The SUN Chemistry Outreach Initiative

SUNCOI

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Problem Identification

• Many underprivileged high schools have no lab space or chemicals, however, the teachers are expected to present and assess, a prescribed practical to their grades 10-12 learners.
• These practicals are an essential part of the learner’s assessment, so not having the infrastructure or resources to host these practicals pose a big problem to these teachers and subsequently to the learners.
• This leads to
  • a decline in the number of learners in physical sciences;
  • ineffective practical work due to lack of infrastructure and resources as well as
  • lack of confidence on part of teachers in doing practical work.
What is SUNCOI?

The department of Chemistry and Polymer Science aims to assist disadvantaged high schools with their prescribed chemistry practical’s by inviting students and teachers to do their experimental work in one of the university’s fully equipped laboratories, working alongside post-grad chemistry students and chemistry lecturers.
Aims

• The primary goals of this outreach program are three-fold:
  • firstly, to provide much needed infrastructure support by offering students and their teachers the necessary laboratory environment to work in,
  • secondly, to develop a deeper understanding of the conceptually challenging topics of their prescribed syllabus (SUNCOI Practicals with Purpose).
  • thirdly, to collaborate with the education faculty through involvement of pre-service teacher education students in practical work with in-service teachers and their learners as well as post-grad chemistry students and chemistry lecturer/researchers (SUNCOI Teaching the Teacher the Nuts and Bolts of Chemistry).
Year Plan

• After successful pilot practical in 2013 -
• Grade 12 – 1st term (March)
• Grade 11 – 2nd term (May)
• Grade 10 – 3rd term (September)
• Teachers Training – November
• Primary School Visits
Typical Programme

- **8:00-8:30** Registration and Breakfast
- **8:30-9:30** Pre-lab lecture
  - Welcome – Prof K. R. Koch
  - Announcements and Programme – Dr R. Malgas-Enus
  - Monitoring and Evaluation – Drs Liezel Retief and Ilse Rootman-Le Grange
  - Titration lecture – Prof K. R. Koch
  - Lab Safety talk – Mrs P. Steyn
  - How to use lab equipment – Mrs P. Steyn
- **9:30-11:00** Session 1: How do you use the titration of oxalic acid against sodium hydroxide to determine the concentration of the sodium hydroxide?
- **11:00-11:20** Pre-Prac Lecture (Esters) – Dr R. Malgas-Enus
- **11:20-12:40** Session 2: Synthesis of Esters
- **12:40-13:00** Monitoring and Evaluation – Drs Liezel Retief and Ilse Rootman-Le Grange
- **13:00-14:00** Lunch
Grade 12

GRADE 12 PRACTICAL

08 March 2014

EXP 1: Synthesis of esters

EXP 2: Titration Of Oxalic Acid Against Sodium Hydroxide

Completed: 101 students - Cloetesville, COSAT, Kylemore
Safety Talk and Demonstration by Postgraduate Chemistry Students
Grade 12
Grade 11

Grade 11 Practical

11 May 2013

Exp: Intermolecular Forces

Completed - 53 students from Luckoff High, Cloetesville High and Kylemore High, as well as mentoring to COSAT

PGCE students, Barend and Tarina, gaining some valuable experience by working with high school students.
Teachers Workshop

TEACHER’S WORKSHOP
November 2013

EXP 1: Synthesis of esters

EXP 2: Titration Of Oxalic Acid Against Sodium Hydroxide

Completed: 99 teachers- Metropole South District, Cape Winelands District

The joys of working in a chemistry lab.

Pipette fillers (pink device) was sponsored to all the participating schools by LASEC.
Monitoring and Evaluation

• 3 Year Study

• This monitoring and evaluation experiments will be designed and implemented by Drs Liezel Retief and Ilse Rootman-Le Grange, academics in the field of education research in chemistry.

• There are three questions that we aim to answer with this research project

• 1. Can the SUNCOI workshops support teachers and pupils in achieving the requirements for the practical part of the school science curriculum?
• 2. How do the teachers and student experience the SUNCOI workshops?
• 3. Do the experiments and lectures presented in the workshops aid the pupils’ or teachers’ conceptual gain regarding the concepts that are covered?
M&E—clicker technology

Dr Ilse-Rootman le Grange demonstrating the use of clickers to the students. These were used for post-practical evaluation.
Monitoring and Evaluation

Preliminary results indicated that:

• Although the majority of teachers have access to laboratories they do not have the apparatus or chemicals that they require to allow their students to do the two prescribed practical experiments.

• Furthermore, the qualitative data revealed that there are additional factors, including a lack of time during the normal school day, that further hampers their efforts.

• Thus it can be concluded that there is a need for an environment where the pupils can conduct the prescribed grade 12 experiments themselves.
Monitoring and Evaluation

- The third research question will be answered by thorough Rasch analysis of the pre and post test data that specifically tests the Chemistry concepts that are covered during the workshops.
- Data was analysed using Rasch analysis on the software Rumm2030. A low Person Separation Index (PSI) of 0.41328 and a good Cronbach Alpha value of 0.64963 was found. The Rating scale model was used.
Innovation

- Our university chemistry lab which stands vacant on Saturdays and during university vacation will now be in optimal use, both in terms of *resources* as well as the interaction of an entire community of scientists:
  - chemistry lecturers (Science Faculty - hosts of the SUNCOI project) and teacher education lecturers (Education Faculty-content mentoring),
  - pre-service (PGCE students act as demonstrators and simultaneous gets assessed for their interaction with the high school learners, in the last few months of their degree and in-service (WCED) teachers,
  - postgrad chemistry students and high school learners (the future scientists).
Innovation

- Chemistry lecturer; subject advisor and teachers review current practical work and design practical work as a team – this has generated new ideas for teaching and resources based on the expertise and experience of the team.
Content Mentoring

Agenda for the Day - Wednesday 09 April 2014

For the session and discussion, Dr Rehana Malgas-Enus will focus on the following:

- A brief intro to Intermolecular Forces (IMF).

- IMF Experimental setup
  - alternatives,
  - potential problems and
  - strategy for completing prac during normal school time;

- General - comments and potential sharing of the six labs (Westridge, Lentegeur, Zisukhanyo, Princeton and Phandulwazi, Intsebenziswano) with neighboring schools;
Inclusivity

• social inclusion (inviting students to the university labs) and working with disadvantaged communities (4 disadvantaged high schools)
  • it creates a space where underprivileged students can experience working in a real chemistry laboratory for the first time
  • it is envisaged that due to understanding the experimental processes taking place, their conceptual understanding of the theory might also improve
  • due to their interaction with the postgraduate students, coming from similar backgrounds as them, they could possibly feel more encouraged to get a tertiary education
• enhancing the University’s engagement with local or regional partners (WCED)
• promotes social/professional development (by offering students and pre-service/in-service educators training skills)
• grows the capacity of new researchers to initiate community-university partnerships (partnership formed with four local schools, schools from 2 districts)
The SUNCOI project is:

• Service-orientated (providing infrastructure and resources),
• Teaching orientated (CAPS prescribed practicals and lectures on the theory),
• Research-orientated (Monitoring and Evaluation of the pupils involved in the project),
• Based on Knowledge partnerships (sharing of knowledge between the academy (Faculty of Science) and education (Faculty of Education), as well as facilitated discussion around the review of the CAPS and the chemistry practical work (discussion with physical sciences subject advisers)),
• promoting Volunteerism (postgraduate students volunteer as demonstrators).
From an educator’s perspective

Ziyaad Moerat
Western Cape Education Department
WHAT TEACHERS WANT

PROBLEM – Work overload:

- A Grade 10-12 CAPS Physical Sciences teacher have to do 9 new formal and 12 new informal practical assessments.
- All formal assessments must be accompanied by a standardised assessment tool that meets the requirements set out by CAPS – lack of good examples in textbooks.
- Teachers not confident in doing practical work.
- Insufficient laboratory facilities/apparatus
SUNCOI’s CURRENT INPUT:

SUNCOI have trained teachers from ALL schools in the Cape Winelands and South Education Districts.

- All the chemistry formal assessments covered.
- Every assessment supported with a worksheet that meets the requirements of CAPS, moderated by WCED Subject Advisor.
- Learners from nearby schools – with limited facilities - were able to do their experiments at the US.
How is SUNCOI different to other workshops?

• Based on formal assessment – teachers are more receptive
• Don’t just provide infrastructure but also content mentoring
• Simplifies experimental procedures so that more schools are able to do the practicals.
• Provide CAPS aligned assessment tool with each experiment.
• Available for consultation
BACK TO THE FUTURE

- A Sustainable relationship between SUNCOI and WCED to ensure better equipped teachers and enthused Physical Science learners.
- Expand teacher training to include the informal practical activities and improve the practical nature of the subject.
- Changing the mind-set of teachers to view practical work and assessment thereof as an integral part of teaching – not as an add on!
- Training teachers in ALL schools and providing facilities to more schools in need.
The rationale for including pre-service science teachers in the 
SUNCOI project

Nazeem Edwards

Faculty of Education, Stellenbosch University
Policy changes affecting schools

Curriculum Assessment Policy Statement (CAPS) has been implemented in Grades 10 – 12 from 2012-2014.

NSC exit examination in Grade 12 based on CAPS in 2014.

Policy changes affecting teacher education

Department of Higher Education and Training’s (2011, p.56) minimum set of competences required of newly qualified teachers:
They “must be able to reflect critically, in theoretically informed ways and together with their professional community of colleagues, on their own practice in order to constantly improve it and adapt it to evolving circumstances”.
Unless initial teacher education can prepare beginning teachers to learn to do much more thoughtful and challenging work, and unless ways can be found, through professional development, to help teachers to sustain such work, traditional instruction is likely to persist in frustrating educational reform, and reformers’ visions are likely to continue not to permeate practice broadly or deeply. (Ball and Cohen, 1999, p.6)
Big ideas in science education

Heywood (2007) has argued that course provision must address the issue of identifying areas of weakness in student subject knowledge, and finding effective strategies for its development. Research has also shown that student teachers frequently possess ideas about scientific phenomena that differ from current scientific explanation.

When the goals of science are seen as a progression towards key ideas which together enable understanding of events and phenomena, then these are big ideas. Heywood (2007, p.522) accentuates this when he asserts that:

There is an important difference between knowing about scientific facts and theories and understanding how and why a phenomenon occurs. The latter demands a coherent causal explanation for the phenomenon that serves to provide a convincing rationale for observations.
What benefits can PGCE science students derive from SUNCOI?

- They get exposure to the implemented CAPS curriculum.
- They interact with learners in an INCLUSIVE classroom / laboratory setting.
- They can appreciate learner misconceptions when they arise.
- They see how the learners develop an explanatory model for what is observed (BIG IDEAS in action).
- They develop their beginner repertoire as part of their pedagogical content knowledge (PCK).
- They understand what under-resourced schools lack to teach science effectively.
- They witness co-operation between the WCED and the university in a community engagement initiative that benefits the learners and promotes science at the same time.
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Grade 12 pupils from three disadvantaged schools, namely Kylemore High (Stellenbosch), Centre of Science and Technology (COSAT) in Khayalitsha and Cloetesville High (Stellenbosch), participated in this event, with the objective of allowing learners and their teacher’s hands-on access.