The impetus to broaden the scope of research education is not new. Since the 1970s, concern has been expressed about the suitability of research education as preparation for a research career outside academe. Initially, this issue emerged within the science and engineering disciplines (Sekhon, 1989). By the late 1990s, it had spread to include all research graduates, as academic positions shrank because of federal funding cutbacks and a greater number of graduates sought work in government, industry and the professions. It is one of the few issues where there is a remarkable consensus amongst most of the key stakeholders in research education – employer groups, academics, governments, research students, and graduates. Developing research students’ broad graduate attributes has become one of the fundamental planks of Australian and United Kingdom governments’ research training policies. This research paper explores the development and piloting of a Research Student Portfolio designed to enhance and document research students’ achievement of several graduate attributes. It was originally developed by an academic staff developer working in close collaboration with research students and academic and research-only staff in a small interdisciplinary research centre at the University of Queensland.

Since the 1990s, debates have raged about the most effective way of developing and documenting research students’ achievement of key graduate attributes (Holdaway, 1996; Cryer, 1998; Pearson & Brew, 2002). Many universities in Australia and the UK have begun offering specific programs that deal with a variety of research higher degree students’ generic skills (Borthwick & Wissler, 2003; Cryer, 1998). There are three basic types of programs offered in this area:

1. one-off workshop sessions and seminars (most common form of development)
2. intensive face-to-face professional development programs (eg. University of Melbourne etc) and
3. online professional development programs (eg. ATN LEAP, Borthwick & Wissler, 2003).

Other professional development programs take a more reflective approach to students’ development of generic skills. Pat Cryer (1998, p. 207) in the UK, for example, has been particularly active in providing programs at a number of universities that are designed to enhance students’ ‘transferable skills, marketability and lifelong learning’. These face-to-face programs are designed to ‘help students to recognise, individualise and internalise the fullness and richness of and the potential for their skills and to make credible cases to support their claims for having acquired certain skills’ (Cryer, 1998, p. 214). More recent Australian programs have sought to develop an individual learning plan that students and supervisors’ negotiate at the beginning of candidature (Kiley et. al, 2004).

**Developing the Research Student Portfolio**

Drawing on all of these approaches, a Research Student Portfolio seeking to develop students’ graduate attributes was designed and implemented in a small, interdisciplinary research centre, the

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1 In 2002, the University of Queensland adopted the term ‘advisor’ to replace ‘supervisor’ in order to capture the mentoring and guiding role advisors play. As a result, all following references will be made to advisors rather than supervisors.
Advanced Wastewater Management Centre (AWMC), at the University of Queensland. The AWMC consists of researchers and research students seeking to develop effective, sustainable solutions to the management of wastewater using the combined, interdisciplinary skills of microbiologists and chemical engineers. The centre currently also has a PhD student from the social sciences studying the integration of management, political, and community aspects of sustainable urban water management.

Data identifying the desired graduate attributes of AWMC research graduates was gathered at separate staff and student focus groups, from which a subcommittee with academic staff, postdoctoral fellows, and research student representatives was formed to work with the academic staff developer to finalise the interdisciplinary research skills program. As Borthwick and Wissler (2003) have argued, it was important to include students’ perspectives throughout the development of the portfolio process. At this level, students often have a concrete set of skills and career goals they want to achieve. For other students, involvement in this project has raised their awareness of the need to engage in strategic career planning. It was also believed that postdoctoral and other research-only staff, who are often at the early stages of their academic careers or who may have had multiple pathways in and out of industry and academe, would have significant recommendations that would enrich the development of the portfolio.

**Research Student Portfolio**

The Research Student Portfolio consists:

- a list of research students’ graduate attributes;
- key performance indicators (KPIs) associated with each graduate attribute, which provide the student and advisor with tangible and practical means of addressing each attribute;
- a reflective review tool which allows students and advisors to reflect on students’ achievement of key performance indicators for each graduate attribute and develop an action plan for further development; and
- a portfolio based on evidence of achievement of the key performance indicators (KPIs).

The list of research students’ graduate attributes originally developed by the AWMC appears below.

<table>
<thead>
<tr>
<th>Figure 1: Attributes of Research Graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Problem-solving and problem-formulation from different perspectives</td>
</tr>
<tr>
<td>• Communication skills</td>
</tr>
<tr>
<td>• Project management skills</td>
</tr>
<tr>
<td>• Industry-focus and/or professional experience</td>
</tr>
<tr>
<td>• Understanding and applying multiple disciplinary and international perspectives</td>
</tr>
</tbody>
</table>

From the list, a reflective review tool was created to assist students and advisors to develop and enhance students’ graduate attributes. In the reflective review tool, each attribute is unpacked, using a full description of how these skills fit into the research context and how they can be achieved.
Interdisciplinary research skills, attitudes and behaviours feature in each of these graduate attributes. Although the AWMC is an interdisciplinary centre, later trials in areas such as Animal Studies and other studies have demonstrated the increasing importance of developing interdisciplinary skills in many current fields of research (Bruhn, 2000; Gibbons et al., 1994; Klein, 1996; Nowotny et al., 2001; Somerville & Rapport, 2000). There is no space to explore all of these graduate attributes in detail so two of the attributes that are most relevant to a wide cross-section of disciplines and interdisciplines will be discussed: attributes 5 and 2.

**Understanding and applying multiple disciplinary and international perspectives**

All graduates, particularly those completing research higher degree studies, are increasingly requiring the ability to understand and apply multiple disciplinary and international perspectives. Table 1 explores how these abilities could be described and developed.

**Table 1: Understanding and applying multiple disciplinary and international perspectives in AWMC context.**

<table>
<thead>
<tr>
<th>Description</th>
<th>How this could be demonstrated (KPIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple disciplinary perspectives</td>
<td>The student has:</td>
</tr>
<tr>
<td>• The student will be able to move beyond the comfort zone of their previous discipline in order to understand ideas, concepts, techniques and methods from other disciplines.</td>
<td></td>
</tr>
<tr>
<td>• The student will be able to deal with the uncertainty and challenge involved in understanding new ideas, concepts, techniques and methods.</td>
<td></td>
</tr>
<tr>
<td>Multiple international perspectives</td>
<td>The student has:</td>
</tr>
<tr>
<td>• The student will have accessed and learnt from local, national and international contacts and perspectives.</td>
<td></td>
</tr>
<tr>
<td>• The student will have, as a result, developed an understanding of many cultural perspectives and approaches to wastewater management.</td>
<td></td>
</tr>
<tr>
<td>The student has:</td>
<td></td>
</tr>
<tr>
<td>• attended at least one international conference overseas and described what they have learnt from their active participation</td>
<td></td>
</tr>
<tr>
<td>• established personal contact with key local, national and international experts in the field of wastewater management (via email, attending professional association meetings, attending industry meetings, individual meetings etc)</td>
<td></td>
</tr>
<tr>
<td>• visited other local, national and international workplaces and labs dealing with wastewater management</td>
<td></td>
</tr>
<tr>
<td>• incorporated different ways of approaching their field in different cultures and locations (eg. Asian countries, Indigenous communities) in their research project.</td>
<td></td>
</tr>
</tbody>
</table>

**Communication Skills**

While a great deal of attention is placed on communication skills at any level of higher education, there have only been a few attempts to define precisely what constitutes these skills at research higher degree level (Borthwick and Wissler, 2003). In addition, UK research conducted by Cryer (1998) has suggested that many research students are unable to articulate the exact nature of their highly developed communication skills and how these might be transferred to various workplace settings and professions. Table 2 identifies the nature of these skills in the AWMC context and how these could be demonstrated.
Table 2: Communication skills in AWMC context

<table>
<thead>
<tr>
<th>Description</th>
<th>How this could be demonstrated (KPIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>To express an idea:</strong></td>
<td><strong>The student has:</strong></td>
</tr>
<tr>
<td>• the student will be able to present their work in several forms (written, spoken or graphically) in different contexts and to different audiences</td>
<td>• effectively presented their work at internal seminars and/or conferences, congresses, etc.</td>
</tr>
<tr>
<td>• the student will have gained experience in teaching/training and advising people.</td>
<td>• clearly expressed their ideas and results (orally and in powerpoint), gathered feedback, and demonstrated how they have improved their presentation skills based on this feedback</td>
</tr>
<tr>
<td></td>
<td>• written well-structured, highly effective reports/papers and indicated their attempts to improve their writing skills</td>
</tr>
<tr>
<td></td>
<td>• demonstrated the ability to plan and organise lecture, tutorial or training sessions and develop and deliver effective training materials and activities</td>
</tr>
<tr>
<td></td>
<td>• facilitated the successful completion of honours projects as honours advisors</td>
</tr>
<tr>
<td></td>
<td>• disseminated special skills like statistical analysis methods to other students.</td>
</tr>
<tr>
<td><strong>To understand and value other knowledges:</strong></td>
<td><strong>The student has:</strong></td>
</tr>
<tr>
<td>• the student will be able to read, listen to and appreciate other people’s ideas.</td>
<td>• compiled an interdisciplinary literature review that will provide them with ways to expand their own work</td>
</tr>
<tr>
<td></td>
<td>• applied other disciplines’ languages and concepts to their work</td>
</tr>
<tr>
<td></td>
<td>• actively participated in meetings and seminars showing that they understand other people’s perspectives</td>
</tr>
<tr>
<td></td>
<td>• emailed other experts in their field after being introduced by their advisor, keeping the advisor in the loop with email communications</td>
</tr>
<tr>
<td></td>
<td>• Received tutor training and been involved in teaching and postgraduate advising.</td>
</tr>
<tr>
<td><strong>To work in interdisciplinary teams to develop social skills, self-confidence and conflict resolution and negotiation skills</strong></td>
<td><strong>The student has:</strong></td>
</tr>
<tr>
<td></td>
<td>• shown effective participation in team work, by giving input to the general project and applying the outcomes to their own work</td>
</tr>
<tr>
<td></td>
<td>• established a bridge between different perspectives as a result of their developing interdisciplinary knowledge.</td>
</tr>
</tbody>
</table>

**Implementing the development of these interdisciplinary research attitudes and skills**

In order to implement the development of these interdisciplinary research attributes, a two-step process was constructed. This involved students completing a reflective exercise each year with their advisor as part of the annual review process and developing a portfolio that organises and documents continuous development of graduate attributes and that could be used as a career development tool. The involvement of the advisor/s in the process was regarded as important, as Borthwick and Wissler (2003) have argued, although it was not expected that the advisor/s would be required to conduct any additional training outside of the usual process of postgraduate advising.

The portfolio template is still under development, although it is expected that it will take the form of an organised collection of evidence demonstrating the achievement of each graduate attribute. It is acknowledged that care must be taken in designing research students’ portfolios to capture the level of sophistication they achieve in these graduate attributes. As Pearson and Brew (2002) emphasise, research students are capable of accomplishing more than merely listing their skills in
project management for example. They become ‘skilful performers’ in these areas (Pearson & Brew, 2002, p. 4) and need to convince employers in industry, the professions or academe of this. Cryer (1998) recommended that students use a transferable skill framework, which was designed to generate students’ reflections about situations in which they had applied their skills and how they might frame and discuss these in ways that employers would appreciate. This is why many of the KPIs for AWMC’s graduate attributes ask students to write brief reflections on various demonstrations of their skill development. In conjunction with their advisors, students would then devise an individual learning plan each year in order to further enhance these attributes.

**Pedagogical features of RSVP**

One of the central pedagogical features of the Research Student Portfolio program has been the need to embed further graduate attribute development within students’ current research projects rather than requiring them to do additional courses. This decision is supported by previous studies of developing students’ skills and attributes at undergraduate and postgraduate levels. Pearson and Brew (2002) warn of the dangers inherent in viewing graduate attribute development as bolt-on aspects of research education. As Pearson and Brew (2002) indicate, this mirrors the debate about embedding generic attributes in undergraduate degree programs (Bowden et al., 2000). Cryer (1998, p. 212) suggests that these skills need to be embedded within students’ research degree programs so that they are ‘part of the students’ everyday thinking, help develop proficiency, facilitate transferability, and develop the habit of lifelong learning’.

There is also an emphasis in the programs on using experiential, active, and interactive learning techniques to help students develop and enhance these skills and attributes (Biggs, 1999; Brookfield, 1990). Some of the key interdisciplinary research skills, such as the ability to understand and apply multiple disciplinary and international perspectives, to be flexible and have a high tolerance for ambiguity, and to develop social, ethical and environmental responsibility, are essentially about attitudinal change and development, which can rarely be taught didactically (Mezirow, 2000; Clifford, 1998). Even some of the more technical skills, such as effective communication and team working, are best learnt by doing (Jackson & Caffarella, 1994; Evans, 2000).

Reflective techniques are also a key aspect of the program and are recognised as a fundamental facet of effective professional practice. Schon (1983) and others (Cryer, 1998; Bolton, 2001; Evans, 2002) have demonstrated conclusively the importance of learning to reflect upon and systematically question your own decision-making and actions as a professional. By requiring students to write reflections on their ongoing development of important interdisciplinary skills and attitudes, the program aims to ensure that research students also enhance their ability to become thoroughly professional reflective practitioners.

**Pilot testing of research student portfolio process**

During semester two 2003, AWMC students and their advisors piloted the research student portfolio process. A student-advisor contract was also developed because some students expressed concern that their advisors may be too busy to engage in the reflective review with them. A further focus group was held with students and research-only staff to modify the reflective review tool and process, and concerns raised by the students were relayed to academic staff. In order to explore how a number of students and advisors engaged in the reflective review process,
two examples have been included here. We will call the students 'Erica' and 'Ramonez' and will explore their responses to the communication skills graduate attribute.

Erica

Erica is approximately halfway through her doctoral studies and has had a lengthy and varied professional career. She indicated that she considered communication skills to be one of her strongest attributes:

I have presented my work at seminars (and previously presented on other topics at workshops and conferences). As an experienced [worker], I have developed the ability to actively listen and draw together ideas. However, both my written and verbal communication would benefit from use of mind mapping to structure the approach. My literature review is interdisciplinary ... and I have maintained contact with my associate supervisors ... [in other disciplines]. I have worked in many teams.

Her advisor agrees but recommends that 'we need to think about your ability to present research outcomes – this is a very different and difficult skill. [We need to] make sure that you have enough opportunities to practice this (student reflective review)'.

Ramonez

Ramonez has just commenced her PhD program and has less prior work experience than Erica. She initially sent her advisor very brief reflections on her communication skills. Prompted for more information and reflection by her advisor, she then added the additional comments. She suggested that:

I feel that my communication skills are fine. I have always had the ability to convey my thoughts and ideas across considerably clearly though I do get exceptionally nervous during presentations with groups of people larger than say, 20 people ... I am able to listen to peoples ideas, analyse them and I do find it very valuable. I have not, as of yet, presented my work at internal seminars or conferences, but I will be presenting [soon] I will gather feedback on my presentation ... I do participate in other disciplines seminars (though they have been restricted to my friends first year reviews) and do have a general idea of their jargon. I will have to make sure that I make an effort to look into the seminars that are presented in [another School]. Also, I am hoping that spending time with [postdoc in another discipline] will allow me to get immerse myself into another field of science and allow me to understand an area that I have previously not been interested in.

Lastly, I have had to organise a tutorial and feel that I would be fine if I had to organise a lecture on a subject that I am familiar with. I've already learnt from tutoring that there is no better way to understand a subject than actually teaching it.

Her advisor responded by agreeing that her:

Oral communication skills—one to one—are excellent. This is a very powerful tool, which I am sure will benefit you. This is something to continue to develop.

However, from a PhD point of view, it is important that you develop a high level of
In exploring the interdisciplinary aspect of communication skills, her advisor emphasised that:

The issue of inter-disciplinarity is an important one. This refers to your ability to develop expertise in more than one area. I feel that you are addressing this well at this stage by integrating [postdoc in another discipline] into the project. Working with [them] over the next couple of years will help you to become 'bi-lingual'. You will need to decide how much skill you would like to develop in the [other] area—which is a very different skill. We need to develop an action plan to help you to develop your skills in this area.

Developing action plans

All of the students and advisors involved in the pilot study negotiated an action plan for the student’s systematic development of each graduate attribute. Table 3 shows how Erica, for example, decided to develop her communication skills:

**Table 3: Excerpt from a Student's Action Plan (completed and reviewed 4 months later)**

<table>
<thead>
<tr>
<th>GA</th>
<th>Action</th>
<th>Who</th>
<th>When</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Communication skills</td>
<td>Improve communication of structured/detailed research methodology and outcomes, using key messages, via: a. 2 presentations to AWMC - on research methodology &amp; research outcomes. b. Publication in international journals such as <em>Water 21</em> and <em>Water International</em> c. presentation at an international conference e.g. IWA World Water Congress (Sept 2004) or IWA sustainability conference (Nov 2004). d. Comment in the preparation of the above</td>
<td>student</td>
<td>Have refined presentation of research outcomes As negotiated in seminar program</td>
</tr>
<tr>
<td></td>
<td></td>
<td>student</td>
<td>Submit when data available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>student</td>
<td>July 2003 discuss appropriate conferences with another lecturer. NO RESPONSE AS YET</td>
</tr>
<tr>
<td></td>
<td></td>
<td>advisor</td>
<td>As needed</td>
</tr>
</tbody>
</table>

Evaluation of the Research Student Portfolio

In December 2003, an evaluation of the Research Student portfolio was conducted with staff and students in the AWMC. Approximately half of the research higher degree students had completed the reflective review process with their postgraduate advisor. A number of students who were nearing completion elected not to engage in the process. Others had been unable to schedule a time to meet with their advisors. A number of postdoctoral fellows also expressed interest in completing the reflective review as an additional career development tool that could be used in
conjunction with their academic portfolio. More recently, they have called for a modified version of the Research Student Portfolio that would be suitable for their professional development needs.

**An effective planning tool**

Students who participated in this pilot study indicated how useful it was for their overall research planning and future career development. In particular, they felt the reflective review was a useful ‘scoping tool’ and could even be used as a ‘problem-solving tool’ (meeting feedback).

Erica commented that:

>I found this a useful exercise in critically reviewing my development as a graduate ... It gave me a useful overall picture of where I was at and where the gaps were ... It allowed me to prioritise certain key actions that I would like to follow up on, like publishing papers, gaining more international exposure and identifying an additional mentor or support group (student feedback).

Another student, 'Bob', found that his advisor was 'willing to support me more in what I wanted to do than I previously thought' (student feedback).

**An effective framework for postgraduate advising**

Advisors have also indicated that the research student portfolio process is a valuable framework within which to situate their advising practice and to ensure that they are providing support in all areas of their research students’ professional development. It also allows them to provide constructive and positive feedback to students, not only about their recommendations for future development, but also about students' achievements, which is very motivating for students. The reflective review tool also enabled them to plan additional interdisciplinary research experiences for students.

At a broader Centre level, this process has allowed for the development of a shared understanding of and commitment to the key elements of research education within this interdisciplinary Centre. It formalised the mentoring role advisors adopt for their research students. In this way, it aimed to ensure that each of the Centre’s research students would have more equitable and transparent access to the intellectual and financial resources they require to develop professionally and personally during their candidature.

**Planned modifications to the interdisciplinary research education program**

As a result of an evaluation of the pilot program by staff and students, a number of modifications were incorporated into the Research Student Portfolio. While it was agreed that six to twelve monthly intervals were appropriate, it was felt that the first six month interval was too soon to complete the first full reflective review. Instead, it was recommended that advisors go through the list of graduate attributes and the reflective review tool with students at the beginning of candidature, and that they start to work on their reflective review after their first half-year seminar at about eight to ten months into candidature. This would ensure that their first full reflective review and action plan was completed as part of the confirmation of candidature process and would then be revisited every six to twelve months after this.

Other modifications included:
revising the order of graduate attributes so that the review process would start with more familiar goals (such as problem solving and communication) and work up to the more difficult attributes

- adding entrepreneurship and commercialising the student’s intellectual property to the industry-focus and/or professional experience attribute

- condensing the written material contained in the reflective review tool

- making explicit reference at the beginning of the reflective review tool that this was intended to be a planning exercise and not just a reflection on what the student had already achieved

- recommending that students not attempt to complete the whole reflective review in one sitting

- developing a portfolio template that will allow students to compile evidence of their achievement of each graduate attribute.

Conclusion

The Research Student Portfolio process is currently being trialled in the Schools of Engineering, Social Work and Applied Human Sciences, and Animal Studies to test its transferability. Participants in a learning circle on postgraduate advising, run by an academic staff developer, are also exploring the process with their research students. It has been tabled for discussion by the university’s Postgraduate Studies Committee and has also informed the current development of university-wide policy on research higher degree graduate attributes. It appears to address the challenge of embedding the development of research students’ graduate attributes into the students’ research studies. As the portfolio aspect of the process is further developed, careful planning will be required to ensure that the portfolio captures the sophistication of research students’ knowledges, attitudes and skills. So too, the issue of the relationship between graduate attributes and research skills identified by Borthwick and Wissler (2003) will also need to be addressed. The Research Student Portfolio process, however, has the clear potential to be a valuable career planning tool for students and a useful framework for effective postgraduate advising. It could also become the basis for a professional development resource for postdoctoral and research-only staff.

References:


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