our planned training visit in July.

It seems that they would like us to provide a dedicated science-based ICT training experience for some of the Gambian "Champion Teachers" group who are to be brought together in July once more for some general ICT training which they are expected to cascade within their departments. The plan at the moment is for Richard Needham and myself to conduct an add-on training course at the end of the two week training event that Mr Njie is about to organise in mid to late July. Given that building work has not yet commenced on the World Bank funded computer suites in Upper Secondary schools as yet, this training is likely to take place at the GTTI, the MDI or the YMCA - not within schools.

Whilst we are happy to take part in this training venture, we do remain concerned at the prospect of these teachers going back into schools which are not likely to have the promised computer equipment in place for possibly several more months to come. Although St Peter's School does have a computer suite, it is not used by science teachers currently and there are no plans to make those facilities available to science teachers. The room is used extensively for general computer teaching - including the use of MS DOS, still! - and for community courses. Clearly, the in-school facilities will need to be in place before teachers can be expected to make proper use of the training they may receive from the Gambian authorities or ourselves. As this issue is one that we are unable to influence we would obviously be grateful for any pressure that your own Department may be able to bring to bear in order to expedite the instatement of the promised facilities.

Gambia College

We spent a very profitable time with colleagues from Gambia College on our recent visit and were very impressed with their obvious enthusiasm for becoming involved with any initiative that would increase their own confidence and competence with the use of ICT. Given that Gambia College currently bears a measure of responsibility for on-going teacher education, post qualification, it would seem good sense to prioritise the training of staff involved with teacher training. Whilst we could see some fairly clear opportunities for possible intervention strategies on our part, it seemed clear from our discussions with Mohammed and Mr Njie at DoSE that this wasn't necessarily thought to be a priority – at least in the short term.

Certainly, the staff at the College (teaching and administrative) are a little way behind the Gambian "Champion Teachers" who have had some measure of training in the use of ICT already. However, given that the IMFUNDO project is about to get off the ground, it would seem sensible for someone to provide fairly extensive training for these staff in the not too distant future. The fact that the College have identified a room for conversion to a computer suite already means that they will be ready very shortly to make a start on this journey into the mysteries of ICT. Richard and myself are very happy to try to develop some means of supporting these staff in the College so that they can start to make use of the computing equipment which is already arriving on site. We were shown a very useful array of laptop computers and laboratory equipment which has been purchased using a grant from a visiting UNESCO dignitary. The Head of Science, Mr Jak and Head of Initial Teacher Training, Mrs Phillott are clearly hopeful that a start can be made shortly on training that will enable them to make use of this equipment within their teacher training sessions. The College have all of the teacher trainees back from school placement in June each year and they would also certainly appreciate being able to build in some ICT training for them during this period, in future years.

We were led to believe that DoSE may have some plans in mind for general computer training for the staff at Gambia College already in the pipeline but we did sense that there was some irritation at Ministry level that the College had failed to send representatives to a previous training event. Similar communication problems seemed at the heart of DoSE concerns over the existence of the equipment bought with the UNESCO grant. If this promised training does not materialise in the fairly near future, we would be happy to provide some input provided that this was an item that DFDI are prepared to support as part of our project remit.

Equipment & software needs

Mr Jallow and Mr Njie were very impressed with the range of support hardware and software that we demonstrated during our visit. These included:

- The video projector – to enable software packages to be demonstrated to a large class using only one computer
- Data logging kit and software – to counter the current lack of specialist chemicals, apparatus and technical support and encourage practical work where none is currently possible
- Simulation software – to provide an alternative and relatively low-cost means of demonstrating many practical aspects of science as well as supporting conceptual understanding in difficult topics
- Digital camera and image processing software – to support web-site construction and group work presentations

Since our own working budget does not include an element for the purchase of computer hardware or software for any of the schools or teachers out in the Gambia we did wonder whether DFID would like to consider the possibility of providing some funding towards the purchase of some of these items for some of the Upper Secondary schools in The Gambia. Failing that, could you advise us on how we might convince the World Bank of this additional hardware/software need – or would it be better to concentrate on convincing DoSE in Banjul of the need to apply for a release of funds from the World Bank towards this end?

IMFUNDO project

Unfortunately the 10 hour delay on our outbound flight made it impossible to make arrangements to meet with the IMFUNDO representative out in the Gambia on our last visit. We did discuss the project with Gambia College and DoSE and discovered that its purpose was primarily to support primary teacher trainees out on placement in some of the more remote regions of the country with distance learning materials in electronic form. Although it would obviously be useful for us to work as closely as possible with this group, we do have concerns that the primary school focus of this work is not supported by the other ICT based initiatives for training that are currently within the Masterplan.

Our feeling is that the primary school sector would certainly benefit from some of the ICT based solutions to teaching and learning which we are likely to be putting forward. Unfortunately, it appears that the Masterplan has made no provision for ICT equipment in primary or junior secondary schools – the very sectors into which the majority of Gambian teachers are currently directed. Although this situation is not one we have any control over, it does seem that the IMFUNDO project would have a greater chance of success if it were backed up by a determination to support the use of ICT within the primary and lower secondary sectors in The Gambia. We will happily meet with any of your IMFUNDO team should you think this helpful in the coming months.

Future steer

Given that we have already established close working links with the main agencies involved in initial teacher training and on-going teacher professional development in The Gambia, the project team at SHU firmly believe that it may be in the best interests of everyone concerned for us to continue to concentrate our efforts on the Gambia for the foreseeable future. We would seek to establish a sound base of skills and confidence amongst the teachers and teacher trainers of The Gambia, before moving on to any other country that you may have in mind. At that point we would expect to be in a position to report to DFID on the overall lessons learned in the Gambia and comment on the possible future strategies for your continued intervention and investment in other developing countries with which DFID currently have an interest.

The continuing delays in the timetable for the commissioning of the ICT suites in Upper Secondary schools mean that it will take longer than we originally planned to establish a self-supporting mechanism for on-going ICT-based continuing professional development and – thinking of the IMFUNDO project – initial teacher training in the Gambia. Additionally, until the ongoing and acute electricity supply and Internet access issues are fully resolved, it will be difficult for Gambian schools to exploit fully the array of opportunities which the arrival of ICT will afford them. It is vitally important that agencies such as DFID seek to help the Gambian authorities to resolve these issues as they could easily derail all of our efforts to encourage the take up and use of ICT within schools.

Depending on the outcome of our forthcoming planned training visit to The Gambia, it may be helpful for us to meet with you again on our return in order to review the on-going shape of the project and determine how best to update the overall terms of reference for our work. Of course, if this note raises issues which you would like to discuss with us before we travel out to the Gambia again, please let us know. We would be happy to arrange a demonstration for you of the additional hardware and software which we are recommending to the authorities in Banjul at your convenience, if this would help. Additionally, should you wish to visit a school in the UK which is making use of some of these teaching and learning strategies, we would be happy to set up such an experience for you.

Summary of forthcoming action points:

- Late July 2001 – 1st training visit to The Gambia – focusing on science based ICT input for the “Champion Teachers”
- August 2001 - Review outcomes of training and report back to DFID.
 - Discuss the need for and funding of additional hardware/software with DFID and other interested parties.
 - Assess the need for and plan the scope and purpose of future training intervention in The Gambia
- Autumn 2001 - Possible 2nd training visit to Gambia (dependant upon the timetable for commissioning of World Bank computer suites in schools and College)

Peter Wilson & Richard Needham
Centre for Science Education
Sheffield Hallam University

June 29th 2001

Appendix C

A report on Sheffield Hallam's
ICT training visit to The
Gambia – Autumn 2001

**Compiled by Richard Needham and Peter Wilson,
Centre for Science Education,
Sheffield Hallam University, UK**

January 2002

A report on Sheffield Hallam's ICT training visit to The Gambia

- Autumn 2001

Overview

A team from the Centre for Science Education at Sheffield Hallam University (SHU) are currently engaged in a DfID sponsored research study into ways of encouraging and supporting Science teachers in developing countries as they begin to make use of ICT in their teaching and teaching preparation and administration. Peter Wilson (SHU) visited a range of schools, colleges and governmental organisations in The Gambia in July 2000 in order to find out about the organisational structure and current needs of schools and the teacher training system in the Gambia. He was familiarised with the Gambian Ministry of Education's "masterplan" for education and its plans for the provision of new and extensive ICT resources for upper secondary schools in conjunction with a World Bank loan.

Following the visit, draft plans were established for a training visit to be conducted by a team from SHU in the following academic year. Unfortunately, there were continuing problems and delays in the procurement and commissioning of the promised ICT resources and uncertainties about the likely timescale for resolving these issues. In order to try to forge a way forward for the study that was not dependent upon the resolution of the outstanding ICT resource issues, the SHU team decided to make one further planning and preparation visit in July 2001 before committing themselves to a formal training visit. Richard Needham and Peter Wilson visited several schools and training institutions in July 2001 which already had some measure of ICT resourcing in place - including St Joseph's School, Marina School, Gambia College and GTTI. Plans were then drafted with ITHRD and DSTE for the SHU team to return in the early Autumn to conduct a training event with some experienced science teachers, the intention being to invite the Gambian "Champion Teachers" group to act as the focus for this visit.

The SHU team returned to Gambia in late September 2001 and conducted the planned workshops making use of the ICT facilities of the YMCA complex outside Banjul. The focus of the workshop was the use of ICT tools for science teaching. The teachers had little prior experience of many of these applications, but all were able to complete the workshop activities successfully. The participants were largely very positive about their experiences and are enthusiastic about the prospect of returning to their schools and making full use of the promised new computing resources, once they have been fully installed and commissioned in the designated upper secondary schools across the country.

The project team are anxious to help this group of teachers build upon the success of this training event and look forward to assisting with any follow up training which will be necessary. Experiences in the UK show the importance of embedding the introduction of ICT into the work of the department and school. With this end in mind it will be important to make the next phase of the SHU study school department based. We intend to draw upon the developing expertise of the teachers who attended this training event to lead their departments forward in exploiting the power of ICT in their teaching.

Issues such as how to incorporate these skills into the important initial teacher-training sector remain unresolved and the SHU team would value a steer from interested organisations on a positive way forward in this matter. The SHU team certainly believe that Gambia College will be a key partner if the next generation of Gambian teachers are to be able to make use of the valuable ICT resources which are likely to find their way into schools over the next few years.

Outcomes of the teachers' workshop

Attendance

Given that there has already been some investment of time and effort in the identification and basic ICT training of a cohort of Gambian science teachers,

we had hoped to concentrate our training efforts on this visit with this Group. However, it became clear that various organisational problems and a most unfortunate family bereavement made it impossible for the DoSE/Science & Technology Directorate (DSTE) to arrange for all of this group of teachers to be present on this occasion. As a further consequence of these problems, the workshop got off to a fairly slow start, with half of the course's participants unable to start until the second day. Amongst the delegates were one school principal and one teacher with no prior ICT experience who each attended for less than one day. Four Peace Corps volunteers accompanied teachers from their allotted schools, although two attended fairly sporadically. These teachers had good ICT skills but had a mathematics rather than science background. One further teacher attended afternoons only after the initial day. There were eighteen regular attendees, one of whom was a Peace Corps volunteer with a Science specialism. The teachers represented four of the six administrative regions of The Gambia. Three were from lower secondary schools and the remainder from senior secondary schools. Disappointingly, few of the ICT - literate delegates were Gambian by background. The majority were from nearby countries such as Ghana and Sierra Leone.

Key points on workshop attendance

- Better means of communicating with teachers and DoSE/DSTE before the workshop would have enabled the selection of a suitable group of Gambian teachers with the right skills and experience to benefit from this training
- Understaffing in DoSE/ makes organisation and communication within the Gambia difficult
- School principals are too busy with school commitments to be able to devote sufficient time to workshops of this nature during term time and whilst their schools are in session
- Teachers need to have some basic ICT skills already in order to benefit from training of this nature

- Workshops of this nature are not the most appropriate nor cost effective way of providing the basic skills training for those with little or no experience of using ICT
- Communication and coordination between ourselves and NGOs such as the Peace Corps would be beneficial before future workshops

Workshop location

The workshop was held at the YMCA, one of the few locations to be able to provide good facilities at reasonable cost. Travel was straightforward for people with access to cars as the facility was based outside the city, although some teachers had to travel hundreds of kilometres and stay with family nearby in order to attend.

The range and quality of computer facilities at the YMCA were adequate for the course and there were sufficient machines for a small increase in numbers to have been possible. Few machines had CD ROM drives but the network manager was happy to run the training software from the server. This did create network security problems later in the week that required some remedial treatment by the network manager. Serial ports and floppy drives did not work on all machines making the use of data logging hardware and the transfer of graphics files difficult. Some machines were using early versions of Windows and Office which again caused some compatibility problems. Internet access was acceptably reliable and fast considering there was only a single dial up connection serving the network.

Power disruptions were a minor nuisance but completely typical of the conditions under which most schools in the Gambia will have to operate with electrical and computer devices. Air conditioning problems did cause severe discomfort for participants in the latter part of the week. Catering services were generally adequate overall, even though the timing of meal breaks was

rather erratic. As a result many participants considered the food inadequate for their needs – they would have preferred to be served a more substantial snack with the morning break given that lunch was rarely served before 2.00pm. The trainers, however, found the meals more than adequate!

The late booking of the room caused some disruption to the YMCA teaching programme, although the YMCA seemed prepared to take this in their stride. We would like to extend our thanks to Poncelet for making it possible for us to use the YMCA's facilities on this occasion.

(Contact: Poncelet O. Ileleji (poncelet@yahoo.com, ymca@ymca.gm))

Key points on training venues

- It is important for trainers (or their contacts) to inspect locations and fix organisational details of the training well before the start of course, as information from some sources is not always accurate.
 - Relationships need to be built with location managers as they do not always understand our requirements from the information they have been given
 - Laptop computers are immune from external power cuts and are essential kit for presenters who hope to conduct ICT training.
 - Digital projectors are not currently available in the country's training establishments and this necessitates the difficult and hazardous transport of such equipment from the UK by trainers.
-

Equipment and resources taken

- Power lead and adapter with surge protector, as there are rarely spare electrical sockets in ICT rooms.

- Digital camera - added an extra dimension and note of professionalism to the production of presentations and documents. Producing lapel badges (or identity cards as they became known) incorporating a photograph was a good way of getting to know people and proved to be a very popular activity amongst participants.
- Four sets of data logging equipment plus apparatus needed for experiments. (There appears to be very little suitable science equipment available in training establishments, and certainly not in the ICT rooms themselves)
- Software and activities on CD ROM, floppy disks and hard drive of laptop computer in order to cater for as many different computer systems and configurations as possible. Improved Internet access within the Gambia may reduce the need for importing CDs and floppy discs of materials and software in the future.
- Multiple copies of printed materials as access to photocopiers is difficult and photocopying paper is in short supply
- Some general stationery (Paper, card, board pens, document and disc wallets and blank disks) as these items are in short supply. Teachers made sure that none of these items needed to be carried back to UK!
- A digital projector is almost an essential item for this type of workshop. In the Gambia it appears that teachers normally expect to teach 'from the front' and, in an in-service training context, expect to be taught similarly. Some teachers therefore found working individually or in small groups on tasks was a new challenge.
- Two laptop computers for presentation, to enable rapid file transfer from the digital camera, and for preparation of support materials

Key points on resources

- Resources to support teaching are not readily nor generally available in the Gambia

- The preferred teaching method is currently the lecture and, if ICT is to broaden the teaching approach used, teachers need to experience a much wider range of teaching methods using ICT.

Learning outcomes:

Programme:

Day 1 Putting graphics in Word documents; using PowerPoint

Day 2 Analysis of data in a spreadsheet; scientific simulations

Day 3 Data-logging; accessing information from the Internet

Day 4 Creating and using e-mail accounts; producing a teaching presentation

Day 5 Evaluation, presentation and closing ceremony

Analysis of pre and post course questionnaires show that for the teachers who were familiar with ICT before the course, word processing, Internet and e-mail were the most familiar applications. There had been little experience of spreadsheets, databases, presentation and web design software before the course. Teachers had not previously seen or used science-specific simulations or data-logging systems.

Teacher attitudes to ICT and its potential use in teaching were always very positive and optimistic. By the end of the week ICT was seen as a valuable strategy for:

- overcoming lack of scientific equipment and chemicals
- teaching disabled and disadvantaged learners
- providing clear and motivating learning experiences

and even...

- reducing the pressure on supplies of chalk!

All the teachers were confident users of word processing packages and e-mail by day 5, irrespective of their prior experience with ICT. Many had produced and presented quite skilfully designed PowerPoint presentations, and all were enthusiastic about the potential benefits of simulation software in their teaching. For some, using the data-logger was the highlight of the week as it provided opportunities for collecting scientific data with a minimum of laboratory equipment.

Discussion at the end of the course focussed on:

- The problems caused by the current lack of teaching and learning resources in secondary schools
- The extended wait for the arrival of up to date computing equipment in schools
- The problems of science teachers trying to book teaching time in computer suites used largely for general computing lessons with pupils or community groups
- The need to maintain the teachers' group identity through e-mail and further joint training opportunities
- The need to invite the same group of teachers to future workshops in order to build upon the success of this week's training. Additionally, this could be the means of providing a coherent and strong cohort of ICT-literate science teachers who will ultimately be able to share their own expertise and good practice with other members of their school's science departments
- The need to let DoSE and schools know what had been achieved during the week as far as individual teacher expertise with ICT was concerned

Key points on staff training

- The training of teachers must coincide with the provision of hardware in schools, as is happening in Senior Secondary schools in the Gambia. The training of teachers without providing them with immediate and on-going

access to ICT equipment in schools, and the provision of new equipment into schools without parallel training in its use, are both likely to be unsuccessful policies.

- Progress is rapid due to circumstances in the country – these include teachers' attitudes to ICT, lack of other teaching resources in schools and a commitment to ICT from DoSE
- There needs to be continuity and progression in training the teachers
- Some essential hardware and software needs to be obtained from abroad.
- Future training needs to link closely with the school curriculum (WAEC) and build upon the success of this set of workshops

Important note:

The current structure of the teaching and teacher training systems in the Gambia is such that Senior secondary schools may have as little as 20% of native Gambians on their staff. In circumstances like these, training courses like this one, which are attended in the main by non-Gambian teachers, may still have little long term impact on the quality of teaching in Gambian secondary schools. The non-Gambian teachers in these schools, even by their own admission, are always liable to leave the country within a few years once they have gained these invaluable and highly marketable ICT skills and especially if the political situation in their own country has improved in the meantime.

Gambian teachers, in contrast, tend to work mainly in the Primary and Basic Secondary Schools, few of which currently possess computer equipment. Neither are there formal plans at present to invest computing resources into these schools. The fact that there were no Gambian teachers from Senior Secondary Schools on this course is a measure of the challenge that faces the country to equip its schools with a cohort of ICT-confident Gambian teachers who are wholly committed to the country's future.

Ways forward

Summary

1. The development of distance learning materials for teachers in developing countries remains an achievable goal.
2. There is tremendous enthusiasm for exploiting ICT in teaching at all levels of the education system in the Gambia.
3. Problems of scarce resources and infrastructure remain but are slowly being overcome.
4. The first step towards using distance learning materials has been successfully achieved.

Training the Champion Teachers

There is a commitment to the use of ICT in teaching at all levels within the education system. Momentum needs to be maintained to ensure that the trained teachers become trainers in their own right. DoSE already has identified them as 'Champion teachers' but they need to acquire pedagogic as well as technical skills in the use of ICT. The next training event should be based in the science classroom, and should focus on how to achieve learning outcomes using a minimum of equipment. Circumstances dictate that currently, most teaching is by lecture from the front of the classroom. The introduction of ICT will allow more active and interactive group and individual teaching and learning to occur. For this reason we recommend that the next round of training be school based and involve several teachers from the same department. Teachers will need the support of their colleagues if they are to introduce new approaches to their teaching.

Equipment required:

A '*science crate*' should be provided for each secondary school containing:

- A laptop computer with Microsoft Office, modem and CD ROM drive fitted
- digital projector
- data logger and basic range of probes
- simulation software
- extension lead with surge protector
- a printer

Additionally, it will be important to provide each school with access to a reliable and affordable ISP account. It is estimated that each '*science crate*' would cost £5000 at current UK prices.

Ideally, there should be one *science crate* in each school, and one available in each regional education office. All science crates should contain identical equipment to allow ease of learning and ease of repair. A technician in the Science and Technology Directorate should manage and service them. The technician may need to be a volunteer from an NGO initially since there is currently very little "home grown" technical support available in the country. The volunteer technician should endeavour to train at least one other member of staff to take over the role in their absence or following their departure.

Benefits of a *science crate* system:

- No specialist room or a.c. (air conditioning) required
- A wide range of teaching activities would be possible
- Relatively low cost – although it is accepted that this cost may not be covered by current World Bank loan provisions
- Flexible use possible within a school across different subject departments.

- Equipment could be 'pooled' for training events involving larger groups of pupils or teachers
- Teachers who prefer to use a more formal or didactic teaching style would not find the use of the equipment as threatening as using an ICT suite

Disadvantages

- Security issues – problems and cost of protecting equipment against theft and damage
- Limited opportunities for direct pupil use – system lends itself more to demonstration activities

Initial Teacher Training

All new primary and BSS teachers are trained at Gambia College. Senior college staff are keen to introduce their students to ICT at the earliest opportunity but equipment and expertise are in short supply. There are two ways that this project could assist the college:

- Provide training for staff in the use of ICT for administration (mainly communication) and as a teaching tool.
- Support efforts to put training materials online. Currently, paper based teaching materials are posted to students on primary school placement each term. This development would link naturally with the DfID INFUNDO project

Continuing Professional Development of teachers is also organised by the College. It seems clear that therefore Gambia College could have a central role in shaping the effectiveness of the teaching profession in the country in the longer term.

Summary of our proposals for the next phase

1. Research the effectiveness of using "*science crates*" to introduce ICT into science teaching in a small number of schools, working with some of the teachers who attended the September workshop. The purpose of using the crates is to familiarise a school with a range of different software tools and teaching approaches, so that they are then in a position to develop skills and resources using a distance learning approach.

Clearly, this plan will first require the identification and provision of an additional funding stream which is not covered by the current DfID/SHU or World Bank / World Links funding arrangements

2. Develop and deliver a training programme for Gambia College, in association with VSO, DfID/INFUNDO and World Links, to introduce the use of ICT into their teaching programmes, which may then lead the production of effective distance learning resources for their placement students.

Potential and actual partners for developing the use of ICT in School

Science in the Gambia

NGOs

Many organisations are currently supporting the use of ICT in teaching in the Gambia.

DfID INFUNDO project

Assisting the professional development of primary teachers in remote areas of the Gambia through the use of the Internet

Programme Officer: Maureen Morrison (mmdfid@qanet.gm)

DfID Maths and Science Distance Learning

Sheffield Hallam University are researching the development of distance learning tools for teaching and learning science in developing countries.

World Links for Development (WorLD)

An offshoot of the World Bank that provided the money for purchasing a computer network for each SSS. World Links is run by Oumar Dioup in West Africa. In Senegal and Mauritania projects have been successfully set up that help schools utilise the Internet for teaching. Progress in the Gambia so far has been a little slower and less far-reaching. The Gambian authorities have provided funding and trainers for two "Champion Teachers" workshops and a Policy Makers' workshop. Oumar is keen to co-ordinate WorLD with this DfID project.

W Africa Co-ordinator: Oumar Cherif Dioup (oumar@world-links.org)

Peace Corps

Young American volunteers, with good IT skills, are attached to individual schools for a two-year period. They support teachers by providing technical rather than pedagogic or educational expertise, running workshops for pupils and teachers. They appear to be making a major contribution to ICT capability in the education sector.

Associate Director, Education: Ya Mai Secka-Jack (ysecka-jack@peacecorps.gm)

VSO

British volunteers are working as teachers and advisers at all levels in the education service. One adviser is linked to Gambia College as a network consultant, although the College network has not yet been commissioned. Education program officer: Sarah Tyler (sarah.tyler@vsooint.org)

Centre for Educational Technology (CET)

Jodi Lis has taught in Gambian schools for a number of years as an ICT specialist. She runs a charity that supports the development of educational technology in the country. Her assistance in running the workshop was invaluable. Jodi is well placed to liaise with DoSE and schools, and to assist in the organisation of future training events.

Chairperson: Jodi Lis (jlis@gamtel.gm)

Government Offices

Department of State for Education DoSE

Amongst other responsibilities, to decide on the content of the science and maths curriculum, and how it should be taught.

Information Technology and Human Resources Department ITHRD

Responsible for the recruitment and training of all DoSE staff. Responsible for Information Technology within the Department. The department in this context includes all schools.

Director: Mohammed Jallow

Directorate of Science and Technology Education DSTE

Purpose: to provide professional advice to the Permanent Secretary and DoSE on all matters relating to science and technology education; supervise the development of the science and technology education policy and strategic plan.

Director: Mr Ebrima Kah

Computer Literacy Program Co-ordinator: Mr Momodou Njie

Gambia College

Responsible for initial teacher training of basic cycle teachers in all subjects (although GTTI contribute to training in IT, technology and craft subjects)

Contact: Mrs Yvette Phillot

University of the Gambia

First enrolment December 2000

Registrar: Mr E J Akpan

Many organisations are promoting the use of ICT in Gambian schools. As equipment is installed and commissioned in schools these initiatives will hopefully begin to have an effect on teaching and learning. The various different initiatives could benefit from a more co-ordinated approach generally. Currently ITHRD and DSTE do not appear to have the staffing resources to undertake this role completely by themselves.

Appendix D - Programme for 2nd science teacher ICT training workshop in The Gambia (November 2002)

Basic skills	Create a questionnaire in Word to find the opinions of workshop participants on the role of ICT in the classroom	Use Excel to analyse the results of the questionnaire in terms of percentage responses to each question	Produce a four page PowerPoint presentation to inform the group of your findings	Create a yahoo E mail account if necessary, and use it to send and receive an attachment (photo?)
	Create an Identity badge with picture, name and school	Create appropriate graphs to illustrate the questionnaire outcomes	Take a photograph with a digital camera, import it and insert into a Word document	Use the internet to access a science simulation and information about DNA
Intermediate skills	Write pupil instructions for carrying out a survey on variation in the class	Analysis of results using the excel template provided	PowerPoint of explanation of variation, utilising images from the internet	Accessing images from Google
	Letter formatting, including mail merge	Excel markbook to monitor pupil progress	Photo sequencing to describe how to set up apparatus	Using a CD ROM simulation as a source of images for presentations
Expert	Use a simulation to model radioactivity (MSS CD ROM)	Carry out an investigation into trajectories, using software to analyse results	Use a light gate to investigate the acceleration of a model car on a slope	Use of revision software on the BBC bitesize website
	Simulation of light mixing experiment (MSS CD ROM)	Create a model electrical circuit using excel	Data logging of weather sequence	Look at science websites, eg physics lab. Download software eg CHIME and ISIS draw
	Look at: Science investigation software	Croc clips physics software	Analysing data logging files	

Comments from 2nd training workshop

Pre questionnaire: What do I want to get out of this training?

- *Build up confidence in all areas* x1
- *Software specific skills* x 5
- *Aid to teaching* x 3
- *Teach pupils computer competences* x1

Post questionnaire:

What have you achieved?

- Software specific skills x 8
- Gained confidence x 3
- Reassured that still a role for the teacher
- Use computers efficiently in science lessons
- Realised that it is much easier to teach science using ICT

What support will you need in schools?

- Equipment x 5
- Regular access via reduced work load
- Access to hardware and internet x 6
- Personal CPD x 2

How easy will it be to get access?

- Need to download software x 2
- Moderately easy x 2
- Very difficult
- Difficult x 2– outdated machines
- Not easy because of workload and no access to ICT suite x 2
- Easy

What ways would you like to use IT in future?

- Simulations and PowerPoint x 3
- Improve skills
- Teach x 3– assignments and interpreting work, creating models
- Teach science where there is a lack of equipment
- Want to use ICT in all aspects of teaching my science subjects
- To communicate, teach and explore
- Personal research – teaching, leisure and business

Gambia Workshop (November 2002)

Questionnaire analysis

Pre - Workshop

Question	Topic	No 1	No 2	No 3	No 4	No 5	No 6	No 7	No 8	No 9	No 10	mean
1	system	4	5	3	4	5	5	5	5	4	4	4.4
2	files	4	5	3	3	4	4	5	5	3	5	4.1
3	format	4	5	3	3	4	4	5	5	4	5	4.2
4	tables	3	5	3	2	3	5	5	5	3	5	3.9
5	images	3	5	2	1	3	5	5	4	4	5	3.7
6	spreadsheet	3	4	2	3	4	2	5	5	3	5	3.6
7	formulae	3	3	2	2	4	1	5	4	3	5	3.2
8	charts	3	4	2	1	2	2	4	4	3	5	3
9	simulations	2	3	2	1	4	1	4	3	1	3	2.4
10	logger	3	3	2	1	3	1	4	3	1	3	2.4
11	e mail	5	5	5	5	5	5	5	5	2	5	4.7
12	browser	4	5	3	3	2	4	5	5	1	5	3.7
13	search	5	5	3	2	4	5	5	5	1	4	3.9
14	database	3	2	1	1	2	1	4	5	4	5	2.8
		3.5	4.2	2.6	2.3	3.5	3.2	4.7	4.5	2.6	4.6	3.6

Questionnaire analysis

Post-workshop

Question	Topic	No 1	No 2	No 3	No 4	No 5	No 6	No 7	No 8	No 9	No 10	mean
1	system	5	5	5	5	5	5	5	5	5	5	5
2	files	4	4	5	5	4	5	5	5	5	5	4.7
3	format	5	4	5	5	5	5	5	5	5	5	4.9
4	tables	4	4	4	5	4	5	5	4	5	5	4.5
5	images	4	3	3	5	4	4	5	4	5	5	4.2
6	spreadsheet	5	4	3	5	4	5	5	4	4	5	4.4
7	formulae	5	4	4	5	4	5	5	4	3	5	4.4
8	charts	4	4	3	5	4	4	5	4	4	5	4.2
9	simulations	5	5	3	5	4	4	4	4	4	5	4.3
10	logger	5	3	3	5	3	3	4	3	2	4	3.5
11	e mail	5	4	5	5	3	5	5	5	5	5	4.7
12	browser	4	4	4	5	3	3	5	5	5	5	4.3
13	search	5	4	3	5	3	3	5	4	5	4	4.1
14	powerpoint	5	3	4	5	4	4	4	4	5	5	4.3
15	advantages	5	3	4	5	4	4	5	5	5	5	4.5
16	prepared	5	4	3	5	4	4	5	5	5	5	4.5
		4.7	3.9	3.8	5.0	3.9	4.3	4.8	4.4	4.5	4.9	4.4

Item	pre-score	post-score
overall mean	3.6	4.4
system	4.4	5
files	4.1	4.7
format	4.2	4.9
tables	3.9	4.5
images	3.7	4.2
spreadsheet	3.6	4.4
formulae	3.2	4.4
charts	3	4.2
simulations	2.4	4.3
logger	2.4	3.5
e mail	4.7	4.7
browser	3.7	4.3
search	3.9	4.1
database	2.8	
powerpoint		4.3
advantages		4.5
prepared		4.5

Appendix E

DIRECTORATE SCIENCE AND TECHNOLOGY EDUCATION **DEPARTMENT OF STATE FOR EDUCATION**

The Gambian Government, through the Director of State for Education (DoSE), established the new Directorate of Science and Technology Education (DSTE) as a result of its concern over poor examination results in Science and Maths, and also government's commitment to promoting Science and Technology Education which would help transform The Gambia into an industrial manufacturing nation as envisaged in the Vision 2020.

Since its establishment in February 2001, DSTE has been identifying issues, developing policy and co-ordinating activities for improving the curriculum, teaching methods, and the quality of students and teachers of Science and Technology.

A notable achievement in this regard has been the identification of the main problems and issues hindering Science and Technology Education, and the development of an interim strategic plan to address them.

The core staff of the new Directorate has been recently strengthened by posting of qualified Gambian teachers recently trained abroad on ICT, and these have been working to implement the interim strategic plan for Science and Technology Education.

As a result of the work carried out during the first year since the formation of the Directorate, a detailed Work Plan has now been developed for 2002/2003.

A major focus of the Work Plan is the "Science and Technology for All" programme which is seen as a key element of the industrial development of The Gambia. Here, DSTE will be the moving force behind the creation of a National Advisory Body on Science and Technology development, whilst also concentrating at grass roots level on the popularisation of specialist Science subjects and ensuring that all students take a course in relevant General Science throughout their time in school.

Through the Work Plan, teaching methods are being improved through better in-service and pre-service training; the current textbook policy is being reviewed; access to more laboratory facilities and equipment is being vigorously followed; and initiatives to improve the elements of English and Mathematics essential for learning Science are being developed in co-operation with the schools.

Another major achievement has been the successful introduction of Computer Literacy Program in the schools, especially the Senior Secondary Schools. Seventeen Senior Secondary Schools are part of the pilot phase. Many of them started their computer literacy lessons in September 2001, having incorporated them in the regular school timetable/curriculum.

To support this program, DoSE recently distributed to Senior Secondary School, about 200 computers (donated by World Links, an international NGO). During the course of three major national workshops, 40-60 school personnel (teachers and school principals) have been given initial training on computers and ICT-related topics/skills. Some of them are currently training other teachers in their schools.

Computer labs have been built or refurbished in most of the Senior Secondary Schools in the pilot project and some are currently in use. By the end of the academic year all the pilot schools will be using their new labs, and will each have received an additional 25 – 50 new Pentium III computers with their peripherals.

During this same period, the trial syllabus of the computer literacy program, which is being reviewed, would have been modified to reflect a more modern approach to ICT education.

It is envisaged that by September 2002, new computer /ICT courses will begin at Gambia College and the University of The Gambia which would enable all pre-service teachers to be computer/ICT literate before they graduate. By the same token more in-services courses will be available at the school level to train teachers already in the system.

A recent survey by DSTE (Computers in Schools) has revealed that although the number of schools with Internet facilities has increased to 8 (out of 14 Senior Secondary School surveyed), most (over 50%) of the schools are still not connected. However, it is expected that the situation will improve by increased participation of Gamtel, and other members of the private sector and NGO community.

A notable problem of the introduction of computer literacy or ICT has been that of power supply. Most of the Senior Secondary Schools in the program have some form of power supply but this has not been satisfactory in most cases either due to lack of back-up, or due to power cuts.

There is, however, good indication that some of these power problems will alleviate with the advent of the rural electrification project of government. In the interim DoSE is working in partnership with school boards, school proprietors, and potential donors, NGOs (e.g. Muslim Hands) to alleviate the power problems in those schools where power is the most critical factor hindering the start of the computer/ ICT program.

DSTE has recently issued a Draft Policy for Science Education and will shortly issue a Draft Policy for Technology Education. These documents will be refined and will form the focal point of Directorate activities over the next 5 years.

Hence it is reasonable to conclude that by the year 2006 DoSE, through Directorate Science and Technology education and its partners would have been able to ensure that:

- 1. ICT will be taught to all Upper Basic and Senior Secondary Schools and made particularly accessible to all students on the basis of gender equity and principles of "Education for All"**
- 2. All Upper Basic and Senior Secondary Schools have computers with Internet connectivity**
- 3. Computers are used for pedagogical purposes especially in teaching and learning of Science and Technology**
- 4. There are adequate personnel trained in hardware and software installation, maintenance and repair**
- 5. All Upper Basic and Senior Secondary Schools have well equipped Science Labs i.e. with at least the minimum provisions required for effective learning and assessment/examinations**
- 6. There are adequate, well trained Science teachers and Lab Assistants and Technicians**
- 7. There are adequate, relevant and affordable Science textbooks in all schools**
- 8. There is a reliable and efficient power supply to all schools**
- 9. There are an increased number of Science specialist students especially among girls and women**
- 10. There is remarkable improvement in the teaching of Science**
- 11. All Schools offer Science in the context of UNESCO's Science and Technology for All**
- 12. There is an improvement in the external examination performance in Science of all students especially girls and women**
- 13. There is an improvement in the elements of English and Mathematics essential for the learning of Science and Technology**
- 14. There is adequate funding for building capacity of Science and Technology Teachers and Educators**

- 15. There is stronger partnership with relevant bodies both locally and internationally in the solution of problems relating to equipment, power supply and capacity development for Science and Technology Education**
- 16. The continuous assessment system (CAS) is used in Science and Technology as well as other subjects**
- 17. The spirit of entrepreneurship and self-employment is encouraged through Science and Technology as well as other subject curricula.**
- 18. Technology is available in SSS schools as an examined subject in the form of Design and Technology**
- 19. Technology is an integral part of the teaching of Science in the context of UNESCO's Science and Technology for All**
- 20. The Science and Technology for All programme is extended to the Community with SSS offering a Community Science and Technology Programme**
- 21. The environmental science curriculum is reviewed and an environmentally relevant curriculum is implemented in all schools**

APPENDIX F - DSTE REVISED WORKPLAN 2002 - 2003

	FOCUS	Deadline	Collaboration
	S & T workshop for Principals and Heads of Science	Feb 2002	
	Final report of Computers in Schools	Feb 2002	
	The teaching methodology improvement programme		
1	Assessment of pre-service teaching methodology training at Gambia College and UNIGAM	July 2002	PPARBD, GC/UNIGAM, SQAD
2	Assessment of in-service training methodology at INSETT (Gambia College) and at UNIGAM.	July 2002	“
3	Assessment of teaching methodology in schools	July 2002	“
4	Review or development of a teaching methodology syllabus for pre-service and in-service teacher training.	Dec 2002	“
5	Training workshop on effectiveness monitoring in Science and Technology teacher training	Dec 2002	“
6	Start implementation of teaching methodology training at G/C UNIGAM and other locations	January 2003	“
7	Start ongoing effectiveness monitoring by SQAD etc	January 2003	“
	Laboratory Facilities and Equipment Provision Programme		
1	Assessment of current status of Upper Basic and SS School laboratories, equipment and supplies	Dec/Jan 2001/2002	REOs, SQAD, WAEC
2	Assessment of the minimum laboratory equipment, material and supplies required for UBS and SSS	Feb 2002	CREDU, WAEC
3	Assessment of Science and technology in LBS	March 2002	Bed, REOs
4	Development of Interim Strategy to ensure access to laboratory facilities, equipment and supplies in UB and SS schools	Mar/Apr 2002	GAMCOP, STWG
5	Research possible sources of funding, donation or other methods of equipping schools (laboratory equipment and supplies)	April 2002 ((ongoing)	PCU Internet
6	Approaching suitable donors or partners for assistance	April 2002 (ongoing)	SMT, PCU
7	Development of Policy for ensuring that all schools are equipped with Science laboratories, equipment and supplies	ongoing	SMT, PCU and external donors, NGOs.
	The Textbook Programme		
1	Survey of quantities and types of textbooks used in UB and SS schools for each Science subject. Perceived relevance of the books as well as methods of access and supply to students	Jan-Feb 2002	Schools, GAMCOP, PPARD, WAEC
2	Assessment/analysis of the popular science textbooks identified in the survey (with regard to coverage of the prescribed curriculum	Feb 2002	STWG, GAMCOP, GC, BPMRU, CREDU
3	Research suitable titles not being currently used	Mar 2002	WAEC and Internet
4	Develop new recommended book lists for each Science subject and each level/type of school	May 2002	WAEC, GC, CREDU, GAMCOP, UNIGAM

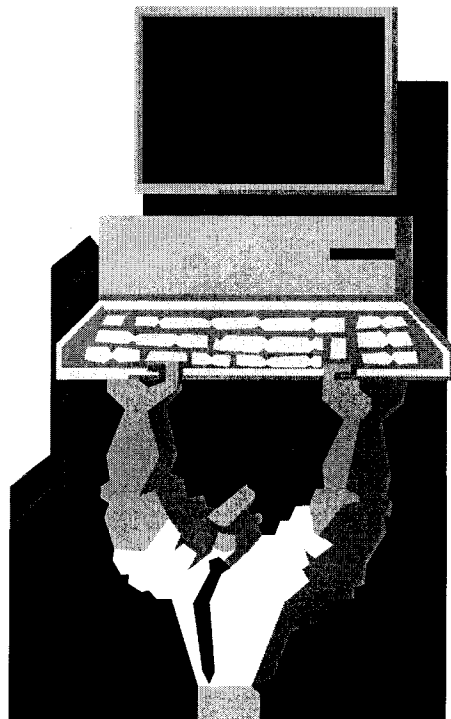
5	Development new policy for acquisition, supply and use of science textbooks in UB and SS schools	ongoing	
6	Approach donors to understand their possible support for providing grants and loans to access some of the textbooks	July 2002	SMT/PCU
	“Science and Technology for All” Programme		
1a	Submission of draft policy on Science education		
1b	Assessment of the status of technology education in schools and colleges		TVET, GTI, WAEC, GAMCOP, CJSS
2	Concept paper on Science and Technology Education for All (including section on Technology Education)		
3	National Seminar on Science and Technology for National Development		
4	Beginning of Science and Technology for All sensitisation programme		
5	Review of curriculum materials and methodology in the context of Science and Technology education for all.		CREDU
6	Workshop on teaching and learning methodology for Science and Technology for All		
7	Submission of draft technology education policy		
8	Promotion/popularisation of science and technology education for all:		
8.1	Development and launching of the Junior Scientist Awards (JSA)		ASAAT, GAMCOP, CJSS
8.2	Conduct and monitoring of JSA		
8.3	JSA Ceremony		
8.4	2 nd Annual Inter SSS Presidential Competition		
8.6	Science and technology Week (Cross Curricular Day, Science” taster” sessions for Year 9 students etc)		
	The Computer Literacy Program		
1	Maintenance Policy developed and implemented	Jan 2002	
2	School ICT policies developed	Feb 2002	
3	Completion of phase 2 laboratory refurbishment	Mar 2002	
4	Review of computer literacy syllabus to incorporate ICT	Apr 2002	
5	Completion of phase 3 laboratory refurbishment	May 2002	
6	Selection of pilot schools for revised ICT syllabus	May 2002	
7	Workshop for ICT teachers in pilot schools introducing changes to existing computer literacy syllabus	July 2002	
8	Delivery of phase 3 computers	August 2002	
9	Pilot schools begin to deliver new ICT syllabus	Sept 2002	
10	Update review of ICT in SSS	Oct 2002	
11	Pilot UBS selected for delivery of ICT syllabus	Oct 2002	
12	Workshop for teachers from UBS pilot	Dec 2002	
13	UBS pilot starts	Jan 2003	
	ICT in Science Programme		
1	Skills criteria developed for use of ICT in Science	Mar 2002	
2	Science software cross referenced to science syllabi	Jun 2002	
3	ICT skills criteria for science teachers developed for pre-service training	Aug 2002	Gambia College
4	Workshop for Science teachers on using ICT in Science	Sept 2002	

	effectively		
5	Science software distributed to selected schools	Sept 2002	
6	Formal ICT skills training incorporated into pre-service training	Sept 2002	Gambia College
	DSTE Communications and Information Strategy		
1	Meetings of Science Teachers Working Group and Computer Working Group to continue on a regular basis	Ongoing	
2	Maintenance of DOSE website	Ongoing	
3	Development of School websites:		
3.1	Development of a template that could be used	Jun 2002	
3.2	Negotiate web space (eg. with Quantum)	Jul 2002	
3.3	Develop policy re planning/sharing learning materials for science and technology on the web	Nov 2002	
3.4	Workshop for Principals/stakeholders introducing policy	Nov 2002	
3.5	Workshop for school ICT managers on website dev/management	Dec 2002	
	Girls into Science and Technology Programme		
1	Programme meetings	ongoing	GEU, FAWE
2	Preparation for girls' summer programme		
3	Girls' Summer Programme		
	The Environmental Education Programme		
1	Appraisal of the EE components of the curriculum in all levels of the schooling system and assessment of the need for modification of the existing subject curriculum		GC, CREDU, DSTE
2	Development and implementation of a strategy for integration of TIPE II materials into the basic schools curriculum		As above
3	Review and modification of secondary school and teacher training curriculum to cater for environmental concepts and methods	See Science and Tech for All	As above
4	Pilot/trial of new curriculum in teacher training college and some senior secondary schools	See Science and Tech for all	
5	Evaluation of new curriculum in pilot schools	As above	PPARBD
6	Implementation of new environmentally relevant curriculum in all schools and Teachers' Training College	As above	CREDU, DSTE

DIRECTORATE OF SCIENCE AND TECHNOLOGY EDUCATION

THE USE OF ICT IN SCIENCE

**GUIDE TO TEACHER COMPETENCIES,
UNDERSTANDINGS AND ASSOCIATED
ASSESSMENT/CERTIFICATION**



THE USE OF ICT IN SCIENCE

It is assumed that prior to addressing the specific usage of ICT in Science teaching, teachers will already have acquired basic computer literacy skills enabling them to use the keyboard and mouse, open software packages in Windows, access the internet and use Microsoft Office packages at the most basic level. Suggested generic skills that should be acquired are listed below:

Basic Computer skills:

- Turning on the computer and associated peripherals.
- Use of mouse
- Use of keyboard although not necessarily touch typing)
- Opening a computer software package through Windows.
- Creating a file in a computer package.
- Saving the file on the hard drive and on a floppy disk
- Making changes to the file and re-saving as appropriate.
- Deleting a file.
- Opening and using a CD-Rom

Word for Windows skills:

- Creating a document
- Changing fonts
- Changing size of font
- Editing a document – deleting, moving and inserting text
- Copying and pasting text
- Inserting pictures from Clipart
- Inserting pictures from file.

Excel skills:

- Creating a new spreadsheet and saving it
- Inserting and deleting data
- Creation of formulae
- Producing charts
- Use of Excel as a simple database for sorting and selecting data

Powerpoint skills:

- Creation of a presentation using a template
- Inserting and deleting slides
- Insertion of pictures from clipart or file

General Office skills:

- Inserting data from one application to another.

Internet skills:

- Creating an email account and sending an email.
- Searching for information
- Saving information from the Internet
- Saving pictures from the Internet for future use.

The following outlines competencies and understandings that teachers should acquire to enable the effective usage of ICT facilities and resources in Science.

ASSESSMENT:

Teachers should produce a portfolio of evidence showing how they have met the following competences and understandings. On completion of the portfolio and successful assessment a certificate will be issued.

Note: Many of these skills are not specific to Science but are generic in their application to any specific subject area.

A: Teachers' knowledge and understanding of, and competence with ICT and its usage in Science:

Teachers should be able to:

A1: Evaluate a range of ICT technologies and content so that they can justify the selection of materials and ICT usage in relation to aspects of planning, teaching, assessment, class management and personal professional development.

A2: Use correct ICT terminology when explaining science related processes to students.

A3: Utilise ICT tools supporting pedagogy in science. (This likely to mean basic general rather than specialist competencies in the software utilised in their subject area.)

A4: Understand the basic characteristics of information including principles of accuracy, validity, plausibility, reliability and bias, storage of information, linking of information via applications and remote sharing of information.

A5: Use ICT to find things out

A6: Use ICT to try things out, make things happen and understand how they happen.

A7: Use ICT to communicate and share ideas. This could be with students and colleagues within the school or between schools.

A8: Utilise ICT to make the preparation and presentation of their teaching more effective

In that context teachers should be able to use aspects of ICT suitable for the intended audience including appropriate forms of presentation to meet teaching objectives.

A9: Teachers should be familiar with the ICT capabilities of their students and should know which ICT procedures and resources are relevant to the age group they are teaching and the subject area. This will include knowledge of ICT specific to science and any relevant specialist courseware.

In the context of usage of ICT in their subject area, teachers should be aware of relevant legal and health and safety considerations.

B: ICT competencies and understandings for effective teaching and assessment in Science

B1: Teachers should know when the use of ICT is beneficial to achieve teaching objectives and when to use ICT would be inappropriate.

B2: Teachers should be aware of the need to avoid using ICT for simple or routine tasks that could be accomplished by other means.

B3: Teachers should know how to organise classroom ICT resources effectively to meet learning objectives.

B4: Teachers should be able to identify in their planning where ICT is to be used.

B5: Teachers should understand how they could assess teaching and learning in their subject when ICT is being used and appropriate assessment methods should be developed.

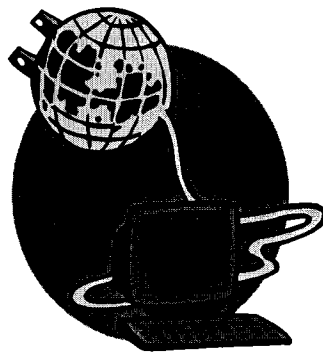
SUGGESTIONS FOR THE USE OF ICT IN SCIENCE

- Use of Excel spreadsheets for data analysis/charting
- Use of specialist data logging software.
- Use of Word/Publisher to produce classroom displays/teacher materials.
- Use of Powerpoint for presentations.

- Use of a range of Internet resources to
 - Replace experiments difficult/dangerous to carry out in the classroom.
 - Enhance experiments
 - Undertake background research
 - Experience otherwise inaccessible materials
 - Use interactive website resources for teaching/learning eg. Games
 - Use examination revision sites for student self study
 - Use email to communicate with other schools/share results of experiments
 - Use of specialist science CD-Roms and other software

Appendix H

**A SYLLABUS
FOR
INFORMATION AND
COMMUNICATIONS
TECHNOLOGY
LITERACY
IN
SENIOR SECONDARY
SCHOOLS**



A SYLLABUS FOR ICT LITERACY

DRAFT

AIMS

The aims of this syllabus are that students should develop competencies in the following area:

- Searching for and selecting information**
- Developing information**
- Presenting information**

Students should also develop an understanding of the following in the context of the ICT use:

- The benefits and disadvantages of using ICT**
- Legal aspects of ICT usage**
- ICT security issues**
- Health and safety issues**

METHODOLOGY

These competencies will be developed in a problem solving context and students will acquire the necessary software manipulation skills to solve the problems set.

ASSESSMENT

Assessment will be through a portfolio of evidence.

WHAT STUDENTS MUST BE ABLE TO DO

1. Searching for and selecting information:

Students must be able to

1.1 Identify suitable sources of information (for example hand-written documents, material to be scanned, files on disks, CD-ROMS, databases, the Internet)

1.2 Search for information using multiple criteria (for example, operators such as 'and', 'greater than' and tools such as search engines)

1.3 Interpret information and decide what is relevant to the purpose (for example, to respond to an enquiry, write a project report, help solve a problem, design or make something).

2. Developing information

2.1 enter and bring together information (for example, copy and paste, or import text, images, numbers)

2.2 use formats that help development (for example, using tabs rather than spaces to align text, using tables or frames)

2.3 explore information as needed for the purpose (for example, follow lines of enquiry, explore the effects of changing information in a spreadsheet model to make and test predictions)

2.4 development information in the form of text, images and numbers (for example, link information, organise information under headings, restructure tables, generate charts and graphs from data, select records or fields and prepare reports from a database)

2.5 derive new information (for example, compare information from different sources to reach a conclusion, use formulae to calculate information such as a total or average.)

3. Presenting information

3.1 select and use appropriate layouts for presenting combined information (eg. Document structures such as margins, columns and headings, borders for images and text, record structures, tables, spreadsheets)

3.2 present information in a consistent way (eg. Paragraph layouts, sizes and styles of images and text, alignments, fonts)

3.3 develop the presentation to suit the purpose and types of information including text, images and numbers (eg highlight information to improve its impact, refine layouts,, make sure the presentation of the work is suitable for the needs of the audience).

3.4 ensure the work is accurate and clear (for example, through proof reading, using a spell-checker, seek the views of others) and is saved

C Tacchi

Directorate of Science and Technology Education

Department of State for Education

Dste2002@hotmail.com

appropriately eg. Use suitable folders/directories and file names, avoid loss)

4. Background issues

Understanding the benefits and disadvantages of using ICT

Understanding Legal aspects of ICT usage

For example, copyright and confidentiality issues.

Understanding ICT security issues

For example, how to minimise risks from viruses

Understanding health and safety issues

For example, how to work safely and minimise health risks.

GUIDE FOR TEACHERS

Any project scenario can be used to deliver a course based on the above competencies and confident staff may wish to develop projects that are especially suitable for their students or their local area.

However, the projects set out below provide a framework that can be followed if required.

Each project is intended to last approximately 8 weeks.

If there are more students than available computers it is possible for students to work in pairs but it is important that teachers monitor who is doing the work and that students are able to identify their own contribution to the project.

PROJECT ASSESSMENT

A template for project assessment is provided as an appendix to this syllabus. All assessment sheets and associated work should be kept in a portfolio for each student for final certification of competencies at the end of the course.

THE ABC BOOK PROJECT

Task:

Students are required to produce a book for children to use to learn the ABC. Each page should be illustrated with pictures and words illustrating each letter of the English alphabet.

References: 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4 (copyright and security issues).

CURRICULUM LINKS: English

ACTIVITIES:

Week 1: Introduction to project. Students access sources of information for pictures to use in the project. Sources could be Clipart, CD-Roms, books with pictures for scanning, the Internet and drawing packages such as paint to produce their own pictures.

Skills to demonstrate to students:

Logging on to the computer. Finding Word and starting a new document. Using Clipart, copying a picture from the Internet, using Paint, using a CD-rom (as appropriate). Discussion of copyright and security when using the Internet.

Homework: Students produce a plan for their project and a design on paper of the layout of the front cover.

Week 2: Students complete front cover on the computer.

Skills to demonstrate to students:

Changing size of text, changing font, changing colour, pasting a picture into Word.

Homework: Students design a template on paper for the layout of a page in the book. They write 2 paragraphs about why their design is suitable for young children.

Weeks 3 – 7: Students work on production of the book.

Homework: Each week students should write in their exercise books a list of new skills learnt.

Week 8: Completed books put on display. Discuss with students the advantages of using ICT to produce the book. Ask the Principal to judge a competition for the best book and give a small prize.

THE PICNIC PROJECT

TASK

The Principal of your school has agreed that you can organise a class picnic. Your task is to work out how much each person has to contribute to enable you to buy food and drink and pay for transport to the picnic location. You must first decide on a location near to your school. You will need to find a method of keeping a record of who has paid their share for the picnic. You should also study what will happen to your finances if the price of goods goes up before the picnic date ; will you have enough money? You will also need to publicise the picnic and produce a letter explaining what is going to happen to parents.

CURRICULUM LINKS: Mathematics, Commerce, Art, English, Home Science

REFERENCES: 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3, 3.4, 4 (Benefits and disadvantages of using ICT)

ACTIVITIES

Week 1: Introduction to the project. Students decide on picnic location via class brainstorming or via individual research. For the purpose of this project all students do not need to decide on the same location.

Skills to demonstrate to students:

Describe a spreadsheet and its purposes. Show students how to get into Excel and demonstrate simply how Excel can be used.

Homework: Students design the layout for a simple spreadsheet to calculate the total costs for the picnic and work out individual

contributions. Note: At this stage students may not know actual costs they are only designing a layout with headings and an outline of the formulae involved.

Week 2: Students experiment with Excel and begin to create in Excel the spreadsheet designed for homework.

Skills to demonstrate to students:

Simple formulae in Excel. How to customise the spreadsheet with coloured text/backgrounds.

Homework: Students write up new skills learnt in books.

Weeks 3 to 5: Students work on spreadsheet adding income as well as projected expenditure. (see appendix for example).

Homework: Students continue to produce a log of skills learnt.

Week 6: Students produce poster advertising the picnic.

Skills to demonstrate to students:

Reminder how to use Paint or the drawing features of Word. Publisher could be used if available. Give sample letter layout when setting homework.

Homework: Students draft letter to parents on paper.

Week 7: Students type up letter to parents.

Skills to demonstrate to students:

Reminder about how to use Word.

Week 8: Student presentation of work and review, discussion of benefits and disadvantages of using ICT.

Homework: Write an evaluation of work carried out.

THE HEALTH AND SAFETY PROJECT

Task:

Students are required to produce posters and a booklet giving guidelines about Health and Safety in the Computer Laboratories and/or in the Science Laboratories.

References:

1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4, 4 (Health and Safety)

CURRICULUM LINKS: Science

Activities:

Week 1: Introduction to the project. Students access sources of information on Health and Safety. If the Internet is available students should be directed to use multiple search criteria. Other sources could be the teacher, textbooks and class/group discussion about the issues.

Skills to demonstrate to students:

**Searching the Internet using simple and multiple search criteria.
Introduction to Microsoft Publisher or other desktop publishing software.**

Homework:

Students produce a plan for their project and a draft of their poster.

Week 2: Students begin work on poster using Publisher.

Skills to demonstrate:

Reminder of how to copy a picture from the Internet and paste it into Publisher.

Week 3: Students finish posters and begin work on booklet.

Skills to demonstrate: How to use Publisher to create a suitable layout for the booklet.

Homework: Students write a short essay on the importance of health and safety in the lab and what health risks are involved.

Weeks 4 – 7: Students work on the production of their booklet and posters.

Homework: Each week students should write in their exercise books details of new skills learnt.

Week 8: Completed work put on display. Students give a brief presentation on their work.

Homework: Students complete an evaluation of their work.