National Initiative on Undergraduate Studies (NIUS) Chemistry: Towards meaningful learning in chemistry

Indrani Das Sen
Homi Bhabha Centre for Science Education

Introduction

- The NIUS programme was introduced in the year 2004 as part of HBCSE efforts to foray into the tertiary science education sector in India
- The programme aims at promoting research orientation among undergraduate students
- Although initiated at 2004, it took time to develop infrastructure in true sense NIUS chemistry fully functional in 2009

Background

- Mundane and emphasis on rote learning for examinations in undergraduate (UG) chemistry
- Chemistry (indeed science in general) viewed as a finished product which students need to acquire
- Near complete disconnect between scientists and UG teachers in India
- Realization of the need of UG teaching to be embedded in a research environment along with healthy link between scientists and teachers in colleges

Background (contd.)

- About a decade ago, the Government of India was contemplating major initiatives for UG education
- NIUS was in response to these concerns
- A natural sequel to the existing Olympiad programme aimed at the higher secondary stage
- Whereas the Olympiad emphasizes on developing competence and rigor at the pre university level, NIUS aims to promote meaningful learning of the subject at the UG through small projects /research like activities[1]

[1]Goedhart, M.J., Finlayson,O.E., & Lindblom-Ylänne, S. (2009). Research-based teaching in higher level chemistry education. In: I. Eilks & B. Byers (Eds.), Innovative methods of teaching and learning Chemistry in higher education (pp. 61-84). Cambridge: RSC

Distinctive features

NIUS chemistry promotes UG research through projects. The aim is however not research per se but to learn advanced chemistry by engaging students in research like activities.

1. Not short time apprenticeship or final year projects
2. Run during vacations of summer and winter (extended engagement)
3. Continual contact through assignments, interim reports and presentation
4. Open ended programme with an emphasis on growth of student
5. Delinking from grades and exams

Structure

The cycle starts every December with an exposure camp: attended by 40-50 first year (B.Sc./ integrated M.Sc.) students across India.

15-20 students are selected for projects

Projects continue in summer and winter vacations

Mentors/ Resource persons (from research institutions, local colleges, chemical industries and HBCSE)

Project areas

Domains had to be carefully decided both in terms of UG students' prerequisites and realistic possibilities at HBCSE.

1. Organic synthesis – emphasis on areas related to green routes of synthesis, one pot synthesis, etc.

2. Physical chemistry – studies of phase behavior of different solutions, effect of chelating agents and metal ions on surfactant systems, etc.

3. Computational chemistry[1] – investigation of formation of noble gas compounds, catalysis using nano noble metals, studies of hydrated electrons in water, etc.

[1]Supported by Theoretical Chemistry group, Bhabha Atomic Research Centre, Mumbai

Report Writing and Recording Work

Communication: emphasis on scientifically writing report and presenting work to a technical audience including peers.

Representative examples of past reports:

- Effect of crown ethers and ionic liquids on the growth of micelles in presence of alkali metal salts.
- Acid-base equilibria of azo dyes in micelles
- A Green Synthesis of 2,3-Diphenyl Quinoxaline using Lewis Acid Catalysts
- Synthesis and characterisation of Hydrotalcites

Our Impressions about NIUS Chemistry

- Improving motivation: with long and continual association with the project, students develop a sense of ownership about their work, this enhances their sense of empowerment and improves their motivation

- The NIUS programme boosts self confidence among students particularly students from regular colleges.

Impressions (contd.)

- With considerable practice with use of instruments in their projects, students overcome their phobia about sophisticated analytical instruments and are able to appreciate their role in research

- Students develop as independent investigators: develop skills to formulate research problems, approaches to solve them, collecting data and extracting meaning out of them and communicating their results.

Impressions (contd.)

Improving students overview of chemistry: because of the research-like and developmental nature of the projects, students ideas about what it is that constitute chemistry gradually change

Overall the NIUS programme in chemistry not only improves students' content expertise but also helps to develop a more mature view of the process of constructing and validating knowledge in chemistry

These impressions need to be formally evaluated and possibly quantified

Thank You