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ASELL: The Advancing Science by Enhancing Learning in the Laboratory Project.

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Introduction

Most researchers agree that the laboratory experience is a significant factor that influences students’ attitudes to their science courses. Consequently, good laboratory programs should play a major role in influencing student learning and performance. The laboratory program can be pivotal in defining a student’s experience in the sciences, and, if done poorly, can be a major factor in causing disengagement from the subject area. The challenge remains to provide students with laboratory experiences that are relevant and engaging, and offer effective learning opportunities.

The ASELL Project

The Advancing Science by Enhancing Learning in the Laboratory (ASELL) project has developed in several Australian universities over the last 10 years. It provides a multi-institutional, collaborative approach for improving the quality of undergraduate laboratories and providing effective professional development for academic staff.

It began in 2000 when a number of chemistry academics noticed increasingly high levels of student dissatisfaction with their undergraduate chemistry laboratory courses. It was also apparent that many of the academics who taught chemistry at the tertiary level were not familiar with educational research related to students’ experiences in the laboratory. After successful development in chemistry, trials were held in physics and biology using the principles that had been developed. As a result of that, the project has expanded to include those disciplines.

One of the tangible outcomes of the project is a database of educationally-validated undergraduate experiments on an open-access website (www.asell.org). For an experiment to be accepted onto the ASELL database, it passed through a rigorous evaluation process (see Figure 1). Submitted experiments also included student notes, demonstrator notes, technical notes, hazard/risk assessment, and the ASELL Educational template. The Educational Template provides information on the context in which the experiment is run, the educational goals which it serves, how these goals are achieved, and an analysis of student feedback data providing evidence of students’ perceptions of the experiment.

The Workshops

The first stage of the ASELL process involves the third-party testing of submitted experiments at a workshop by both academics and students and the evaluation of the educational and scientific merit of the exercise. The first of these workshops (in chemistry) took place in 2001 and the first multidisciplinary workshop was held in 2006. The aims of these workshops are twofold. Firstly the testing serves to demonstrate that the experiment is transferable to a new institution, by having it set-up and got running away from its home laboratory. The technical notes and student notes supplied need to provide sufficient information to anyone who is unfamiliar with the experiment. Secondly, testing provides valuable feedback to submitters on the strengths and weaknesses of the experiment. At the workshops, a community of practice is also fostered where discussions of practical educational theory take place.

After an experiment completes its workshop testing, it is returned to its home institution where modifications could be made before further student data is collected using the ASELL Student Learning Experience (ASLE) survey. The ASLE survey consists of Likert-scale and open-response items, and the student evaluation part of the Educational Template must include a summary of the Likert-scale data and a content analysis from the open-response items. The project team and the website provide...
guidance as to how the analysis can be completed, including examples.

Following the analysis and provided the student data meets certain criteria, the submitter is in a position to finalize the Educational Template and write the manuscript for publication. Complete submissions are then sent for peer review by 3 referees – a student who has participated in a workshop, a staff member of a university, and a member of the project management team. Normal editorial processes are followed where the submitters can respond to referee’s comments. Acceptance of the submission leads to the inclusion of the experiment on the ASELL website. If the submission included a full manuscript, this would be submitted for publication in the educational journals appropriate to the relevant branch of science.

The first ASELL workshop

The first large-scale multidisciplinary ASELL workshop was held at the University of Adelaide in April 2010. At this workshop 39 experiments were submitted for evaluation in parallel sessions across the three disciplines, biology, chemistry (including 2 biochemistry experiments) and physics. Testing of these experiments was completed over a four day period by a team of 42 academics and 41 students. In addition, a special 2-day workshop was run for Deans, Associate Deans and/or their representatives (13 delegates). This was the first time there has been such a good representation from the Deans at a workshop.

Table 1(a) provides a summary of the delegates who attended the ASELL Science Workshop and (b) Number of experiments and some of the types of activities tested at the ASELL Workshop

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</tbody>
</table>

Table 1: (a) Summary of the delegates who attended the ASELL Science Workshop and (b) Number of experiments and some of the types of activities tested at the ASELL Workshop

The Deans of Science at each of the participating institutions agreed to provide financial support for a team from each of the three disciplines at their institution to attend the workshop. Thus, the workshop was self funded and did not rely on external funding to run, which was the case in the past.

The workshop was organized following the procedure shown in Figure 2

![Figure 2](image_url)

Figure 2: The process undertaken to set up the ASELL workshop held at the University of Adelaide

Delegates were sent an invitation to submit an experiment and attend the workshop. Academic staff delegates submitted an Expression of Interest for the experiment they wanted to evaluate. After consideration of the types of experiments submitted, academics were notified whether their experiment was accepted to be evaluated at the workshop. Following the acceptance notification, academics were required to submit all the necessary documentation for the experiment.

The technical notes, experiment notes and risk assessments were passed onto the technical staff and PhD students who were employed to set up the workshop. Using the notes provided the experiments for the chemistry and biology workshops were set up in the corresponding laboratories at the University of Adelaide (setup commenced about 2 weeks before the workshop). Academics that submitted physics experiments were asked to send or bring their own
equipment, except for common equipment provided on a list by the host institution. Equipment for biology and chemistry activities was provided by the host institution. Not all the experimental activities were easy to set up and some experiments required assistance from other disciplines. For example, two biochemistry experiments that were run at the chemistry workshop required equipment that was provided from biology. If there were any materials that could not be provided by the host institution, the submitters were asked to either send these beforehand or bring it with them (this was kept to a minimum). Fortunately, in most cases, enough laboratory space was available for the majority of experiments to be set up the day before they were due to be run. The PhD students who set up the experiments acted as technical staff throughout the workshop.

The workshop itself had a very packed schedule. A flowchart of a typical day’s events is shown in Figure 3. Each day involved early morning discussion sessions focussing on the educational aspects of laboratory work where delegates were guided through an educational analysis of their submitted experiment (this provided scaffolding for completion of the ASELL Educational Template). Morning and afternoon laboratory sessions (each 3 hours long) were separated by a communal discipline lunch break. The Deans started participating on the second day of experimental work and completed the same activities as the other delegates.

![Flowchart of a typical day’s events at the ASELL Science Workshop](image)

**Impact on the Host Institution**

Hosting the workshop raised the profile of not only ‘what makes a good experiment’ but also the similarities of these factors across what had previously been considered to be a lack of any common ground. In concert with other curriculum renewal activities currently in progress, the workshop has provided increased opportunity for development of a more holistic approach to curriculum design, particularly in the core Level 1 discipline areas, with a focus on improving the student experience within the laboratory programs.

**Conclusion**

The ASELL Workshop held in April 2010 was the first workshop of its kind. In the past, discipline-specific workshops had been organized, in particular for chemistry. This workshop is the first example where experiments from all three disciplines were tested at the same time, while also allowing for cross discipline interaction during free/social time. The representation of Deans at the workshop was also much greater than at any previous workshop. The April 2010 workshop marks the start of more cross discipline interaction, conversations with the Deans and discussions about laboratory activities in future.

For further information go to: [http://www.asell.org/](http://www.asell.org/)