The ODP Undergraduate Student Trainee program: taking part in experiential learning at sea

Kelsie A. Dadd and Rachel Sandwell

Department of Earth and Planetary Sciences, Macquarie University, Sydney

Abstract

On the 6th November, 2002, the second author sailed out of Panama on board the Joides Resolution as an Undergraduate Student Trainee on ODP Leg 206. In 2002, Rachel was a second-year student enrolled in the Marine Geoscience strand of a Bachelor of Marine Science at Macquarie University, Sydney Australia. Experiential learning is a critical component of teaching and learning in the geosciences in Australia and includes such things as field work, vacation employment and occasionally work-place learning units as part of the main stream curriculum. Opportunities are rare however, both in Australia and overseas, for this type of international research-based marine investigation at undergraduate level. The ODP Undergraduate Student Trainee program was designed to offer the student a wide range of scientific and technical activities while aboard ship and to train the student under the guidance of a scientific mentor. The objective of Leg 206 was to sample a complete oceanic crustal section at a site with a superfast spreading rate to document one end-member style of mid-ocean-ridge development. The leg had only one site; site 1256 adjacent to the East Pacific Rise on the Cocos Plate. Rachel's interest in marine geophysics led to her being primarily positioned in the paleomagnetic laboratory. The main techniques used on the core in this laboratory were alternating field (AF) demagnetisation, to remove the drilling overprint and determine the characteristic remanent magnetisation on all sediment and some hard rock samples, and anhysteretic remanent magnetisation (ARM) and isothermal remanent magnetisation on some discrete samples. Rachel also took part in writing explanatory notes for the ODP report volume. She described her experience saying, "I worked along side recognised geophysicists learning new techniques that will be invaluable to my continuing studies". Rachel followed her nine weeks at sea by completing a project-based subject and producing a report describing and discussing the results of her work on board the Joides Resolution. Her time as a student trainee counted towards this subject. The ODP undergraduate trainee program was an excellent means of providing students with new oceanographic and scientific skills while gaining a range of both technical and interpersonal generic skills. The program inspires not only the student involved but others with whom they come in contact at their home institution. Rachel described her time at sea as "an extremely intense learning experience, but practical and a lot of fun". Experiential learning allows students to interact with working scientists who pass on enthusiasm as well as knowledge. Rachel was the first and last Australian student to be involved in this scheme and there is now a need to develop an ongoing Australian program placing undergraduate students into marine research programs.

1. What are the Benefits of the Undergraduate Student Trainee Program?

Benefits to the student:

- Learning by doing increases the chances of understanding
- Exposure to research in action
- Learning environment is free of distractions
- Learning to negotiate a team work environment
- Development of coping mechanisms due to isolation from peers
- Empowerment through decision making
- Learning to cope with the unexpected and become adaptable
- Development of generic skills

Benefits to the university:

1. Exposure of the university in a research setting
2. Prestige in having a student chosen for the program
3. Returning student brings back enthusiasm for science and research

Benefits to the community:

- Exposure of the program and research to more people through interaction with the student
- A community member with better life-skills

2. What is Experiential Learning?

Experiential Learning is defined by different people in different ways. I see experiential learning as a teaching technique that incorporates such things as field work, work-based training, simulations and groupwork (eg. Weil and McGill, 1989; Petersen, 1989; Evans, 1994). Participation in research cruises by undergraduates is another example. Experiential learning recognises that learning takes place in settings other than within formal institutions. Depending on the experience and its construction in terms of learning outcomes, it may be more valuable to the learner than many formal learning contexts.

Experiential learning is learner-centred, active and related to the life and life experiences of the student. Participation in research cruises places the student in a learning environment that engages their full attention. The student must make their own decisions and experience the results of these decisions (eg. Weil and McGill, 1989). The cruise allows interaction between the student and research scientists and the student gains not only insight into the science they are working on, but also the methods, morals and attitudes adopted by the scientists. In this case, the experience for the student will depend on the scientists or mentors on the ship, but is likely to be more broad than it is possible to create within a formal classroom situation. Experiential learning is seen as a "process that links education, work and personal development" (Kolb, 1984).

Experiential learning is about both personal and practical involvement in the learning situation (Henry, 1989). Personal involvement leads to the development of a number of generic skills such as empowerment, and becoming conscious of ones needs and desires (Henry, 1989). Practical involvement leads to greater student motivation and, through active involvement, a deeper understanding of the subject content (Henry, 1989; Ramsden, 1992; Boud et al., 1993).

Much of the view of **experiential learning** presented here **relates to learning in context**. Students given a contextual setting for their learning can see where the experience is heading and move forward with greater motivation. Participation on a research cruise involves active participation within context. This learning experience can then be incorporated into the traditional teaching environment (the university course the student is undertaking).

3. Assessment

Rachel was able to use her time and the experience gained during Leg 206 toward **credit in a project-based unit** at Macquarie University in the Division of Environmental and Life Sciences (ELS303 Marine Science Project). Assessment is via a contract between the student and a nominated supervisor from within the Marine Science Program. The requirements for acceptable contract proposals in ELS303 include:

- *The program must involve a minimum of 160 hours.*
- *The project must be able to be completed and assessment material*

submitted in the one semester.

- *Approval and agreement to supervise completion of this contract and undertake assessment by a supervisor deemed appropriate by the unit convenors.*

Such **contracts or learning agreements** (Figure 1) are an ideal way to assess project-based courses such as ELS303 in which the content and outcomes can vary considerably. The stages in development of a learning agreement and its outcomes should involve the following:

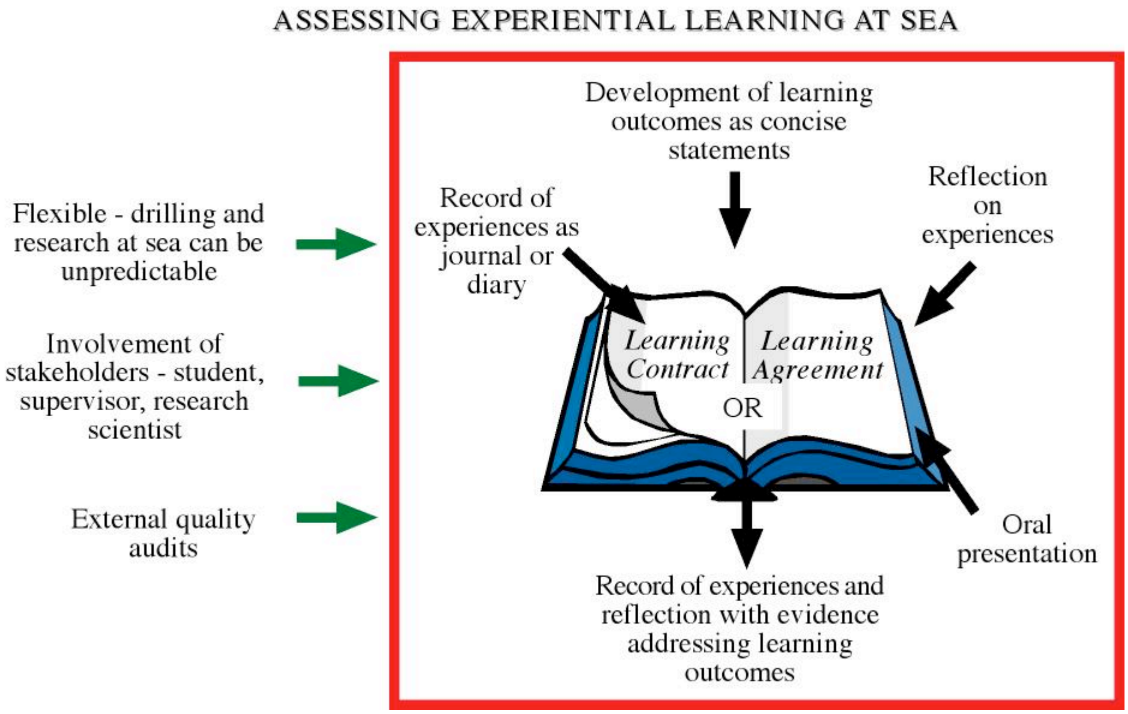

Fig 1. Inputs and outputs in the development of a learning contract or agreement for assessing experiential learning at sea.

- **Recognition of learning outcomes** or key competencies expressed as a series of concise statements that can be used as a tool for assessment (Evans, 1994).
- Records of the individual's experiences while on the cruise as a **note book, journal or diary** indicating the type of experience and how it fits into the list of learning outcomes.
- **Reflection on these experiences** recorded in the note book, journal or diary.
- **Synthesis of the results and reflections, along with evidence**, compiled as a report addressing each of the learning outcomes.
- After submission of the report, an **oral presentation** can be used to assess the depth of the students' understanding and involvement in the program.

Other factors to consider include:

- The development of the learning outcomes and the assessment of the report **need to involve a number of**

stakeholders. These include the student, the supervisor and possibly the supervising scientist on the cruise.

- The role of the sea-based supervisor must not be too onerous as they have their own tasks to perform.
- The **learning outcomes and the agreement or contract must be flexible** and be able to be renegotiated to allow for the unpredictable nature of drilling and sea-based research.
- The entire assessment process should be able to **stand up to an external quality audit**.

4. ODP Leg 206

During November and December 2002, the Ocean Drilling Program (ODP) conducted a scientific expedition on the drill ship JOIDES Resolution (Leg 206) (Figure 2), to core a complete oceanic crustal section at a site with a superfast spreading rate (~200 mm/yr) (Wilson and Teagle, 2002). The leg has only one site; Site 1256 situated on basement rock with an age estimated by magnetic anomalies to be ~15 Ma. The ocean depth at this locality is 3655 m and there is a sediment thickness of 250.7 meters below sea floor (mbsf) (Shipboard Scientific Party, 2004). Four holes were cored at this site and the core passed through various laboratories, one of which was the paleomagnetic laboratory in which Rachel worked. Here measurements were made on both the split-core archive half samples and discrete samples collected from the working half of the core.

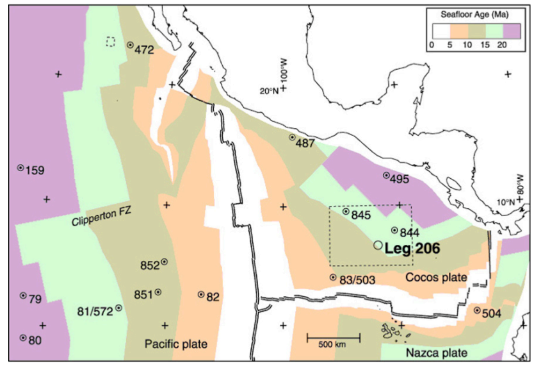

Fig 2. Locality of site 1256 in relation to the Central Pacific, site 844 and site 845. The figure also displays the magnetic anomaly age, with the wide spaced isochrons in the south reflecting the super fast spreading rate (Wilson and Teagle, 2002).

5. Rachel's view of life on board the Joides Resolution

Ship life is simpler (without the hustle and bustle of everyday life) but it is also a lot more intense (you deal with the same group of people all day every day), and on board the *JOIDES Resolution* everything seems to come back to science! It is great to be gaining work experience in the field that I have been studying. I worked along side recognised geophysicists learning new techniques that will be invaluable to my continuing studies. I made many friends among those on board. I shared a cabin with three other people. The cabins were selected by placing people of similar ages and fields together to encourage friendship. The crew on board were very friendly and always willing to help me out, show me around and answer my many questions about the ship. It was an extremely intense learning experience, but practical and a lot of fun. When it all got too much, at the end of a twelve-hour shift, I could go and watch one of the new DVD's on the large projector screen or go to the gym (Figure 3).

Fig 3. Rachel Sandwell gets a special gift from Santa for being the youngest on board. (ODP, 2004a)

6. Scientific and technical skills developed by Rachel during her time on Leg 206 include:

- analysis of raw data and presentation in a range of styles (eg Z-plot - stereogram-like presentation)
- exposure to analytical equipment - multisensor track (MST), archive multisensor track (AMST), cryogenic magnetometer, Schonstedt Thermal Magnetizer
- cleaning of components and calibration of equipment - predominantly the cryogenic magnetometer
- alternating field demagnetisation of drill core, to remove the drilling overprint and determine the characteristic remanent magnetisation on all sediment and some hard rock samples
- anhysteretic remanent magnetisation and isothermal remanent magnetisation on discrete core samples
- computer skills eg using Macintosh computers rather than PCs
- exposure to new software: KaleidoGraph, LongCore V 3.3, CorelDraw, Adobe Illustrator, Adobe Acrobat
- report writing - data analysis and methods for the ODP report volume
- exposure to a variety of laboratories allowing different forms of analysis to be explored eg. palaeomagnetics and palaeontology (Figure 4)

Fig 4. Undergraduate student trainee Rachel Sandwell (Australia), at work in the core shack (ODP, 2004b).

7. Generic skills developed by Rachel during her time on Leg 206 include:

- making contacts within the industry
- learning to work in a team environment
- working in close proximity with fellow scientists (amplifies the need to assist one another both with knowledge and workload)
- communication
- developing an understanding of the niceties of group dynamics
- coping with the unexpected and becoming adaptable
- empowerment through decision making
- broadening horizons through the interaction with people from different cultures (19 nationalities

were represented onboard including crew)

- report writing
- opportunity to be involved in new science
- problem-solving skills

8. Other undergraduate and high school programs that incorporate components of experiential learning and marine science

There are a number of programs available that allow students access to marine research vessels and allow them to work alongside research scientists, including:

1. University of South Florida's College of Marine Science Executive Internship Program in Marine Science (USF, 2004): enables Year 11 and 12 high school students to explore career opportunities in ocean science over one or more semesters. Students are able to sail aboard one of the State of Florida's scientific research vessels while working as part of the scientific staff, and collecting and analyzing various oceanographic data. The fields of study include physical, biological, chemical, and geological oceanography.

2. SEA Semester offered by the Sea Education Association of Woods Hole, Massachusetts (McClennen and Meyer, 2002): a 12-week (semester-length) program combining onshore and at-sea training on a research vessel. Students are trained in a number of oceanographic techniques while onshore and complete a project while at sea. This program is seen as highly successful.

3. The Australian Maritime College, Faculty of Fisheries and Marine Environment (AMC, 2004): the college has a number of programs designed to serve the maritime sector. Students spend time aboard the Bluefin and receive training in vessel technology, fisheries biology, and ocean and coastal processes.

9. Where do we go from here?

At present there is no specific Australian program that directly supports regular undergraduate participation in marine research cruises (Neal Denning, pers comm). Australia's participation in IODP is unknown. A small number of organisations in Australia have research vessels that would be appropriate for a program such as the ODP Undergraduate Student Traineeship. These include:

- The National Facility Steering Committee (NFSC) that oversees access to the National Facility Research Vessel Southern Surveyor (Figure 5).

Fig 5. The southern surveyor (CSIRO, 2004).

- The Australian Antarctic Division that operates the Antarctic research\supply vessel Aurora Australis (Figure 6).

Fig 6. The Aurora Australis at the ice adge. Australian Antarctic Division photo. Commonwealth of Australia (AAD, 2004).

- Australian Institute of Marine Science that operates the smaller vessels Lady Basten and Cape Ferguson.

Participation in research cruises is largely through the development of research proposals and application to one of these organisations. Proposals are ranked by merit and take into account available ship time. Applications to the NFSC are open to researchers from all Australian marine research agencies - government and universities. Once a proposal is accepted, it is often the Chief Scientist who decides on the team, including the inclusion of students, typically postgraduates.

The number of berths on the Australian vessels is generally limited compared to the Joides Resolution that can accommodate 50 scientists and technicians (ODP, 2002). For example, the Southern Surveyor has only 12 scientific berths, the Lady Basten has 7 berths for passengers and the Cape Fergusson has 14 berths including crew. However the Aurora Australis can accommodate around 50 scientists during its research voyages. While most of its voyages are as supply trips for Australia's Antarctic territories, typically two voyages a year are for research (Michael Stoddart, pers comm.).

The NFSC appears to be the most appropriate body to oversee a program similar to the ODP Undergraduate Student Trainee Program but has limited berths available. The Australian Antarctic Division itself, as a government body, is not permitted to use student volunteers but has the greater capacity to absorb students into its research staff numbers. The length of voyages aboard the Aurora Australis may be a problem as research voyages are usually combined with supply voyages. However time can be spent working on data if the facilities are available.

The Australian scientific community, possibly involving a joint venture of the NFSC and one of the new ARC Networks, needs to develop a scheme and policy to support this type of program. The benefits to the Australian students involved are likely to be many but the flow on to other students through publicity of the program could influence the career choices of many more young Australians.

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