

A Model for the Teaching of Occupational Health and Safety and Risk Management within the Science Curriculum

The aim of the project was to develop a model for teaching Occupational Health and Safety and Risk Management in the undergraduate curriculum within the tertiary science education sector. We have now developed a series of modules for students at the Honours, First Year Introductory chemistry and Second Year Organic chemistry levels. The models vary between year levels because the teaching and learning objectives differ and are meant to reflect the prior experiences of the students and the necessity to encourage an attitude of personal responsibility for safety issues as the student progresses through the Science degree.

Completion of Objectives:

Integrate Occupational Health and Safety aspects of chemistry and risk assessment into course material:

OH&S and Risk Management modules have been incorporated into the Honours (25 students in 1997 and 6 in 1998), Level 1 Chemistry (600 students 1999) and Organic Chemistry II (80 students 1998) subjects. An extensive OH&S reference database has been established for use by the Honours (and in 1999 Level III students) students. An interactive computer tutorial system has been established as part of the core course material for Level 1 and Organic Chemistry II students. The incorporation of OH&S and Risk Management into the entire undergraduate course is still in progress, as we have not completed Level III chemistry nor the Physical and Inorganic Level II courses. This is part of the ongoing commitment by the two Project Leaders in collaboration with other staff members.

Teach students how to access relevant information using online data base services:

This has been completed at the Honours level and includes reference material for Honours students including information on accessing the main university library, accessing the computer catalogue and the material safety data sheets on CD ROM in the Department of Chemistry, as well as relevant internet sites and links.

Teach students how to interpret Material Safety Data Sheets correctly:

For Organic Chemistry II a large proportion of the computer tutorials (preliminary questions and questions at the end of the practicals) are aimed at introducing student to OH&S terminology found in the material safety data sheets. Some of the questions in the Honours assignments involve the interpretation of material safety data sheets as the students have not had significant exposure to the terminology as part of their undergraduate courses.

Teach students how to assess the risks involved in both the small scale and large scale use of substances:

At Honours level, scenarios were presented to students in which they were the managers responsible for a chemical process. In many cases, students had to compare disposal problems encountered with both small and large scale reactions. This topic is being further developed as part of our Level III module for 1999.

Teach students how to prepare reports on the comparative costs for the handling, storage and disposal of different classes of chemicals

In some of the Honours assignments the students were asked to compare the handling, storage and disposal of different classes of chemicals. In their answers students considered the safety and disposal aspects of the chemicals involved, including comparative costs of handling, storing and disposing of the materials. At this stage students do not have access to the pricing information that would be necessary for this type of comparison and so we are developing resources to assist in this area.

Teach students how to prepare reports on the potential health aspects of particular procedures

Again this is similar to the point above. The Honours students were asked in some of the assignments to consider a product and compare routes to its preparation in order to determine the most appropriate in terms of health and safety. We are also increasing the resources available to students in this area.

Develop curriculum material that can be used by academic and laboratory staff to incorporate into existing courses

Curriculum material was developed in the form of computer tutorials, core lecture material and post practical questions. Developing curriculum material which can be used by academic staff for incorporation into their courses is currently taking place and will be an ongoing feature of this project. This is successful with staff who are enthusiastic about the teaching of OH&S topics but is less

successful with staff who are reluctant to make room for the material as part of their core teaching. We have attempted to incorporate as much of the OH&S material into computer based format as this greatly assists in incorporating it into the teaching program with minimal disruption to staff teaching programs.

Prepare computer programs that can be used as part of course material for both undergraduate and postgraduate chemistry students

Interactive computer tutorials for both Chemistry I and Organic Chemistry II students have been prepared and are now an integral part of the syllabus and assessment.

Develop material for use in peer group teaching and assessment at 3rd year and Honours level in the form of role-playing

This aim has not been implemented to date. As part of our Level III course students undertake an investigative mini-project in groups of 3 or 4 and we plan to use this venue for the role playing exercise.

Not to increase the overall workload on students but rather complement course material

In all cases, the material necessary for the students to complete their assignments was already collated and readily available. Chemistry I students will be provided with on-line information sheets for all hazardous and dangerous substances used in their practicals. This same material will be used for the core teaching component. Organic Chemistry II students were provided with both material safety data sheets and a resource folder that contained all the additional information that was needed for completing the tutorials or post-practical questions. This material is also the database for the core teaching component. Honours students were provided with all the necessary reference books. These books were purchased with the express intent of minimizing the time students used in locating information in order to complete the assignments. A comprehensive on-line catalogue with key word index was prepared for these reference books so that the students could access the information with the minimum of effort. A comprehensive list of additional reference sites was also compiled, e.g., appropriate internet sites.

Collate material from a wide variety of sources in Australia

Relevant material was purchased from the South Australian Department of Labour, Workcover, SA Water, Standards Association of Australia, RACI and the EPA (South Australia). In addition, internet sites that either provided OH&S information or contained links to OH&S related material have been recorded, as have all the OH&S resources available within the University of Adelaide.

Present this material in a form which is suitable for use by academic and lab staff in their courses

Filemaker Pro was used to construct an OH&S reference catalogue so that the material could be easily located and accessed by any member of our Department.

The aim of the project was to develop a model for teaching Occupational Health and Safety and Risk Management in the undergraduate science curriculum. The project was multifaceted and involved a large number of subjects within the chemistry curriculum. It is also an ongoing project in that modules are still being prepared and material will continue to be incorporated into the core teaching components, as the necessary resources are now available. The funds for this project were used to employ a Lecturer Level A who assembled the various modules and assisted in their incorporation into the existing curriculum.

Chemistry students are now being better equipped with the knowledge, understanding and appreciation of the issues involved in Occupational Health and Safety in the workplace and the professional management of the risks involved in carrying out science related activities. The integration of these activities into the main lecture, tutorial and assessment activities within the chemistry curriculum has begun but is not complete at this stage. This is part of our ongoing commitment to the project.

We have attempted to build the modules with an emphasis on students developing skills, which have a more general applicability than simply the factual content of their courses and believe that this will benefit their professional standing with future employers. When all of the modules are in place (probably by the end of 1999) an important need of the community for graduates with an ability to access important information affecting the general health and well being of the community will have been achieved.

The final impact of the program will be evident when students have progressed from Level 1 through to Level III and Honours.

The individual modules are now discussed in more detail.

Honours Chemistry

A previous small grant from the University of Adelaide had enabled us to collect a wide range of OH&S/environmental/chemical safety reference material from sources such as Workcover, EPA, OHS unit at Adelaide University and these have formed part of a Departmental reference Library for students. This collation was completed as part of this present project. In order for this material to be accessible by the students a catalogue was needed. The software application, Filemaker Pro was used to produce a catalogue of all the reference material and subsequently placed in the OH&S section of the departmental library. The catalogue contained the title, author and publishing details of each reference. Keywords were prepared so that students could search the computer catalogue for particular topics.

Sample questions and answers were prepared for an Introductory lecture to Honours students on their OH&S assignments. The course material was aimed at introducing students to their legal responsibilities when handling, storing, using and disposing of chemicals and the responsibilities of employers and employees in terms of chemicals in the workplace.

In 1997 there were 23 Honours students and 11 OH&S assignments were prepared for the students to complete in pairs (a copy of one is attached in the Appendix). In 1998 there were 6 students and so the best questions were selected from the 1997 assignments and rearranged to form 6 modified assignments (The "best" questions were selected on the basis of the quality of answers received for the questions used in the previous year and feedback from the students while attempting the questions).

Reference material was prepared for the students on how to find information for the assignments. This included an overview of the OH&S legislation that related to chemical safety, a list of appropriate internet sites, information on how to access the University of Adelaide main library and its online data bases, e.g. OHS-ROM, where to find material safety data sheets in the Chemistry Department and how to access and search the OH&S computer catalogue prepared above.

Some impediments to the achievement of the intended outcomes in 1997 were: the students at this stage did not have the benefit of previous education on OH&S topics and the background information of students varied widely. In previous years there had been no formal training in chemical safety in the Department (apart from safety notes from the various Practical Manuals and the Postgraduate Safety Manual which deals with specific chemical problems rather than the broader aspects of responsibility and management) and hence the assignment questions at the Honours level could not be as advanced as originally hoped. This is likely to change over time as OH&S and Risk Management strategies are introduced progressively to the undergraduate students. The assumed knowledge of the Honours student in a few years time will be much more than the present students and hence more involved questions and scenarios will be discussed.

In 1997, after the Honours students had completed the assignments, the students were asked to anonymously complete a SET (Student Evaluation of Teaching) form regarding the assignments. The completed SET's were sent to the Advisory Centre for University Education at the University of Adelaide (copy attached in the Appendix). The assignments answered well however it appeared a small number of the questions within the assignments were not clear and hence these were either eliminated from the 1998 assignments or modified to increase clarity. In 1998 the students did not appear to have any problems with the assignments, only one student required minor assistance. The assignments were generally well answered and the students indicated they felt more confident about discussing OH&S issues.

This is now a compulsory course for all Honours students in Chemistry at the University of Adelaide and represents a commitment by the Department to this project. The cost in terms of staff time for this new course is minimal since the students use the resource centre formed as part of the project and we now have a sufficient number of case studies to rotate from year to year.

Organic Chemistry II

At this stage science students have had a minimal level of exposure to the issues relating to OH&S and Risk Management. This will change with the introduction of course material in Level 1 Chemistry in 1999. We have combined the objectives of embedding OH&S into the core curriculum material with the students expectation of safety issues relating to the laboratory by requiring a number of safety and OH&S questions to be completed before each practical. This material is then used as part of the core lecture and tutorial presentations. The advantages of embedding the OH&S material into our computer based teaching and assessment program are that the staff resources required for an ongoing commitment to the modules is minimal and it ensures that the use of the modules does not depend solely on the two original proponents for this project. It is convenient for the Department to continue the modules. This has been one of our aims in designing the format of the modules. They should not depend on a few committed staff members. This has been one of the difficulties encountered in embedding OH&S and Risk Management into all curriculum areas within the chemistry course. Some staff are reluctant to allow OH&S material to displace "real chemistry".

A computer based interactive tutorial on OH&S for every practical in the current Organic Chemistry II practical course was developed. Questions were aimed at encouraging the students to consider the broader aspects of the work they were engaged in. Issues addressed included the terminology used in MSDS, how to interpret a MSDS, the legal prerequisites for the preparation of a MSDS, the labeling requirements that exist by law for chemicals, (e.g., transport labeling, dangerous goods code, dangerous goods symbols, EC symbols, SUSDP requirements) and the storage requirements in the laboratory.

As the practicals are completed by the students in numerical order, the tutorial questions were written so that the information gained by the student in one tutorial could be used and built upon in the subsequent tutorial. We have had considerable experience in writing software applications using the program Authorware and so used this to prepare the questions. The students could then access the tutorials from a number of computer suites in the University. A trial run of the tutorials was carried out and the appropriate modifications made after feedback from students and staff. The tutorial questions were also prepared in a format suitable for incorporation in the Practical Manual. The students could therefore work on the tutorial questions during the practical session and also access the reference material simultaneously. The time on the computer is minimized. The students only have to enter the answers on computer rather than work them out on the spot. This same material is being used for incorporation into the core teaching program and weekly tutorial sessions.

In order to minimize the extra workload for students in completing the tutorials all the information necessary for answering the tutorial questions was provided in the laboratory. Material safety data sheets were collated from a variety of sources and in addition to the material safety data sheets; six copies of a resource folder were prepared. The resource folders contained material collated from a variety of sources and contained additional information required to answer the tutorial questions, e.g., glossary of OH&S terminology, information on selected chemicals, excerpts from OH&S legislation.

The response of the students to the computer based tutorials and hence the success of the project was gauged from anonymous comments that the students could write at the end of each tutorial (see attachment in the Appendix). Using the first tutorial as an example, the positive comments generally indicated that the students found the tutorials useful, and a good teaching method. One response also indicated that in particular the explanations written after the answers were a good feedback for the student, rather than a simple correct/incorrect response. The negative responses generally were related to technical problems that were to be expected with setting up such a large scale computer tutorial exercise. There were one or two comments given by the students that they didn't like doing the questions (no reasons given), with some students suggesting they would prefer a one-off lecture rather than ongoing tutorials.

Level 1 Chemistry

This part of the project has only recently been completed and will operate for the first time in its entirety in March 1999 and so we do not have student feedback at this stage. The core lecture and tutorial material is being used in Semester 2 of 1998.

At this level the students do not have a high level of experience in the issues relating to OH&S and Risk Management. Students still regard OH&S as being relevant only in the Laboratory. We have combined the objectives of embedding OH&S into the core curriculum material with the students expectation of safety issues relating to the laboratory by requiring a number of safety and OH&S questions to be completed before each practical. This material is then used as part of the core lecture and tutorial presentations.

A series of multiple choice questions for 8 out of the 12 practicals in the current Chemistry I course have been prepared. Only the chemicals that are classed as hazardous according to Worksafe or classed as Dangerous Goods are considered. The questions at this level are aimed at covering the students responsibilities in basic first aid responses to minor accidents, the properties of the various chemicals used in the practical, disposal of chemicals in the laboratory and safe handling procedures. The questions are designed to "stand alone" as the practicals are not done in any prearranged order. As with the Level II material we have used our past experience with the program Authorware to write a suitable application for the students. In this form they are mounted onto a file server and made available to Chemistry I students from a number of computer suites at the University of Adelaide. The students must complete the tutorials before they are allowed to begin the corresponding practical in the laboratory. The tutorials are marked automatically by the computer and the results recorded. At the end of the tutorial the students may comment anonymously on the exercise.

At First Year level the chemistry students have not been formally introduced to material safety data sheets. According to serverly staff in previous years the material safety data sheets have always been made available to the students but in practice, very few students access them. Material safety data sheets use specialist terminology to describe chemicals which is often difficult to understand without formal training. In Level I chemistry it was thought that easy to understand information sheets should be prepared which describe the major consequences associated with the chemical concerned. These sheets were designed to complement the material safety data sheets and not replace them as they are not as detailed. The information sheets were prepared using the information gathered from material safety data sheets from a variety of different sources. The students need to use the information sheets to answer the computer tutorial questions and hence the sheets have been placed on computer and can be accessed by the students whilst completing their tutorial. By the end of the year students will be using the Material Safety Data Sheets as a natural progression once they are comfortable with the format and understand better the information contained within them.

In 1999 we will have OH&S modules operating at Level 1, II and III of the undergraduate chemistry curriculum as well as the Honours OH&S course. As part of our ongoing commitment to this project we will prepare an entry and exit survey of students in each of these levels. Since this project was multifaceted and involved a large number of students and subjects within the chemistry curriculum it has not been possible to obtain a quantitative measure of OH&S knowledge of the students overall. We will endeavor to remedy this as more modules are added. We still do not have modules available for some subjects at Level II and III.

Embedding the teaching of OH&S issues into the core curriculum is still the primary objective for this project. It will take more time to achieve this in all curriculum areas primarily because the enthusiasm is not uniform amongst all the teaching staff. This was anticipated and is the reason we have used the computer tutorial system for much of the work for Level I and II. At Level III many of the students are involved in collaborative projects and this will be the most appropriate format for embedding OH&S teaching material. These students will be able to access the resources already assembled for the Honours students.

We feel that the most appropriate format for distributing these modules and associated teaching materials to other tertiary institutions is to construct an OH&S and Risk Management Web site. This would allow other teaching staff to assemble the material in a manner appropriate to their teaching methods and would allow students access to the on-line resource material. We feel this is a separate project to the present one and will make an application through CUTSD for funds for such a project.