Chapter 19
Chemistry Aid: How Innovative Solutions to Chemistry Education Are Making a Difference

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Abstract In Kenya, as in many developing countries, the government has placed great importance on science education. This importance on science education is difficult to realize, however, because of the challenges facing science education, especially Chemistry education. These challenges include a lack of well equipped laboratories, the high cost of chemicals and equipment, a lack of mains electricity, lack of mains water, and students' lack of laboratory gear such as goggles and lab coats. Many students continue to perform dismally in Chemistry as well as other sciences. In addressing this problem, the Scientific Advisory and Information Network (SAIN) Kenya and the Chemistry Video Consortium (CVC) UK have initiated a program, the Chemistry Aid initiative that has been working on devising and promoting the use of innovative solutions to problems facing Chemistry education in Kenya and other developing countries.

19.1 Introduction

Science education in Kenya is regarded as important to the economic development of the nation. There are however numerous challenges that are experienced in the teaching and learning of sciences in Kenya. This situation is not unique to Kenya alone. Many developing countries also face similar challenges in the teaching and

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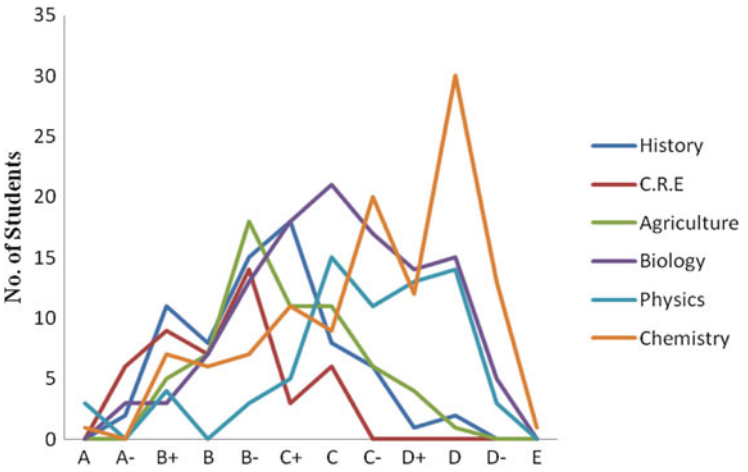


Fig. 19.1 Subject grade distribution in chemistry, physics, biology, agriculture, C.R.E (Christian Religious Education) and history – Kenya Certificate of Secondary Education (KCSE) 2010

learning of sciences especially Chemistry. Chemistry has therefore become unpopular among many students in developing countries. Lack of properly equipped laboratories and high cost of chemicals are some of the challenges that many developing countries are facing in Chemistry education. Also, in many rural schools there is lack of electricity and running tap water. In addition to the above challenges, students find Chemistry to be very abstract. In developing countries the students also lack important gear such as lab coats and goggles [1].

Due to the numerous challenges facing the teaching and learning of Chemistry (as well as other sciences and mathematics), the grades achieved by students in national examinations are lower for these subjects compared to humanity subjects as portrayed by Fig. 19.1.

In order to tackle the challenges faced in Chemistry education, the Scientific Advisory and Information Network (SAIN) a non-profit making, non-governmental organization (NGO) in Kenya has partnered with the Chemistry Video Consortium (CVC) of the University of Southampton in UK to develop and offer innovative solutions to the challenges facing the teaching and learning of Chemistry in developing countries. The two organizations have been working under the banner of the Chemistry Aid initiative (see http://www.chemistry-aid.com) to promote and encourage the use of innovative solutions.

19.2 Innovative Approaches to Chemistry Education

Our innovative approaches to the challenges facing Chemistry education are geared towards making Chemistry ‘lively’ and therefore very interesting to both teachers and students. These approaches are as follows:

(a) Promoting and encouraging the use of ICT multimedia resources (audio-visual resources) in the teaching and learning of Chemistry;
(b) Promoting and encouraging the use of readily available chemicals and materials that can be used to perform Chemistry experiments;
(c) Use of sporting activities in encouraging Chemistry education;
(d) Devising a simple solar power generator that can be used in schools that do not have mains power connection.

19.2.1 Promoting and Encouraging the Use of ICT Multimedia Resources

For a long time in many Kenyan schools, Chemistry has been taught as a "theoretical" subject making the students to have a feeling that Chemistry is an abstract subject. The lack of properly equipped laboratories has meant that students taking Chemistry have not been able to have a "hands on" experience on Chemistry. In order to overcome this challenge the Chemistry Video Consortium (CVC) has provided ICT multimedia resources, mainly Chemistry CDRoms and DVDs to the SAIN for distribution to schools in order to enhance the teaching and learning of Chemistry in Kenya (Fig. 19.2). These materials have been developed by the Royal Society of Chemistry (RSC), UK and the CVC [2]. Also, the RSC has made Chemistry educational materials available for download in developing countries [3].

The ICT multimedia resources have been found to have several benefits as follows:

(a) They have been found to be very motivating to the students. Through the use of these materials students have been encouraged to learn Chemistry;
(b) Since these resources mainly involved the use of computers students have been motivated to develop ICT skills even when they are out of class or even school;
(c) The use of these resources by students has encouraged independent learning as well as active learning;
(d) The students have been able to see practical experiments that they are not able to perform due to lack of laboratory equipment. The students are therefore able to see "live" Chemistry via the ICT multimedia materials;
(e) The ICT multimedia materials have instructional consistency.

19.2.2 Promoting and Encouraging the Use of Readily Available Chemicals and Materials

Readily available chemicals and materials can be used in doing Chemistry experiments. The Chemistry Aid initiative has been promoting and encouraging the use of materials such as:

"Chemistry Aid" helps to better African chemistry

COPIES OF A CD-rom entitled *Practical Chemistry for Schools and Colleges* have been despatched to Kenya in an education programme that is expected to be extended to other African countries. The initiative has been dubbed "Chemistry Aid".

It follows a request from the Scientific Advisory and Information Network in Nairobi, Kenya for help with teaching practical chemistry. Many schools in Kenya rely on visits to better equipped schools for practical science lessons and examinations. In 2003, the average mark of the 198,747 students that sat the Kenya Certificate of Secondary Education (KCSE) chemistry exam was only 26.85% – the lowest mean score in the three science subjects.

Dr Colin Osborne, the RSC's education manager for schools and colleges, said: "Chemistry is probably one of the most difficult subjects to teach in developing countries because students do not have access to chemicals and equipment and teachers cannot demonstrate chemical reactions. Yet such countries need indigenous chemists as part of their development plans."

The CD-roms were jointly produced by the Chemistry Video Consortium (CVC), which is based at the University of Southampton, and the RSC. They show laboratory experiments and stress practical techniques. They can be used by teachers to present topics to students and by students for individual study. The RSC said the initiative could be expanded through the British Council and the Commonwealth.

A CD-rom on practical chemistry is helping Kenyan students to improve their grades

The encouraging response could open up possibilities for providing other resources for teaching chemistry, as the CVC/RSC has a database called "Chemistry Images", which includes VHS tapes, laser disks and CD-roms for teaching, learning and training. Dr Osborne said the scheme "could even be extended to developing countries worldwide".

Offers of help, support, donations, and sponsorship should be sent to: Dr Colin Osborne, Education Department, Burlington House (address on page 16), tel +44 (0)207 437 8656, or Dr Tony Rest, School of Chemistry, University of Southampton, Southampton SO17 1BJ, tel +44 (0)2380 593595. Colin Osborne can also provide further information

Regional meetings come to a conclusion

THE 2004 SERIES of regional meetings has now been completed. Over 200 members attended the nine meetings, which were held in London, Dublin, Huddersfield, Leicester, Stirling, Liverpool, Bristol, Aberystwyth and Cambridge.

There were two main topics for discussion. The first subject, which created a good deal of debate, was the proposed changes to the RSC structure of governance. Though the changes were supported by a large majority of members, there were some concerns voiced over how to ensure that the new bodies would be representative of the RSC as a whole.

The second item on the agenda was the RSC's Campaign for the Chemical Sciences. This presentation provided members with an overview of how the RSC was evolving into a more proactive organisation and how it intended to become an advocate for the chemical sciences.

If you would like more information on regional meetings, contact David Lindores at Thomas Graham House (address on page 16), tel +44 (0)1223 422264, email lindoresd@rsc.org. Summaries of the meetings are available at www.rsc.org/lap/rsccom/regions/regindex.htm

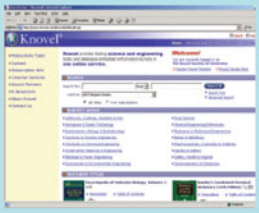
WWW.RSC.ORG

Knovel takes the strain out of chemical sciences' research

ALMOST 700 SCIENTIFIC databanks and electronic books are now available to RSC members through the Knovel web-based search engine.

The chemical sciences' collection includes: *Lange's Handbook of Chemistry*, *Endocrine Disrupting Chemicals* and *Yaw's Handbook of Thermodynamic and Physical Properties of Chemical Compounds*.

Nazma Masud, information officer with the RSC's Library & Information Centre, said: "Imagine having to consult these works individually. The simple interface on this immense resource allows the construction of search strategies in an intuitive manner to search the entire collection at once or in groups of one of 16 subject areas. The types of searches can range from using basic keywords to specifying ranges of numeric property values such as vapour pressure or dissociation constant in appropriate units."



For example, an advanced search for alcohols with a melting point of 50C to 100C and boiling point of 200C to 300C retrieved 54 matches in seven books, including Knovel Critical Tables. Results include the name, links to synonyms, structure, melting point and boiling point, the ranges of which hyperlink to new windows that give full bibliographic details of the data source. In addition, the results can be copied and pasted into Word or Excel using an export feature, which automatically cites the work.

For further information, contact Martin Cadman or Nazma Masud at library@rsc.org. To start searching, go to www.rsc.org/lic/knovel_library.htm

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Fig. 19.2 June 2004 RSC news article

(a) Use of plastic Ziploc bags in doing Chemistry experiments [4].
(b) Use of kitchen/supermarket chemicals such as bi-carbonate, vinegar, lime juice in doing Chemistry experiments (Fig. 19.3).
(c) Use of plastic document wallets in doing 'micro-scale' Chemistry experiments.

Fig. 19.3 Students during a 'hands-on' supermarket chemical reactions workshop

One advantage of the use of readily available resources is that it has been found to cut on the cost of doing "hands on" experiments. Also the materials are environmentally friendly hence are easy to dispose after use. Since these experiments focus on everyday life, and could be done outside the laboratory/classroom, they were of great interest to the students. The plastic Ziploc bags and plastic document wallets can be used in place of the laboratory bench.

19.2.3 Use of Sporting Activities in Encouraging Chemistry Education

Sports are a great youth attraction all over the world. The SAIN and the CVC under the Chemistry Aid initiative have launched the Sports 4 Science program aimed at using sports in enthusing young people in science (Fig. 19.4). The program uses sports to promote science education among the youth. The SAIN and CVC acknowledge that it is possible to associate science with youth sporting activities. One of the activities in our 'Sports 4 Science' program is football tournament for the teens. During the tournaments the teens are motivated to perform well in science subjects by giving them talks on how science is related to football. We have informed the teens that the sporting gear such as the uniforms, shoes, gloves and the soccer ball are made from materials that are products of chemical processes. As a result, the teens have been able to associate their favourite sporting activity with Chemistry. Some scholars have argued that youth participation in sporting activities is essential for their education [5]. Sporting activities can therefore be used to influence young learners' attitude in Chemistry.

Fig. 19.4 Teens during a Sports 4 Science tournament organized by the SAIN and CVC

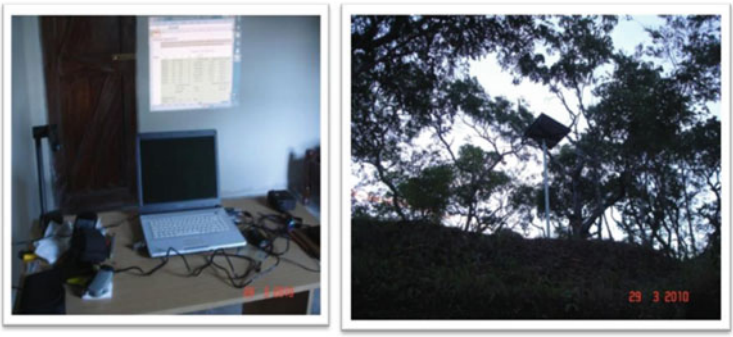

Fig. 19.5 Solar power generator kit: hand held projector, phone, laptop and solar panel

19.2.4 Solar Power Program

A major challenge facing many rural schools in developing countries is lack of mains electricity. In order that schools benefit from the use of ICT multimedia resources, they need electricity. A way of overcoming the challenge of lack of electricity is by the use of portable power generators. However, portable power generators have several disadvantages and are associated with several safety hazards. Also, in developing countries, producing power via a petrol powered generator is expensive due to the cost of petrol fuel and maintenance. Solar power is an alternative to petrol driven generators, so under the Chemistry Aid initiative a simple Solar Power Generator has been devised for use in solar powered classroom. The solar powered generators enable students to make use of the ICT multimedia materials, hence experience the "hands-on" experiences of chemical experiments. The generators can be connected to portable computers such as laptop and data projectors [6] (Fig. 19.5).

19.3 Conclusions

In several developing countries, the teaching and learning of Chemistry as well as other Sciences and Mathematics remain a big challenge. Most schools especially in the rural areas lack important facilities such as laboratories and equipment. Also chemicals are expensive and most schools cannot afford to offer practical laboratory sessions. This is in addition to lack of mains electricity. In order to overcome these challenges, there is need of developing countries to embrace innovative solutions. The Chemistry Aid Initiative of the SAIN and CVC is a model that can be used by developing countries in applying innovative solutions to the challenges facing teaching and learning of Chemistry as well as other Sciences.

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