The University of the Sea and the Benefits to Student Learning of Participation in a Marine Research Expedition

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Abstract

The University of the Sea has provided university students from the Asia-Pacific region with experience on multi-week, marine research expeditions since 2004. The program is UNESCO-funded and generously supported by Geoscience Australia. During 2007 and 2008, students were surveyed to ascertain whether they felt the program was a valuable learning experience. The survey had both Likert-scaled and open-ended questions. The students enjoyed the experience, found it valuable, appreciated putting theory into practice, and liked the interaction with scientists. They gained skills and knowledge that will help guide their career paths. However, most felt they required more information prior to the expedition, and a greater knowledge of the research aims and their role in the expedition. Students incorrectly assumed the expedition would be tailored to their learning and would provide didactic learning experiences. They did not automatically see the experiential learning activity was valuable in itself.

Keywords: Marine research, Survey, Experiential learning

1. Introduction

Experiential learning, a teaching technique that incorporates elements such as field work, work-based training, simulations and group work (eg. Weil & McGill, 1989; Petersen, 1989; Evans, 1994) is a critical component of learning and teaching in the geosciences. 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-centered, context-based, active and related to the life and life experiences of the student. The learning activity is closely related to real-world activities and as such is a form of situated cognition (Brown et al., 1989).

Opportunities are rare, both in Australia and overseas, for student participation in experiential and research-based marine investigations particularly at undergraduate level. Examples of this type of activity include the Ocean Drilling Program Undergraduate Student Trainee program (eg Dadd & Sandwell, 2004), which ended in 2003, and the University of the Sea (UoS) program, which began in 2004. These programs are an excellent means of providing students with new oceanographic and scientific skills while gaining a range of both technical and interpersonal generic skills. Participation in research expeditions 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 & McGill, 1989). The program inspires not only the student involved, but others they come in contact with at their home institution.

This paper examines the results of surveys conducted in 2007 and 2008 after legs of the UNESCO and Geoscience Australia -funded multi-week UoS program. There were 18 students involved in the program in 2007 and 10 completed the survey; in 2008 there were 24 students with 14 completing the survey. While these low numbers do not allow rigorous statistical analysis of the data, they do provide an overview of the student perception of their learning experience and allow comment to be made on the themes of integration of research and teaching and experiential learning.

2. University of the Sea Program and study participants

The University of the Sea program is a partnership between a number of agencies and universities (Table 1). The program has operated since 2004 and the research expeditions have investigated problems in the Coral Sea, Arafura Sea, Tasman Sea and Indian Ocean, adjacent to Australia. The research problems have included sea level change, gas hydrates, petroleum potential and benthic habitats. All expeditions to date have been run in conjunction with Geoscience Australia, the Australian national geoscientific survey. Geoscience Australia values the training of young scientists and has generously made berths available during these expeditions. The UoS program places the students in the role of researcher allowing young local scholars to address specific regional problems through marine-based research. The students have the opportunity of working with senior researchers from the region.

In 2005 the UoS program had 20 students, 19 in 2006, 18 in 2007 and 24 in 2008. The results discussed in this paper are based on the expeditions in 2007 and 2008. Students apply to participate in the program and are selected on ability and the need for a spread across participating countries and universities. Over both expeditions there were approximately 40% final year undergraduate and 60% postgraduate students. The respondents were 50/50 male/female in 2007 and 64/36 male/female in 2008. The ethnic background of the participants was not included in this study, as due to the small number of students surveyed and their diverse backgrounds, the data would have enabled most to be identified.

The author of this study participated in one "leg" of each expedition involving three weeks at sea in 2007 and four weeks in 2008. She also spent time with the student participants for several days before and after legs in a more social situation. This allowed a rapport to be developed between the students and supervisor and sufficient time was spent together in close conditions for a sense of "prolonged engagement" and "persistent observation" (eg Lincoln and Guba (1985)) to develop. Participation on two expeditions allowed the author to validate the data by comparison. Each of the other legs also had a student supervisor who monitored the work and performance of the students as well as helping with their personal issues. The relationship between the supervisor and students, and that between the scientists and technical staff and students, will have varied slightly between each leg. However work and living conditions were the same on a single expedition and similar between the two expeditions. The use of two different ships with different facilities and rules, and cultural differences between the ship's crews, will have had an impact on the survey results. Both expeditions were "dry" and drugs are not permitted.

3. Methods

All students on the 2007 and 2008 expeditions were invited to complete a questionnaire. Each expedition consisted of a number of legs, three in 2007 and four in 2008, after which the ship returned to port where the scientists, students and some crew left the ship and were replaced with a new cohort. The questionnaires were distributed and collected near the end of each leg as the ship traveled back to port. Participation was voluntary and anonymous and students could choose to return uncompleted questionnaires. Based on the number of returned and completed survey forms, almost all students on the two legs were actively involved in the study.

The questionnaire included both quantitative and qualitative data including questions about participant demographics. There were fifteen rated responses, using a "strongly agree" to "strongly disagree" Likert scale, and nine open-ended questions (Table 2).

4. Survey Results

The following section examines the results of the rated responses most closely related to the student learning experience and includes graphs showing the distribution of responses for 2007 and 2008, and selected student statements taken from the open-ended question responses (the number after each statement indicates which question in Table 2 the student is responding to).

4.1 Aims, objectives and structure of the learning experience

The chief and co-chief scientists of each leg present an introductory talk that covers the aims of the expedition and how it will be run. The students are also given information by the UoS administrative staff via email, prior to leaving on the expedition. Although rated responses (Figure 1) suggest that most students thought that there were clear aims and objectives, this was not evident from the data gathered by the open-ended questions. Several students criticized the timing of material given to them and would have preferred written material well in advance. To facilitate the distribution of material in the future, the UoS organizers should aim to develop an outline for the program that contains standard information into which the specific aims and objectives for each expedition can be pasted.

*"Clearer objectives and expectations" [2]**

"Better information on objectives and conditions beforehand (eg what the opportunities might be, what resources (books and equipment) would be available)" [2]

"Better background information of what the expedition was actually about. I really knew nothing coming into it." [2]

"Background materials should have been made available weeks in advance" [8]

**Numbers in brackets indicate the relevant open-ended question in Table 2.*

The design of the student work varies from one expedition to another and usually from one leg to another. The design is left to the Chief Scientist in charge of the leg and is dependant on the scientific aims and scope of the program. In 2007 the choice of project topics was left to the students, supervisor and staff to organise once the expedition was underway and the students had naturally slotted into the work schedule and begun communicating with the scientific staff. In 2008, the students were presented with a project to work on when they were not otherwise engaged with the general scientific program. The students had reservations about both techniques (44% neutral or disagree in Figure 2) and this in part probably reflects whether the work was in their area of specific interest.

Where a more structured project framework is used, the students need to engage with the topic and see its relevance to the overall aims of the expedition or they will identify it as being simply a time wasting exercise. The student report completed in 2008 was used by Geoscience Australia when preparing the expedition report, but this end-result was not obvious to the students at the time.

"Give students tasks that need to be done not tasks to keep them busy" [2]

Many students felt that the expedition should be better structured in order to aid in their learning, including the use of lecture programs and targeted skills development. However, the expedition is a real scientific cruise that has been carefully planned to meet its primary objectives, not an educational tool for the students. They benefit simply by participating in the experience. This needs to be made much clearer to the students in their initial information package to avoid misunderstanding.

"Increase the number of lectures and lectures about the methodologies used" [2]

"Structured lectures on most days" [2]

"Clearer direction as to what was expected and what we could do to learn" [4]

"Better structure with more options available for students. Work should be related to the students field of interest" [2]

A large proportion of students felt they were not encouraged to reflect upon what they were learning. Experiential learning itself involves reflection and as the students are immersed in the learning environment, they must be reflecting on how it impacts on their learning and personal lives. The learning experience might be improved by asking the UoS students to present results part way through the trip or by scheduling more debriefing sessions to update progress and discuss skills development. This would provide an excellent opportunity for the students to share their mental reflection with the group.

"Perhaps having regularly scheduled discussion periods for information sharing and learning new material would have been more productive – the irregularly held talks … were very appreciated" [4]

4.2 Was the UoS program seen as a valuable learning experience?

The UoS program was seen as valuable by students on both expeditions (Figures 3a & b) and almost all students indicated that the expedition was an effective learning experience. Students valued the opportunity to participate, to work and talk with the scientists and to interact with the other students. This appears to be the most successful part of the program. The comments below emphasise the diverse range of opportunities that the students value. The excitement and enjoyment felt by most of the students while participating with the program would have added to their engagement with the subject matter and therefore promote a deeper of understanding of what they learnt (eg. Yair, 2000; Hu & Kuh, 2002; Weiss, 2003).

Being on the boat at sea, meeting new and different people, seeing sampling equipment in action" [1]

"Diversity of research and abundance of opportunity to learn completely different fields of science" [1]

"The hands-on experience gained" [1]

"The opportunity to pursue a small project and report on my findings gave me more confidence in my marine science knowledge" [5]

UoS students apply for places in the program and are interested in marine science (Figure 4). However each expedition has a specific focus and this may not always be in the area of interest of the student. Some students focused on the positive benefits of being exposed to areas outside their own while others had a more narrow focus and did not appreciate having to cover areas outside their chosen direction. Australian postgraduate students are expected to complete their study and submit their thesis within three and a half years. This time may include working as a teaching assistant in order to develop skills needed for an academic career. Such time constraints can make the students very focused and goal-oriented.

"have practiced my marine skills over trip in species ID etc" [5]

"I think it would have been better to advertise for geology students. And emphasize the petroleum focus more" [9]

"More training is required for post-processing techniques" [7]

"Diversity of research and abundance of opportunity to learn completely different fields of science" [1]

"I have experienced what kinds of information has led to the development of conclusions/theories in other science fields" [5]

A larger number of students saw the opportunity not only to practice within their own field (Figure 5) but to learn more about closely related ones. In practicing the theory learnt in the classroom and placing this in a real world context, students are more likely to challenge misconceptions, see learning less as the acquisition of a set of "facts", and thus develop new knowledge (Apedeo & Reeves, 2006). Through reflection students may then develop a deeper understanding of the new knowledge. It is interesting to contrast this idea with those of the student responses to the statement "Encouraged to reflect upon skills and abilities", which had a relatively negative response (48% average strongly agree or agree). Based on comments made, students may perceive the act of reflection as an open, verbal activity, rather than an internal, mental process.

"Put all the theory I have learned in the last few years into practice" [6]

"now that we have had the opportunity to do what we have learned in a classroom we have a better understanding of how things work at sea" [5]

"the chance to learn so much about geology and marine science from so many experts on all different levels" [7]

4.3 Instruction and technical support

Although UoS students generally felt they had reasonable one on one instruction, some felt that more was needed (Figure 6). This may relate to their expectations of the expedition as a student-training trip rather than as comment on the instruction that was given. Each student cohort on a UoS expedition is accompanied by a supervisor. Supervisors are volunteers from the University sector and represent one of the universities participating in the program. To date, all supervisors have come from Australian universities located mainly on the eastern seaboard. They have been drawn from a range of disciplines related to marine science, but predominantly from the field of geology. While most supervisors are familiar with the marine science techniques used by the students on the ship, they are not given training in experiential learning itself prior to sailing. Subsequently some supervisors may have no background in these learning and teaching methods from their own education (Lawson, 2007) and may find the learning environment difficult. Without the structure provided by more didactic teaching methods, the supervisors may not perform as well as the students would wish. The same situation exists for the scientists and technicians on the expedition who, while not present as student supervisors, may be viewed as "teachers" by the students.

"More direction in what I was required to do" [4]

"Better supervision from the University of the Sea lecturer would have helped" [2]

"More explanation from GA's staff" [4]

"I learned how to obtain optimal data which was good, but I did not learn any processing techniques" [7]

"advice and support from xxxxx which are very valuable and of great help" [4]

"The approachability of all people involved in the survey and their willingness to answer questions" [1]

The staff/student ratio on the UoS expedition was excellent and much better than students would experience in a class room setting so it is difficult to understand the range of responses shown in Figure 7 in relation to technical support. Senior students may expect more detailed and focused technical support particularly in areas that are not their own. It is possible that the technical staff did not see supporting and training the students as part of their duties. The students may have seen the scientists and technicians as "teachers", and not recognized that their main goal was science and data collection. The development of a technical-support library may alleviate some of these issues, allowing the students to research unfamiliar concepts rather than rely on others to train them particularly during busy periods.

"More experience in weak areas such as deep sea biology since we were doing a lot of deep sea sampling" [2]

"Recording and processing of the sonar bathymetry because only the information technology specialist is involved" [3]

"Diversity of scientists and technicians with different backgrounds and perspectives provided an interesting and well balanced learning environment (lots of videos and good food was also very welcome)" [7]

Despite feeling that they had insufficient technical support, students thought that they had sufficient opportunity to talk with staff (Figure 8).

"Research staff also very open and encouraged involvement" [9]

"I didn't get to work with the geologist doing what I was most interested in, although every time I was still awake on day shift I'd track him down and ask questions" [7]

"Transferring the knowledge; give some lectures from GA staff to the student" [2]

4.4 Interpersonal and transferable skills

Working in close conditions on a 3 to 4 week expedition appears to have been effective for enhancing interpersonal skills (Figure 9). The students formed close bonds and supported each other. They were able to mix with students, scientists and crew, including those from other cultural backgrounds.

"Being on the boat at sea, meeting new and different people…" [1]

"Able to work with other people with different backgrounds" [6]

"…difficulty in understanding different accents, unfamiliar food" [3]

Students were able to work with others and share tasks (Figure 10). They appreciated the opportunity to work with the scientific team from Geoscience Australia. The interpersonal and team-work aspects of the expeditions were highlighted as "best aspects" by 44% of the students.

"Working as an integral part of the formal research team" [1]

"The approachability of all people involved in the survey and their willingness to answer questions" [1]

"Developing camaraderie with my shift mates…" [1]

"Working with experienced, knowledgeable GA staff; team work, friendly environment; equality between GA staff, ship crew and students" [1]

5. What can be learnt about the research-teaching nexus?

Programs such as the University of the Sea are an example of where students are directly exposed to research and can therefore be used as an example of the research-teaching nexus. This has been a topic of interest in academia for some time now (eg, Brew & Boud 1995; Zubrick et al. 2001; Healy 2005a; b). Student engagement should be increased when they are immersed in an environment where learning is based on research. Baldwin (2005) suggests this should occur as early as possible in the students' undergraduate education and that learning should be underpinned by research experiences.

In this context, it is interesting to reflect on whether the students saw the scientists and the supervisor as "teachers" or "researchers". The term "research" or "researcher" appears 19 times in the written responses whereas "teach" or "teacher" appears only once. However the words "learn", "learning" or similar terms appear 36 times. Learn is a much more neutral term and students can learn in a myriad of ways including being part of a research team. It is pleasing to see that the students are reflecting on their learning rather how this knowledge is gained and this may be an integral part of experiential learning. This is supported by the research of Healy (2005a; b) who suggests that when students are involved in research through various forms of active learning, such as inquiry-based learning, they are most likely to benefit in terms of depth of learning and understanding.

“Clearer direction as to what was expected and what we could do to learn” [4]

“Further enhance of knowledge and learn new things” [6]

“staff were always willing to teach and help you understand” [5]

“Working as an integral part of the formal research team” [1]

“I appreciate the logistics, costs and effort required for deep sea research” [7]

“Research staff also very open and encouraged involvement” [9]

6. Reflections from a student supervisor

I have now participated in two legs of the University of the Sea program, learnt a great deal and thoroughly enjoyed the experience. Most of the results from this survey were not unexpected as students voiced their concerns during the expedition. Students clearly expressed the need to provide more pre-expedition information and that this information should accurately reflect what will happen on the expedition. They expected more didactic learning opportunities and more direct supervision. They also expected to be involved with the science to the point of producing publications. These expectations were not met and did not seem to have been communicated to the supervisors or scientific staff on the expedition. The supervisors should ensure that there is ready access to information during the expedition, either in the form of literature brought on board or access to the internet. This will become less of an issue in the future as research vessels improve satellite internet connectivity.

While most of the students enjoyed their experience at sea, those from distinctly different cultures and with English as a second language clearly had more problems. These students appeared to have less understanding of what life at sea would be like and were therefore, less well prepared. They did not anticipate sea sickness, for example, and did not bring the appropriate medication; some did not have appropriate clothing or footwear. As this program is funded in part by UNESCO and seeks the participation of students from the local Pacific region, more should be done to ensure these students have an enjoyable and effective learning experience.

7. Conclusions

The University of the Sea program is clearly an exciting and enjoyable way for students to learn about marine science and in particular marine geoscience. Students are given the opportunity to work with research scientists and technicians with a range of backgrounds and skill sets. This type of experiential learning is seen as very effective by the students involved. The students particularly like some of the more generic skills or graduate attributes such as team work, working with the scientists and enhancing their interpersonal skills. In line with most other studies on experiential learning, the students value the learning experience and see that it enhances many of the skills they cover theoretically in the class room. They are exposed to research in action, in an environment that is free of the other distractions of everyday student life. While working with new techniques and new people they must learn to cope with the unexpected and become adaptable.

There are also a few lessons to be learnt and incorporated into future legs of the University of the Sea. Students need to be provided with adequate information before the expedition. They are keen to know what is expected of them, what the aims of the research are and to begin on any background reading to support this. Supplied with more information, they will be more confident. This early information should also stress the nature of the expedition they are participating in – it is a research expedition, not solely a teaching exercise, and it is privilege to be selected and to participate.

Student participation in research expeditions also has benefits to the university the students represent and to the wider community. Students will bring back and share their knowledge and experience with their peers, friends and family. Their engagement with science and research should have provided them with a new skill set to take into the community and hopefully the desire to be involved in further scientific research.

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(www.es.mq.edu.au/GEMOC/). The ethical aspects of this study have been approved by the Macquarie University Ethics Review Committee (Human Research).

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Table 1. Organisations participating in the university of the sea program

University of the Sea Partners
Intergovernmental Oceanographic Commission of UNESCO
University of Sydney
Australian National University
University of New South Wales
Macquarie University
University of Technology Sydney
University of Tokyo
Korean Ocean Research and Development
Institute
Tongji University China
Partnership for Observation of the Global Oceans Canada
National Institute of Oceanography Goa
Indonesian Research Centre for Marine Technology

Table 2. Open-ended questions used in the questionnaire

Open-ended questions
1. What were the best aspects of the expedition?
2. In what ways could this expedition be improved?
3. With what aspects of the expedition did you have difficulty, and why?
4. What extra support would have helped you during the expedition?
5. Do you feel more confident to apply marine science theory after the expedition? Why?
6. What were the main objectives you had when you enrolled for this expedition?
7. How has the expedition fulfilled these objectives?
8. Did you require more information or support before going on the expedition?
9. Please feel free to make any other comments regarding the expedition.

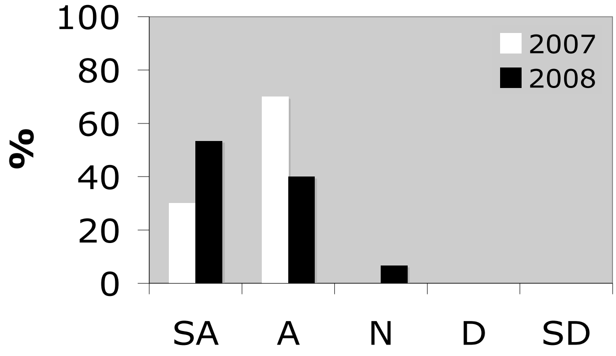

Figure 1. Clear aims and objectives; average 79% strongly agree or agree

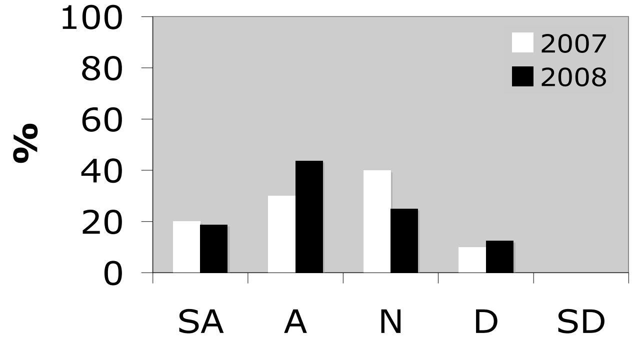

Figure 2. Work was structured to assist my learning; average 56% strongly agree or agree

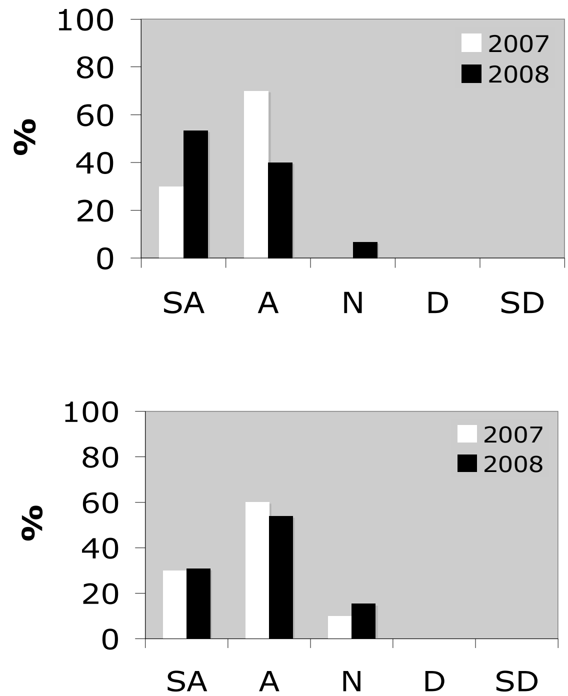

Figure 3. a. Valuable for my learning; average 97% strongly agree or agree; b. Experiential learning was an effective learning experience; average 87% strongly agree or agree

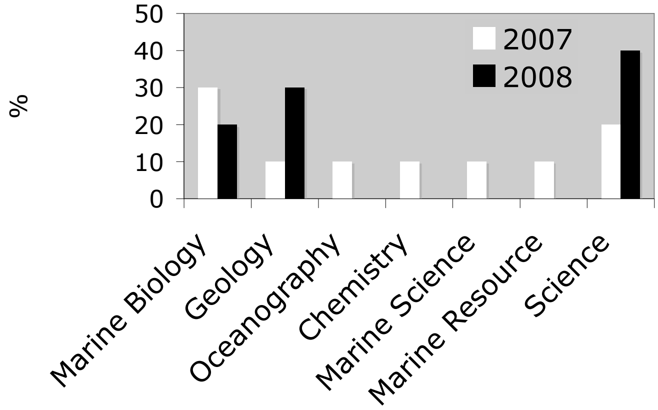

Figure 4. Degree or major of participating students

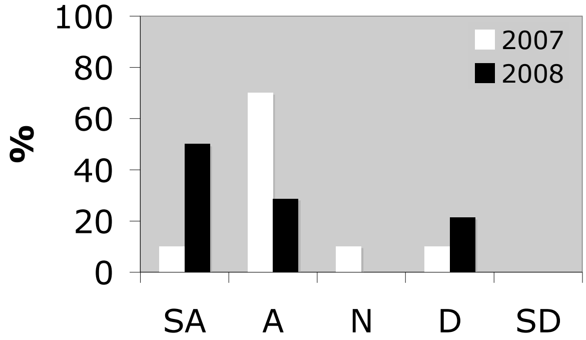

Figure 5. Helped see application of theory into practice; average 86% strongly agree or agree

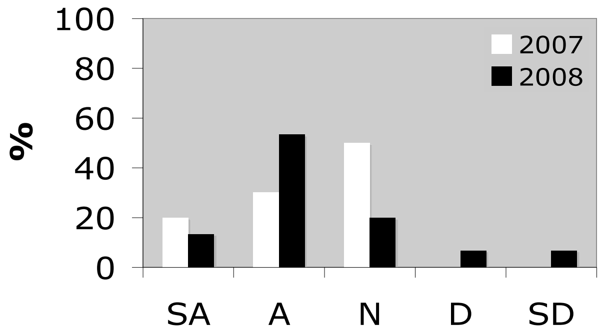

Figure 6. Sufficient one on one instruction to develop my skills; average 58% strongly agree or agree

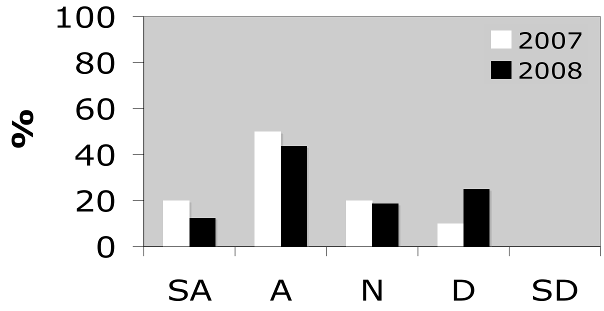

Figure 7. Sufficient technical support to resolve difficulties; average 63% strongly agree or agree

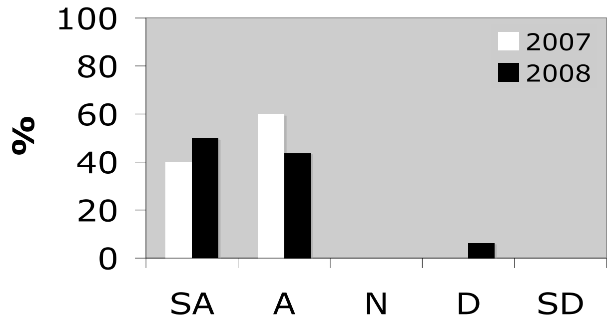

Figure 8. Enough opportunities for communicating with staff; average 97% strongly agree or agree

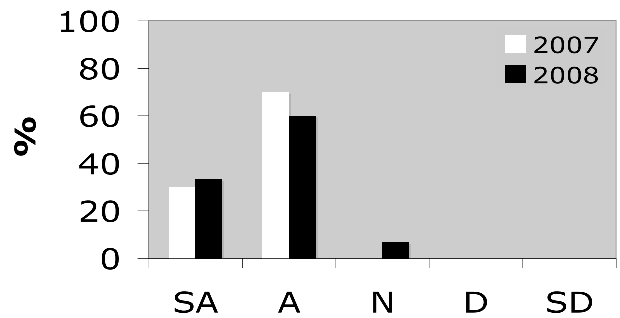

Figure 9. Opportunity to enhance interpersonal skills; average 97% strongly agree or agree

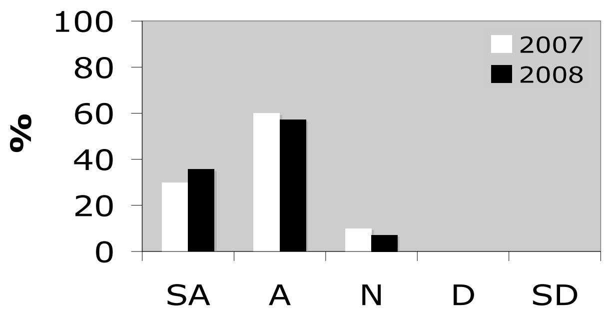

Figure 10. Opportunity to enhance team-work skills; average 91% strongly agree or agree