Report of the Satellite Workshop

Venue:Department of Chemistry, School of Physical Sciences
College of Biological and Physical Sciences
University of Nairobi P.O. Box 30197, Nairobi, Kenya

Theme: "the Relevance of Chemistry in a Global Society", 11-12 august,2008

Prepared by Prof. Shem O. Wandiga
Chair, Kenya Chemical Society

Sponsors

Foreword

The meeting was organized by Prof Shem Wandiga on behalf of the Kenya Chemical Society and was held at the University of Nairobi. Approximately 60 delegates registered, and they included university staff and students and secondary school teachers of chemistry. Whilst the majority was from Kenya, there was a significant minority from Uganda and Tanzania also. Most of the first day was taken up with three plenary lectures and general discussions about these:
ICT as a Tool for Collaborating in Chemistry – Dr J Mwaniki
Low-cost Experiments in Chemistry – Prof JD Bradley
Public Image of Chemistry – Prof S Wandiga
For the final session of the day, participants split into three separate groups to discuss further one of the topics presented. Each group was chaired by the plenary speaker and a rapporteur was elected. I chaired the Low-cost Experiments group, for which Prof JI Jondiko (Maseno University) was rapporteur. A lively discussion took place in this group, which extended well beyond the expected closing time. There was enthusiasm for the microscale chemistry concept and an awareness of the activities in Kenya during the past few years to introduce it. Whilst some teachers were conservative and reluctant to change, this attitude was also justified by the Kenya

National Exams Council (KNEC) policy regarding practical exams. They specified only traditional equipment and no alternatives. The Kenya Institute of Education (KIE) had approved microscale equipment, but in spite of this the KNEC policy remained. The consensus was that the situation was unsatisfactory and that concerted representations should be made by all stakeholders. It was also suggested that a pilot implementation project should be advocated.

On the second day, the Low-cost Experiments group spent 1,5 hours in practical activities with microscale equipment. The activities were all ones presented at 20ICCE in Mauritius, and exemplified the use of microscale equipment in understanding the air and water environment. Participants were able to complete 2 or 3 of the 5 activities available in the session, and there was general success and satisfaction.

In the second and final session of the day, rapporteurs from each group presented a review of the discussions and experiences, and there was an opportunity for further questions.

Prof Wandiga closed the meeting at lunchtime. In my opinion it was a successful East African satellite meeting of 20ICCE, providing a worthwhile stimulus for chemistry education in the region.

JD Bradley 18/08/08

Introduction

The Workshop was opened by the Prof. Paul Shiundu, Dean, School of Physical Sciences, College of Biological and Physical Sciences, University of Nairobi. He was represented by Dr. David K. Kariuki who also represented Prof. Duke Orata, Chairman, Department of Chemistry. In his welcome remarks Prof. Shiundu thanked the participants for attending the workshop. He noted the theme of the workshop as very current and appropriate for socio-economic development of Africa. He concluded by thanking the sponsors.

Presentations

There were three paper presentations by Dr. Joseph Mwaniki on ICT, Prof. John Bradley on Low Cost Experiments in Chemistry and by Prof. Shem O Wandiga on Public Image of Chemistry. Dr. Mwaniki's and Prof. Bradley's papers are attached as power point presentations to this report. Prof. Wandigas' paper is reproduced below.

PUBLIC IMAGE OF CHEMISTRY

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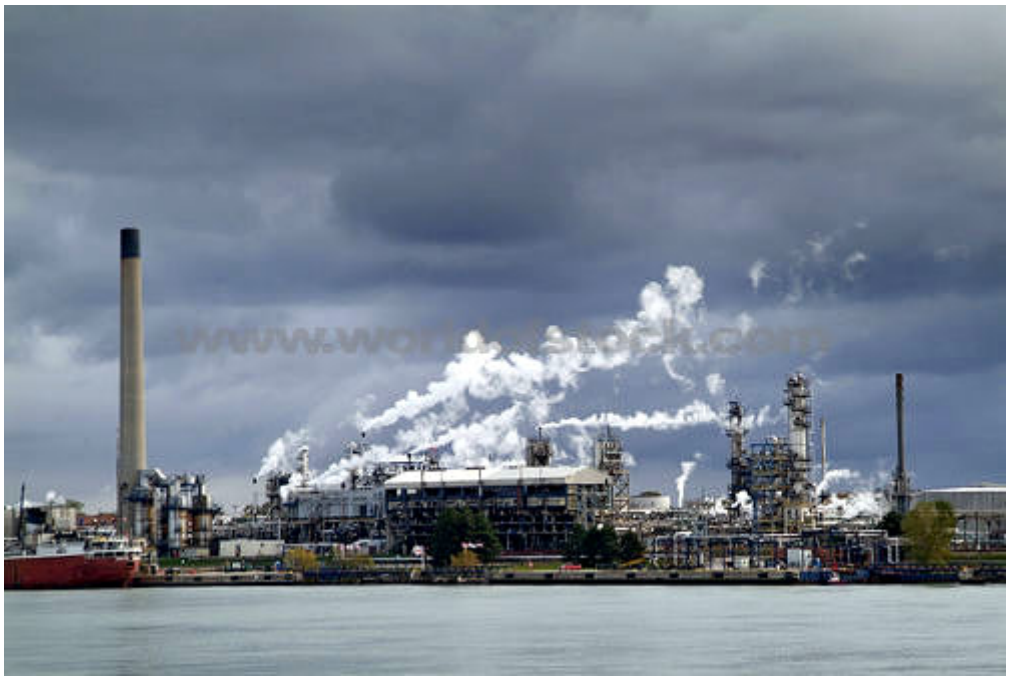
A paper presented at the 20th ICCE Satellite Workshop at the University of Nairobi, 11-12 August, 2008.

The public image of chemistry depends on the sophistication of the society and varies from one region to another. Chemistry is new to Africa and its applications are far and in between. Africa does not boast of major chemical industries except for SASOL in South Africa. However, in its cities and country sides may be found small chemical plants of one type or the other built with no environmental protection and human safety considerations. African peoples' past and present cultures relates well to magicians than to sorcery and Frankensteins. No chemical war has been waged in the continent. Neither have widespread chemical pollutions been a frequent occurrence in the continent. Hence, linking chemistry with sorcery, Frankenstein, hazards, poisons, chemical warfare and environmental pollution are held by a minority of the society.

Major chemical activities in the continent are associated with companies in the agriculture and mining industries. Other chemical companies are dealing in packaging and sales of finished chemical products. Chemical companies specializing in manufacturing and research are even scarcer. The subject is often feared by the educated persons. My experience, whenever I introduce myself as a chemist, I am often met with surprise and owe. The response is often, "you must be bright to have studied that" or "I never passed chemistry". The understanding of the subject by the general public is low. However, the support of the subject by the government is strong. This is due to the hope that knowledge of the subject will help countries develop economically as has been in the developed countries. In our education system, chemistry is introduced at primary or secondary level. Children are still allowed to do chemistry practicals in the laboratory. The number of students reading chemistry at the university level is increasing. We should strive very hard to keep it that way as there are potential of solving several societal problems ranging from food security, clean drinking water to finding cures of our myriad diseases through chemical sciences knowledge.



Chemical Industry Plants polluting the air and water, the St Clair River

In the developed Western World the image of chemistry has been very much associated with poisons, hazards, environmental pollution, intentional and unintentional harm done to the population due to distribution of toxic chemicals in the environment, fear of explosion/harm to children in the laboratory and application of strict regulatory laws on safety.

The African societies are not yet that sophisticated but will not remain so forever. Issues of environmental pollution are acutely being propagated by civil societies and African governments are keenly promoting revisions of environmental laws such as the Kenyan Environmental Management Act of 1999. We now have requirements for any business to report its effluents into the air, water system and soil. Environmental impact assessment reports are mandatory for any new business. Strict enforcement of water and air pollution, with heavy fines, is provided for in the laws. Further more, the introduction of precautionary principle in these laws is enshrined.

The "precautionary principle" – adopted by the European Union in 1992 as the basis for regulation of toxic chemicals –- holds that in the face of scientific uncertainty, government should err on the side of protecting public health and safety. In other words, if scientific evidence indicates there is a good chance that a chemical may pose a risk of irreversible harm, regulators should not wait for absolute proof before acting.

As chemistry practioners we should be aware of these new developments. We need to be aware that:

- the current state-of-the-art processes are not perfect, and only the constant search for new improvements will lead to a sustainable future;
- every reaction design and process should use the best available knowledge of sustainability, renewability and environmental safety;
- promotion of chemical safety is critical. Students should never be made to fear chemistry and retreat to the western fear of the subject;
- knowledge of what is objective and rational today may not remain so tomorrow.

Events of the past years have made us keenly aware of the impossibility of tracking the fate of every chemical compound used and generated in a reaction process. Incidences of chemical seepage into the water system have resulted in fish, birds of prey and human deaths. Drinking of contaminated waters, eating of contaminated foods or breathing of air with toxic chemicals may cause endocrine disruption, internal organs damage, poisoning and death. However, used with strict safety standards, chemicals benefit mankind.

Chemical sciences are at the forefront of the green revolution which transformed India from a basket state to a food sufficient state. Chemistry has produced most materials used in clothing, building, car manufacture, and medicine to name just a few. Chemical sciences will still be required for pest control, water purification, production of new materials for everyday life. Africa requires uplifting the socio-economic standard of its people and I dare say this may not be done without chemical sciences. Therefore, the image we portray to the public about the subject must be well reasoned out, project the correct picture without resorting to mimickery or stage managed adverts.


Fish die of chemical pollution, Ahmedabad

Therefore, we should aim at using only the benign chemicals. Our standard for judgment of acceptable reactions should include not only conversion and selectivity but also efficiency, sustainability, recyclability, degradation, and elimination or reduction of hazards. It is far much better to emphasize to students the connectivity between the structure and compound activity. Explicit understanding of chemical functionality (sterics, electronics, hydrophobicity/philicity, toxicity) do provide basic understanding of how chemicals impact the environment. Above all students should be made aware of the transfer, transport and fate of chemicals in the environment.

Many of our colleagues work in companies that were designed before the introduction of the precautionary principle. Some are called upon to improve these industries or design new ones. If you are given the chance to do so, one should remember that all industrial processes are imperfect and can always be improved to maximize economic and environmental benefits. All industrial designs should put premium on sustainability, stressing minimal waste production, use of renewable and recycled resources, and highest possible energy saving efficiency. In order to assess and evaluate a chemical process one needs the assistance of colleagues who are experts not only in chemistry and chemical engineering but also in ecology, toxicology, biology, social sciences and environmental engineering/sciences. Only projects that avoid end-of-pipe treatment should be accepted and promoted. The precautionary principle charges every industry to be responsible for every compound from cradle-to-grave. Hence, life cycle assessments must consider factors such as renewable feedstocks, feedstock acquisition, waste treatment, environmental persistence, energy requirements, and energy sources (1).

Global Issues

Africa is a vast continent with abundant resources. Exploitation of resources has created a second scramble for the continent. African countries aspire to be like developed countries and are opening the door for import of western technologies or any technology that would be used to exploit its resources, earn foreign currency and create jobs and wealth. On the other hand, developed and newly industrialized countries are looking for inexpensive and lax regulations, and low priced feedstock resources. They are keen on maximizing profits on technologies they already have, some of which are environmentally unfriendly. These reasons lie behind the driving force for outsourcing. Outsourcing is looked at favourably by African countries but fiercely fought by citizens of developed countries. It leads to loss of jobs, estimated at 3.4 million U.S. jobs by 2015 (2). It leads to extreme environmental damage in developing countries, affecting their livelihoods for many generations and depleting natural resources, including energy and clean water (3). Hence, globalization be assessed and evaluated and only industries that are environmentally responsible be allowed to take root in developing countries.

References

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Group Discussions

The participants were divided into three groups according to individual's interest. The reports of the group discussions which continued to the next day are attached below:

COMMENTS FROM MICRO-SCIENCE GROUP

The names of members of the group are in the registration form.
Chairman was Prof. D. Bradley and the repportuer was Prof. J.I. Jondiko

a) **Experiences and comments from the group:**

1. There is need for more ideas on micro-scale experimental procedures to improve the teaching and practical exams in Kenya. Can the experiences in the institutions which have experimented with the kits help?
2. Small scale experiments: Will it require more procedures and new textbooks? What are supposed to be included in order to achieve the objectives?
3. There is curiosity about how the kits look like. How shall I satisfy the curiosity so that I may make up my mind on the suitability of usage for students and me. The response was that the session on 12th shall be used to satisfy the curiosity.
4. The details of how to overcome the challenges in the implementation of change from macro-scale to micro-scale require investigation. What is the strategy for overcoming the challenges? The approach which was suggested was that a nationally organized project should be implemented with an objective to obtain data and information which shall enhance

making appropriate policy for the use of micro system at primary secondary, university and teacher training institutions.

5. The 1st and 2nd year are large classes in the Universities. What are the activities that micro-small scale experimental procedures shall aid the University education? The response was that teachers and lectures should be involved in the identification of experiments which may be implemented using the approach.
6. I was observed that teacher training programmers required for in-service to teachers could also be a good entry point. How can use the system? The response was that workshops and seminars should be organized to achieve the use of in-service activity as a means of advocacy and transfer of skills required to the teachers.
7. How can we encourage the teachers in implementing the micro-scale? The response was that information on the micro-scale approach should be availed to the teachers through collaboration with Professor Bradley and Wandiga.
8. How can we apply micro-scale in titration experiment? There exists apparatus for this application and the information can be obtained from Professor Bradley.
9. How can we scale down the kit to correlate the outcome of the use of the two scales in experimentation? The response was that the kit has got instruction on scaling procedures, especially those dealing with concentration requirements.
10. How can we develop the ICT and micro-scale experiment? The response was that this required collaboration with ICT experts to develop the necessary materials.
11. Training of laboratory technicians was observed to be another entry point. How can we train the technicians to assist the teachers? The response was that in-service for technicians can be achieved through short training periods and workshops or inclusion of the micro-scale experimental procedures in the curriculum. However this requires changes in the curricula that must be developed by institutions responsible for this in the ministries of educations.
12. It was observed that Micro-scale will respond positively to conservation of environment and reduce cost: How can we apply micro-scale in research? The system was not designed for this but researchers should design apparatus that would be used in the research activities. However there are some analytical and chromatographic apparatus which can be used especially in the biochemical analytical laboratories. .
13. Is there a kit that can be used in several experiments? Are there experimental procedures? The response was that the kits and their components are versatile and the varieties of experiments are limited by availability of chemicals and compatibility with the materials used for making the apparatus.
14. Micro scale can reduce costs in schools and university. There is need to address: availability, user friendliness and application in research. What is practical experience in South Africa? The response was that the information should be obtained from Prof. Bradley who advised that those with the interest to communicate to him through emai.:Jojn.Braley.Wits.ac.za
15. There is need for users to get hands on experience so that we may be agents for the creation of changes in attitude and implementation. The response was that the scientist must be advocates for change through the print and electronic media.
16. The group was given the experience that the kits worked in a school with only one laboratory for 657 students taking chemistry: The kits solved the problem in large class at relatively low cost and the students performed well in the Kenya National examination. The commenter indicated the exposure of training and advocacy for attitudinal change made the implementation succeed.
17. Nairobi University has studied the micro-scale kits from UK and South Africa but found that they are suitable but production and trade environments are the bottlenecks. The use of syringes has reduced the cost in experiments at the University of Nairobi and the University

collaborated with teachers in a secondary school to successfully standardize the making of solutions for the use of Kits. .How do we overcome the challenge? The response was that there is need to approach the relevant government authorities and companies manufacturing the kits in order to solve the problem. the actual reduction in the amount of standards for analysis by the use of syringes. It will be good to look at how we can extend this to undergraduate practical.

18. The research for MEd was done at Kenyatta University on the use of the Kit at a secondary school with statistically evaluated examination performance indicating that students using the Micro-scale apparatus performed better than those using the traditional apparatus. The apparatus has been used to teach methods of teaching chemistry to undergraduate students at Masinde Muliro University of Science and Technology. It was observed that such attempts should be done in a more universities and teacher training institutions.

Report from Bomet Siwot Secondary School

- Bought the KITS in 2007 for SMASSE programmed and obtained some donated KITS and used them to solve their problem
- Manual, drawing procedure were obtained and used for the experiments
- The teachers were trained to use the kits which were assembled by students themselves during practical sessions.
- The 657 students did the practicals in the laboratory and in classrooms and wrote the reports during the period of their stay in the school.
- The performance of the students was comparatively better than the previous years when the experiments could not be done in Kenya Certificate of Secondary Education (KCSE)..

Observations from Bomet School

There is need for a kit per student. Each kit goes for 600/= and can be used for four years
Expenditure was 20000/= for four years.
The chemicals were prepared for the kits at UON
It solved the problem of shortage of laboratory
Reduced expenses and toxicity
Apparatus for scaling down
Expertise to scale down to match the requirement for KNEC
There is need to establish training

Mr. Michieka Experience

The use of Micro-scale kit for chemistry and electricity.
The students had fear and nervousness when using the kits in experimentation .It is appropriate to establish ways that can help reduce the fear and improve aptitude in the use of the kits in primary school.
There is need to implement the micro-scale at primary school due to lack of apparatus in many Kenyan schools.
Implementation:

- Chose four primary schools
- Trained teachers
- Four control schools

- Compared performance of students

Results

- Shared the photographs
- Experimental kits performed better than control students statistically
- There was motivation among the students who used the kits

Recruited students at secondary school in use of micro-scale and ICT
Saving cost 20:1
Chemical disposal was easy and environmentally friendly
There is need for a functional laboratory
The kit has everything for several experiments
There is need to tailor the activities to the KIT and the worksheet eg. The kit for Electrolysis is a good example.

Challenges:
Teachers attitude are negative: one of the reasons is that kits are not used in Kenya National Examination Council (KNEC).
Accuracy is better for titration.
Concept transfer is effective.
Amenable to primary, secondary and University
The first report has been shared with SMASSE
The head's association should receive it.
Chemistry teaching method has been incorporated at Masinde Muliro University, Kenyatta University (Med) programme.

Mr. Vincet Madadi:

Recommended that kits be introduced at primary and secondary in consequential manner.
A set of chemicals and Kit: Are there possibility of replacement. Is there need for measurement?

- Replacement as stock is possible but not to replace parts piecemeal. Ordering a few parts may not be cost effective.
- The experimentation mainly for qualitative analysis.
- Quantitative analysis may not be easy since there is no measurement.

Distillation apparatus is not in the kit thus there is need for improvisation.

- There is a COMBO scale apparatus for distillation.

There is need for keen care for the KIT.

Challenges by the group in implementation of the use of micro-scale experimentation in our countries.

1) Lack of awareness – exposure
2) Negative attitude of teachers
3) Lack of tested knowledge based results
4) Lack of results on performance of students
5) Lack of comparativeness between units used in MACRO-SCALE and MICRO-SCALE SYSTEMS.

6) Lack of policy supporting the implementation from stakeholders in the ministries of education and schools in our countries.
7) Negative attitude of KNEC and Kenya Institute of Education (KIE) in Kenya or equivalent institutions in Uganda.
8) Lack of coordination: ministry, the university, schools, and teacher training colleges.
9) The glassware for micro-scale is expensive but can be used for 3rd and 4th years
10) Lack of implementation of procedures and technology for disposal of toxic chemicals

Mitigation

1) Academy of sciences and chemical societies to spear head advocacy
2) Identification of large-scale acquisition
3) Establishment of official research involving stakeholders to evaluate the policy and implementation.
4) Preparation of documents for advocacy and research and development project for implementation of change from macro-scale to micro-scale.
5) Kenya National Academy of Sciences, Uganda National Academy of Sciences, Examination councils, Kenya Institute of Education, Uganda National Examination Board should spearhead introduction of micro-science teaching and learning process.
6) There is need to integrate principals of green chemistry.

COMMENTS FROM THE ICT GROUP

Introductory remarks

At the beginning of the discussion session, members introduced themselves and gave their general views on the role of ICT in collaboration and teaching of chemistry. The following emerged as highlights of the remarks:

- That ICT, being an important tool for access and dissemination of information, say from the internet, should be embraced in the teaching of chemistry. The challenge would be how to incorporate ICT in the teaching.
- That ICT should be used in problem solving in chemistry. During the discussion, members would give suggestions on how to do this.
- That ICT could be useful in illustration of abstract ideas through simulation and animation, thereby demystifying certain concepts of chemistry. For instance, visualisation of three Dimensional structures of chemicals may be simplified by ICT using specific software such as ISIS DRAW.
- That comprehensive and successful ICT application in teaching chemistry needs to be supported by an ICT incorporating (or ICT based) curriculum.
- Since ICT aids networking amongst users, it should be utilised as a tool for collaboration and resource sharing, especially among the chemistry educators.
- Some ICT equipment and infrastructure were reportedly expensive for most schools
- Members concurred that Teachers need to be trained and equipped with ICT skills so as to enable them to effectively utilize ICT in teaching and learning of chemistry.
- That some sections within chemistry, such as computational chemistry, demand extensive knowledge and application of ICT from the learner and teacher.

KEY PRIORITIES OF CHEMICAL SCIENTISTS IN ICT

The members suggested the following to be key priorities for chemical scientists in utilisation of ICT:

Networking and collaboration: The members observed that there is a need for networking between chemists and non chemists for purposes of knowledge-sharing. In addition, members noted the need for collaboration between different institutions, within and out of the country, in matters relating to chemistry. It was therefore agreed upon that chemists should aim to champion the utilization of ICT in this networking and collaboration.

Computer literacy: It was noted that chemists should aim at acquiring skills that will enable them to effectively and optimally utilise computers both in research and teaching. The use of ICT in the learning environment calls for exemplary computer application by the teachers.

E-learning at all levels of education: It was suggested that the use of computers in the learning environment at all levels be prioritised. However, an observation was made that most schools in the country lack the necessary infrastructure such as electricity.

Website for Kenya chemical society: Members suggested that the Kenya chemical society (KCS) should exemplary in ICT usage. To this effect, it was suggested that KCS should launch a website and also post its journal onto this website.

Development of an e-learning curriculum mainly at tertiary levels for science teachers

DIFFICULTIES WITH THE CURRENT SET UP

Participants identified the following current constraints to successful utilization of ICT in the teaching and learning of chemistry:

Power supply: It was mentioned that most educational institutions, especially secondary and primary schools, do not have access to electricity. In instances where electricity is available, the tariffs are high, making it costly to have a significant level of ICT application.

Lack of infrastructure (computers e.t.c): Most schools lack funds to buy the computers for use in ICT applications. Most schools are unable to have physical space for these computers.

Lack of the training of personnel: Most of the chemists who are supposed to aid the teaching and learning of chemistry are themselves incompetent in use of ICT resources, especially those that are computer based.

Lack of motivation: It was noted that there are some chemists out there with the necessary skills to effectively utilize ICT in supporting the teaching and learning of chemistry but due to lack of monetary motivation, they are reluctant to share their knowledge and experiences.

Lack of National policy on ICT: The absence of a clear national policy on the incorporation of ICT in teaching and learning at all levels of educational makes it difficult for interested teachers to have the school administrations prioritize ICT based instruction.

Maintenance and financial constraints: Most of the educational institutions run on constrained budgets and have limited or lack funds which would be earmarked for maintenance of ICT resources.

New activities which should be undertaken by chemical societies

- Chemical societies should arrange and hold seminars for teachers, industry e.t.c regarding ICT usage in the teaching, learning and application of chemistry. These would equip the participants with the necessary skills and knowledge required for effective utilisation of ICT resources in the area of chemistry.

- Chemical societies could champion the development and recommendation of Software that best aids the teaching and learning of chemistry. The chemicals could collaborate with information technicians and computer scientists to develop top quality learning materials such as applets, computer programs that would foster the understanding of concepts and their applications in industry.

Other key chemistry related topics relevant to Africa which need to be incorporated

Participants suggested the following issues as worthwhile ventures for the chemists as individuals or as societies:

- Promotion and engagement in technical cooperation with other countries on ICT and its applications in chemistry. This cooperation could as well be between industry, universities and tertiary institutions within the country.
- Advocacy for programs for in-service teachers and curriculum redesign to cater for ICT competence.
- The chemists, through their societies and as individuals, could launch a public awareness campaign to sensitize the masses on the importance of incorporation of ICT in the teaching and learning of chemistry.
- The chemical societies could engage in dialogue with governments over establishment of subsidies on the cost of ICT introduction and maintenance in schools. For example, the societies might want government to reduce the electricity tariffs for such schools.

PUBLIC IMAGE OF CHEMISTRY-GROUP DISCUSSION REPORT

Membership

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General Public Perception of Chemistry

Job Evaluation

Job market for chemists are few and where available the salary is low compared to other professions such as in Business

There are fewer senior jobs in the market hence graduates end opting for teaching profession against their aspirations

The few senior jobs available are taken up by citizens of the country from where the technology has been imported

Mismatch between Theory and Practice

The present university curricula has little relevance to market demands hence university courses should involve field visits to industries. This will impact positively and result in higher retention of what is learnt.

Allow participation of stakeholders/users in the development of curricula in order to harmonize syllabus with market needs

The curricula should emphasize more on cognitive abilities of how to source and use information-presently there is a lot of memory emphasis

Relevance of Curricula

Presently organic and physical chemistry are taught but students find very few field applications in the Kenyan set up as most Kenyan industries are doing packaging and repackaging of products

The market has more opening for environmental chemistry due to the establishment of the National Environmental Management Act and its enforcement by the Authority

Curriculum Issues

Students develop biases against the subject which include fear for being hurt/injured, chemicals one is in contact with may lead to development of cancer and unpleasant odors

Presently stakeholders are not involved in curricula development

There is inconsistency between text book description of concepts/colors and the examiners marking scheme- in text books color of chlorine is given as greenish yellow which is not accepted by examiners; nomenclature of chemical units is not emphasized hence students are confused about writing kJ and KJ

The examiners ought to be sensitive about the abilities being displayed by learners-to avoid being too strict otherwise learners get disillusioned

Lighten the work of students by providing functional and adequate facilities, equipment and apparatus. This is particularly of concern as many principals of schools view the subject as expensive and hence do not purchase equipment and chemicals

Professionalizing the Discipline of Chemistry

Set standards for admission into society-what it means to be a chemist

In teaching let there be more emphasis on practical work by providing high weighting in the final examination grade so as to encourage learners

Diversify the course combination so that one can do for instance law based on environmental chemistry

During the formation of teachers let the students demonstrate appreciation and competence in high school chemistry as this is relevant to their teaching.

The Chemical Societies should be more active and should establish websites for wider dialogue between the professionals
The Chemical Society should take more interest in national development by assisting in setting correct priorities

Other Recommendations

Attach chemistry students to industries for deeper understanding of applications
Examinations are generally geared towards grades-hence make the focus of examinations to be career development, with an evaluation of wider spectrum of learner's abilities
Harmonize the differences that exist amongst university chemistry courses and even from one lecturer to another. Let there be quality control mechanisms for harmonization and standardization of academic programs
The Government should consider:

- Improving teachers remuneration in order to retain them on the job
- Make B.Ed degree a post-graduate course by awarding a post-graduate diploma in education or making the course a five year course with the first four years dedicated to subject courses
- Provide funding to support research on chemical education

Annexes

1. ICT as a tool for collaboration in Chemistry - ppt
2. Low-cost experiments in Chemistry - ppt
3. Public Image of Chemistry - ppt
4. List of participants

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5. Workshop Program

"The Relevance of Chemistry in a Globalized Society" 11-12th August 2008

Monday 11th August, 2008

8.00-9.00 Registration of Participants

9.00-9.45 Opening Ceremony; Introduction of participants and opening speeches

9.45-10.15 Tea/Coffee Break

10.15-11.00 ICT as a tool for collaboration in Chemistry (Dr. Alex Tindimubona)

11.00-1145 ICT as a tool for Collaboration in Chemistry (Dr. Joseph Mwaniki)

11.00-12.30 Low Cost Experiments in Chemistry (Prof. John Bradley)

12.30-14.00 Lunch Break

14.00-14.45 Public image of chemistry (Prof. Shem O. Wandiga)

14.45-15.45 Questions and answers on lecture topics

15.45-16.15 Tee/Coffee Break

16.15-17.00 Break out session into three groups: ICT, Low Cost Experiment and Public Image of chemistry Chaired by Dr. Mwaniki and Tindimubona, Prof. Bradley and Prof. Wandiga
The Low Cost Experiment Group will have a hands on experiment using microscience kits. 1. Electrolysis of water (using Advanced microchem kit). Drawing molecular representations using our molecular stencil.
2. Determining boiling points of organic substances (using Advanced Microchem kit + some new pieces). (1-propanol and 2-propanol) Molecular model building (using our low-cost kit!)to discuss structure-property relations.
3. Determining concentration of aqueous solutions (eg NaCl) by conductivity measurements (using new conductivity unit and multimeter). Using the molecular stencil to represent aqueous solutions of different concentration.

17.30-18.30 Cocktail

Tuesday 12 august 2008

9.00-10.30 Second Group Discussion

10.30-11.00 Tea/Coffee Break

11.00-12.30 Plenary Discussion: Report from Dr. Mwaniki, Prof. Bradley and Prof. Wandiga

12.30-13.00 Workshop Closure

13.00-14.00 Lunch

Guidelines for the Chairs of Group Discussion

1. The chair should allow the group to elect a rapportuer and invite each of the participants to introduce themselves and invite them to comment briefly on the theme topic of the group from their local perspective (5min max) before opening up to wider discussion
2. What should be the key priorities of chemical scientists and how do we mobilize resources for the objectives?
3. What difficulties exist with the present setup?

4. What new activities not presently being undertaken by anyone should the chemical societies be engaged with?
5. What other key chemistry related topics relevant to Africa should we be involved in?
6. Chairs are free to add other questions relevant to the topic.

Reports: The chairs should record a summary of the output from the discussion and any proposed action for plenary presentation

General Points

- The breakout session chairs should encourage dialogue and not monoploze the discussion
- Chairs should try and involve all the participants
- Focus discussion around the theme where possible