



MAKING RESEARCH SKILL DEVELOPMENT EXPLICIT IN COURSEWORK

Final Report
2010
(no Appendices)

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Making Research Skill Development Explicit in Coursework: five universities' adaptation of a model to numerous disciplines

FINAL REPORT (no Appendices)
March 2010

The University of Adelaide
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The project leader also expresses thanks to Dr Kerrie Le Lievre and Ms Irene Lee, without whose rich and varied skills the project would have been far poorer.



EXECUTIVE SUMMARY

Undergraduate and Masters by Coursework courses can explicitly and effectively develop student research skills, with both immediate and long-term advantages for both students and academics.

Aims and deliverables

This project was designed to trial and evaluate the effectiveness of coherent, explicit and incremental development of discipline-specific student research skills in content-rich courses, as informed by the Research Skill Development Framework or RSD (see Appendix 3). The project aimed to build a large research team across all faculties in order to trial the RSD in as many disciplines and types of courses as possible, and answer two specific research questions.

In late 2007, 14 academics representing all faculties across five Australian universities used the RSD to inform discipline, course and assessment specific marking rubrics for content-rich undergraduate or Masters by Coursework courses. These rubrics were used in assessments through 2008 to develop students' awareness of disciplinary cultures and standards of research and to help them recognise that their studies were designed to explicitly develop and assess their research skills. While the project team members did not routinely change other elements of the curriculum at this point, students experienced a change in the curriculum in comparison to previous years due to changes in classroom dialogue about research and because of the new assessment framing.

In 2009, another 13 academics and two librarians joined the project team, and 28 courses in total (three of which were at Masters level) applied RSD approaches in a similar fashion.

The research questions addressed by the project team were:

- What are the advantages and disadvantages of explicitly developing students' research skills?
- What factors support student research skill development, and what factors hinder its development?

Four types of evaluation were used to answer these questions:

- Students' self-assessment of research skills and attitudes to research, gained by using pre-course and post-course questionnaires.
- Academics' measures of student research skills, and their development during a course, utilising the marking rubrics structured according to the RSD.
- Interviews with students conducted one year after their completion of a course which explicitly developed their research skills
- Interviews with academics using the RSD in a course.

First, pre-course and post-course questionnaires were given to students in RSD-based courses. There were statistically significant improvements evident across disciplines in student self-assessment of discipline-specific research skills; capacity to develop research questions; evaluation skills; and written or spoken communication skills. However, their attitudes to research generally did not change.

Second, project team members' measures of students' research skills using RSD-based assessments indicated that these skills improved during the semester: when faced with end-of-semester tasks that demanded more autonomy, a higher degree of conceptual understanding and greater rigour, student research skills improved when compared to those demonstrated early in semester.

Third, 46 students of differing ability were interviewed a year after completing RSD-based courses. Eighty-nine per cent of these students stated that the research skills they had developed in content-rich courses were useful for employment and 75 per cent said the skills developed were useful for subsequent study. Seventy-two per cent reported the ability to find information or generate data as a benefit of the RSD approach, 52 per cent the ability to critically evaluate sources and data, and the same percentage reported enhanced critical thinking skills.

Of 331 student comments about features that helped the development of their research skills, 44 per cent were attributed to elements associated with RSD use, 38 per cent were attributed to the course more generally, and 18 per cent to factors outside the course. Of 224 student comments about features that hindered the development of their research skills, 40 per cent were attributed to elements of RSD use, 25 per cent were attributed to the course more generally, and 35 per cent to factors outside the course. Students therefore identified that, from their perspective, most of the factors that support their research skill development are within the control of teaching academics, and that a good proportion of hindering factors can also be controlled at the course level.

Finally, the project's external assessor interviewed 20 project team members and reported that they found the RSD assessment process more efficient than standard assessment, while providing more substantial guidance and feedback to students. The reviewer also found that some academics' perspective of research in their own disciplines began to change as they engaged with explicit development of their undergraduate students' research skills. During the timeframe of the study, nine new approaches to using the RSD framework were identified, with five of these coming from within the project team, and four coming from universities outside of the project team.

Dissemination

The project's approaches were disseminated by means of a series of seminars, workshops and publications.

From 2007 to 2009:

- 33 seminars and workshops were conducted in the project's partner universities
- 15 seminars and workshops were conducted at 10 other Australian universities, one international university and at two conferences
- two journal articles were published and one was in press
- five peer-reviewed conference papers were presented and 15 conference presentations made at 14 different conferences (including three international events)
- two conference keynotes on RSD were presented (including one international conference)
- approximately 1100 sets of RSD handbooks and laminated RSD framework charts were distributed.

The most effective form of dissemination seemed to be the three-hour combined seminar and workshops, approximately two-thirds of which have produced tangible outcomes in the form of teaching academics, librarians, academic language and learning staff or academic developers using the RSD to improve student learning and to develop their own teaching skills.

The RSD website, averaging 90-150 unique visitors each week, and especially word-of-mouth communication, have made a substantial contribution to dissemination.



Conclusion and recommendations

It must be acknowledged that the 28 members of the project team are 'early adopters'. This potentially skews data and outcomes towards the positive. The adoption of RSD approaches and rubric across programs of study is therefore not happening systematically, but there are signs of this occurring in several programs. There are therefore five recommendations for future RSD activity:

1. That RSD approaches be trialled and evaluated at program level to determine the optimum use and value of the RSD for students and faculty, both through whole programs of study and from program to program.
2. That the RSD website be further and more substantially developed to better provide for the needs of the academics visiting it and in order to develop interactive and networking components that will enable the community to share and circulate resources. These processes should mirror as closely as possible the collaborative rubric-making processes used successfully in the project.
3. That the RSD framework be explored by universities as a way to support a consolidating agenda to pull together the sometimes conflicting agendas of teaching and research. The RSD framework may assist in bringing together multi-pronged teaching and learning agendas, including policies for well-framed course outcomes, mapping of program graduate attributes, internationalisation of the curriculum, and assessment and feedback policies.
4. That academics and universities adopt a practice-driven approach to use of the RSD framework, rather than a policy-led approach. As a conceptual framework, the RSD can provide individual academics with a vision for action, and the role of policy in this case should be to support academics' initiatives.
5. That special consideration be given to supporting schools of education in adopting and teaching RSD approaches as there are potential long-term benefits in enhancing the researching ability of school students, in advance of their entry into university faculties.



1 INTRODUCTION

The project's conceptual underpinning, the Research Skill Development framework or RSD was devised at The University of Adelaide's Centre for Learning and Professional Development in 2004 and 2005. The framework was designed to address the perception that students would benefit from having discipline-specific research skills taught explicitly and coherently from undergraduate level on. Six 'facets' of the research process were identified from the literature, and each of these was elaborated into five 'levels' describing degrees of student autonomy in the research process. These facets and levels form the basic structure of the RSD framework.

A collaboration with Eleanor Peirce and Mario Ricci from the School of Medical Sciences began in November 2004 and focussed on how the RSD could be applied in a medium-sized first year undergraduate course. The RSD framework was used to develop marking rubrics. After some refinement of both the RSD framework and the rubrics, advantages for both students and teachers were noticed in two consecutive first-year courses. In August 2006, Brian Ng and Said Al-Sarawi, who co-ordinated a Masters-level course with a research component in Electronic Engineering, adapted Dr Peirce and Dr Ricci's use of the RSD successfully for use with their primarily international students. In October 2006, the present formulation of the RSD was finalised.

In late 2007, staff members in Petroleum Engineering, Nursing, and English at The University of Adelaide joined the existing teams to successfully bid for an internal grant from within the university. This enabled them to trial RSD use in courses across three faculties at The University of Adelaide. Following this, academics from Macquarie University, Monash University, The University of Melbourne and the University of South Australia joined this group to successfully gain an Australian Learning and Teaching Council Competitive Grant in April 2007.

1.1 Project team members

The original project team consisted of members from The University of Adelaide, Monash University, Macquarie University, The University of Melbourne and the University of South Australia.

The University of Adelaide

Dr John Willison, Centre for Learning and Professional Development (Team Leader)
Dr Said Al-Sarawi, School of Electrical and Electronic Engineering
Professor Steven Begg, Australian School of Petroleum Engineering
Mr Frank Donnelly, Discipline of Nursing
Dr Moffassel Hossein, Australian School of Petroleum Engineering
Dr Joy McEntee, School of Humanities
Dr Brian Ng, School of Electrical and Electronic Engineering
Dr Eleanor Peirce, Discipline of Anatomical Sciences
Dr Mario Ricci, Discipline of Anatomical Sciences
Mr Richard Warner, Centre for Learning and Academic Development

Macquarie University

Dr Judi Homewood, Faculty of Human Sciences

Monash University

Dr Jan Schapper, Department of Management

The University of Melbourne

Dr Eu-Jin Teo, Department of Accounting and Business Information Systems



University of South Australia

Dr Rowena Harper, International Studies

As the project developed, additional academics from The University of Adelaide, Monash University and the University of South Australia joined the project team.

The University of Adelaide

Dr Leonard Crocombe, Australian Research Centre for Population Oral Health

Dr Rebecca Forder, School of Agricultural and Animal Science

Dr Susan Hazel, School of Agricultural and Animal Science

Dr Li Jiang, School of Computer Science

Dr Sophie Karanicolas, School of Dentistry

Dr Clinton Kempster, School of Dentistry

Ms Irene Lee, Centre for Learning and Professional Development (Project Manager)

Dr Vicki Skinner, School of Dentistry

Dr Cathy Snelling, School of Dentistry

Dr Linda Westphalen, School of Education

Dr Mike Wilmore, School of Humanities

Monash University

Dr Glen Croy, Department of Management

Dr Susan Mayson, Department of Management

University of South Australia

Ms Jennifer Stokes, Division of Education, Arts and Social Sciences

Project Support

Ms Irene Lee, Project Manager

Dr Kerrie Le Lievre, Research Officer (Academic)

1.2 Project aims

The primary aim of the Research Skill Development (RSD) project was to trial and evaluate the effectiveness of the RSD framework when embedded in the assessment regime of courses in numerous different contexts. To that end, it was designed to answer two main research questions:

1. What are the advantages and disadvantages of explicitly developing students' research skills?
2. What factors support student research skill development, and what factors hinder its development?

As the approach had been successfully piloted in several diverse contexts, the project also aimed to disseminate the approach in substantial and practical ways, and evaluate its usage in these more broadly-spread contexts.



1.3 People involved

The project involved an external reference group and an independent external assessor.

External reference group

The project's external reference group was drawn from senior management, academic development units and a library at eight Australian universities. Its members were:

- Professor Birgit Lohmann, Pro Vice-Chancellor (Learning and Quality), The University of Adelaide (Chair)
- Professor Kerri-Lee Krause, Griffith Institute for Higher Education, Griffith University
- Associate Professor Dianne Bills, Hawke Research Institute, University of South Australia
- Associate Professor Lynne Badger, Dean: Learning and Teaching: Division of Education, Arts and Social Sciences, University of South Australia
- Associate Professor Andrys Onsman, Centre for the Advancement of Learning and Teaching, Monash University
- Associate Professor Kim Watty, Faculty of Economics and Commerce Teaching and Learning Unit, The University of Melbourne
- Associate Professor Anna Reid, Learning and Teaching Centre, Macquarie University
- Dr Janet Taylor, Learning and Teaching Support Unit, University of Southern Queensland
- Mr Richard Dearden, Branch Library Manager (Kelvin Grove), Queensland University of Technology.

External assessor

Dr Peggy Nightingale agreed to be the project's external assessor in May 2008. She interacted with the project team and external reference group at their regular meetings and visited the universities involved in the project in 2008 and 2009.

Other acknowledgments

The project team would like to thank: Professor Birgit Lohmann, Pro Vice-Chancellor (Learning and Quality) at The University of Adelaide, for chairing the external reference group and for her support of the project; Professor Geoffrey Crisp, Director of the Centre for Learning and Professional Development at The University of Adelaide, for his support of the project; and all of the students who took part in feedback interviews.

1.4 Dissemination methods

A variety of strategies were used for disseminating the project's objectives and results to stakeholders and the Australian and international scholarly communities. These included:

- an ongoing series of seminars and workshops introducing teaching academics to the RSD framework
- conference presentations and published papers
- a comprehensive project website
- a book proposal
- word of mouth.

Seminars and workshops

Dr John Willison and members of the project team conducted 50 RSD workshops and seminars at 16 universities—including all of the project's partner institutions, 10 additional Australian universities and one international university (Trinity College, Dublin)—one National conference and one international conference.



Conference presentations and papers

Members of the project team disseminated their research and the RSD framework through two keynote addresses, three conference papers and 15 conference presentations at national and international levels.

Project website

A website showcasing the RSD framework and the project was developed in 2006 and has been updated regularly throughout the life of the project. It includes detailed information on the RSD framework, its development and potential for use in curriculum design; examples of RSD assessment tasks and marking rubrics; and lists of RSD workshops, papers and conference presentations as well as contact information. The site also provides links to other websites and online publications that focus on developing undergraduate student research. It averages between 90 and 150 unique visitors each week.

Book manuscript

A book proposal focussing on the RSD framework and its use, featuring chapters by members of the project team and other international academics, is currently with Routledge, UK.

Project communications

The project team members met regularly (every six to 10 weeks) using virtual classrooms such as WIMBA Classroom and Elluminate Live! Recordings and transcripts were made of each session, with minutes or a report distributed to participants after the event, to ensure that all participants had a full record of the discussion. Email, face-to-face and phone communications were used on a needs basis.

1.5 Stakeholders

Three groups of stakeholders were identified during the project: primary, secondary and tertiary stakeholders.

The primary stakeholders were teaching academics, for whom the RSD framework was designed.

The secondary stakeholders were students, who received the benefits of the RSD framework in their coursework, marking and feedback, and university support staff, including librarians, academic language and learning staff, and academic developers.

The tertiary stakeholders were senior (non-teaching) academics at the level of head of school, associate dean (learning and teaching) and so on, who were aware, and supportive of, RSD framework use by teaching academics.

1.6 Related ALTC projects

ALTC funded projects related to the RSD framework project include:

Professor Kerri-Lee Krause, Griffith University: 'The academic's and policy-maker's guide to the teaching-research nexus: a suite of resources for enhancing reflective practice'. Professor Krause was a member of the 'Research Skill Development Framework' project reference group.

Professor Angela Brew, Macquarie University: 'Enhancing undergraduate engagement through research and enquiry' (National Teaching Fellowship). RSD project presentations were presented by invitation at state and national fora for this fellowship.

Dr Margaret Kiley, The Australian National University: 'The Role of Honours in contemporary



higher education'. This team has submitted a proposal for a follow-on project and invited a member of the RSD project team to be a part of their reference group.

Dr Simon Barrie, The University of Sydney: 'Integration and assessment of graduate attributes in the curriculum'. RSD project presentations were presented by invitation at this project's State and national forums.

Ms Carol-Joy Patrick, Griffith University: 'Work-Integrated Learning (WIL): a national framework for initiatives to support best practice'. Dr Sue Bandaranaike, James Cook University, has adapted the RSD framework to suit WIL, and has kept Ms Patrick informed about its development and evaluation.

2 PROCESS

Funding was sought to determine the effectiveness of explicitly and coherently developing student research skills in content-rich courses in a variety of contexts: at Group of Eight, Australian Technology Network of Universities and unaffiliated universities; in first year courses, through into Masters by Coursework courses; and within all major faculty groupings. The research questions addressed by the project team were:

- What are the advantages and disadvantages of explicitly developing students' research skills?
- What factors support student research skill development, and what factors hinder its development?

2.1 Initial development of the Research Skill Development Framework

The Research Skill Development (RSD) framework was devised in 2005 for the express purpose of aiding academics to make explicit the development of student research skills. Early trialling in first year courses showed promise, and through use and incorporation of key literature, the framework was refined to better speak to academics in numerous disciplines. The RSD was used to frame conceptually the methods used in the project.

2.2 Methodology

The project methodology initially incorporated three strands:

- raising awareness of, and informing the use of, the RSD framework
- implementing the project's RSD approach
- evaluating that implementation, to address the project's research questions.

A fourth strand also emerged during the course of the project. This was the incorporation of alternative approaches to using RSD, some of which were developed by members of the project team, and others of which were developed by academics who adopted the RSD framework either independently or in response to dissemination activities by the project leader and project team.



2.2.1 Awareness raising about, and informing the use of, the Research Skill Development framework

The 14 teaching academics named in the original project team already had commenced working with the RSD framework. However, they continued to refine their approaches and develop their use of the RSD throughout the project, particularly by embedding it in more assessment tasks, or across different courses.

At the same time, the project leader and members of the project team ran school-specific workshops and seminars to raise general awareness of the RSD framework and its potential for use, and to identify teaching academics with an interest in trialling an RSD approach in their teaching. Academics who approached the project leader or project team members following a seminar or workshop presentation were given direct assistance in the form of extended discussion of their aims in adopting RSD approaches and assessment rubrics; and/or assistance in drafting, revising and implementing one or more assessment rubrics.

Fourteen of these academics were then invited to join the project team, and the RSD approach used in the project was embedded in the assessment regime of a further 18 courses.

2.2.2 Implementation of the project's RSD approach

The project involved teaching academics implementing the following procedure at course co-ordinator level.

1. Modify an existing assessment or generate a new one for diagnostic purposes and develop a marking rubric for it guided by the RSD framework.
2. Survey students to gather their own impressions of their research skills and attitudes toward research.
3. Implement the diagnostic assessment early in the semester, mark and return to students while retaining a copy for records (optional).
4. Generate marking criteria for a summative assessment usually marked up to 'Level 3' or 'Level 4' of the RSD.
5. Generate and implement formative assessments (or develop and implement learning tasks) to facilitate student research skill development; mark and return to students while retaining a copy for records.
6. Implement the summative assessment developed at Step 3 (above), mark and return to students while keeping a copy for project records.
7. Repeat the survey of student attitudes to research and assessment of their own research skills.
8. Nominate students for interviews to ascertain details of their of research skill development, one year after the completion of the course.
9. Present or co-present faculty-level seminars and/or workshops with project leader.
10. Present papers and/or workshops at discipline-specific and higher education conferences to further disseminate RSD approaches.
11. Produce discipline-specific and higher education focussed journal articles.
12. Continue to use RSD assessment tasks and rubrics in courses and, if warranted, expand usage within the same course or across other courses.

The majority of academics in the project team followed a modified-to-context version of this protocol.



2.2.3 Evaluation of implementation of project's RSD approach

The effectiveness of RSD development and implementation in each course was evaluated using the following strategies:

- use of pre-course and post-course questionnaires with 15 Likert-scale questions and two open response questions. These were analysed for statistically significant changes in scores
- recording of student marks for each RSD-based assessment task in a database for analysis of trends
- interviewing of a range of students one year after completing an RSD-based course, with emergent category analysis performed
- review of course documents, evaluation materials, and interviews of project team members, conducted in 2008 and 2009 by the project's external assessor, Dr Peggy Nightingale.

2.2.4 Incorporation of alternative approaches to using the RSD

During 2008 and 2009, both members of the project team and academics working independently of the project developed some alternative approaches to using the RSD framework. This enhanced the project team's understanding of the ways in which the RSD can be used.

Examples of alternative approaches to using the RSD developed in this way include:

- adaptation of the RSD to organise hyperlinked resource modules co-developed by the Library and Faculty of Education at Queensland University of Technology (see Appendix 6)
- an assessment matrix for PhD research proposals, based on the RSD—called the RSD7—developed for the Integrated Bridging Program at The University of Adelaide
- analysis of existing problem-based learning curricula in Medicine, and across undergraduate, Masters and PhD courses in Nursing at Trinity College, Dublin
- development of a highly modified rubric format, appropriate for use in the humanities, in the discipline of English at The University of Adelaide
- development of related frameworks for different purposes, including the Work Skill Development Framework created by Dr Sue Bandaranaike at James Cook University (see Appendix 7)
- development of student-negotiated marking criteria in the School of Education at The University of Adelaide
- policy guidance, at the University of Maastricht in the Netherlands.

The demonstrated flexibility of the RSD framework has increased general interest in its use. Several of these approaches used together, especially at program level, may prove to be mutually reinforcing.



3 OUTCOMES AND DELIVERABLES

Six outcomes and three deliverables were specified in the original project proposal. These are listed below.

3.1 Project outcomes

The project outcomes as stated in the initial proposal were:

1. that diagnostic and summative assessment of student research skills, informed by the research skill development (RSD) framework, would be embedded in the assessment regime of coursework students in at least eight disciplines, in four universities
2. that measurable improvement in student research skills would be produced in each course involved
3. that students in the involved courses would report being better prepared for and more interested in research generally and in higher degrees by research
4. that undergraduate students in each course named in the application would report a more satisfying learning environment and greater skill development compared to courses not using the RSD approach
5. that the RSD approach would be trialled in eight courses in addition to those named in the original application by the end of the project
6. that an understanding would be developed of how to effectively transfer the RSD approach to different disciplines, other Group of Eight universities, the network of Innovative Research Universities and the Australian Technology Network universities.

All of these outcomes were achieved during the course of the project, as indicated below.

3.1.1 Diagnostic and summative assessment of student research skills informed by the RSD framework embedded in the assessment regime of coursework students in at least eight disciplines in four universities

Diagnostic and summative assessment of student research skills were embedded in the assessment regimes of 31 courses in 17 disciplines and two service courses across five Australian universities:

The University of Adelaide

Animal Science (one second year and one third year undergraduate course)
Dentistry (one first year undergraduate course)
Electronic Engineering (one Honours and one Masters by Coursework course)
English (two combined second year and third year undergraduate courses)
Higher Education (two Graduate Certificate level courses)
Integrated Academic Program (one bridging course for new international students)
Media Studies (one second year undergraduate course)
Medical Science (two first year undergraduate courses)
Nursing (one first year and two second year undergraduate courses)
Oral Health (two first year and one second year undergraduate course)
Secondary Education (one Masters by Coursework course)
Software Engineering (one third year undergraduate and one Masters course)
Veterinary Science (one first year undergraduate course)

The University of Melbourne

Business Law (one second year undergraduate course)



Monash University

Business Ethics (one Masters course)
Human Resource Management (one first year undergraduate course)
Introduction to Tourism (one first year undergraduate course)

Macquarie University

Psychology (one first year and one third year undergraduate course)

University of South Australia

Introduction to Tertiary Learning (one pre-university course)

3.1.2 Measurable improvement in student research skills produced in each course

Both student self-assessment, conducted early and late in RSD-based courses, and their results, based on project team members' use of RSD marking rubrics, show distinct and measurable improvement in discipline-specific research skills (for details see Part 4: Results and Analysis).

3.1.3 Students in involved courses report being better prepared for and more interested in research generally and in higher degrees by research

Pre-course and post-course questionnaires analysing students' assessment of their own research skills and their attitudes towards research showed statistically and educationally significant increases in perceptions of research-relevant skills: question-framing, evaluating, and written or spoken communication.

While these questionnaires show no statistically significant changes to student levels of interest in research, or in higher degrees by research, data from student interviews suggest that in the longer term student interest in research and higher degrees by research has increased. Eighty-nine per cent of students indicated in interviews that the research skills they developed in RSD-based courses were useful in employment, and 75 per cent that they were useful for subsequent studies (see Part 4: Results and Analysis).

3.1.4 Undergraduate students in each course report a more satisfying learning environment and greater skill development compared to courses not using the RSD approach

Data from student interviews conducted in 2008 and 2009 show a strong trend towards student preferring RSD-based assessments to non-RSD-based assessment tasks in other courses. This includes responses from students who achieved lower grades than average in their RSD-based courses.

The data from student interviews also suggest that students' perception of research skill development is greater when students have completed RSD-based courses, compared with their perceived development in non-RSD-based courses (see the Part 4: Results and Analysis: Student Interview Data).

3.1.5 RSD approach trialled in eight courses in addition to those named in the original application by the end of the project



In addition to the nine courses named in the original project proposal, 22 courses have trialled the use of RSD-based approaches in 2008 and 2009, as listed above.

3.1.6 An understanding developed of how to effectively transfer the RSD approach to different disciplines, Group of Eight universities, the Innovative Research Universities and Australian Technology Network universities

The availability of the published conceptual framework, and readily accessible and useable examples of RSD-based rubrics from a range of disciplines, has enabled academics and others at Australian Technology Network universities (Queensland University of Technology, the Royal Melbourne Institute of Technology), an Intensive Research University (James Cook University), and the University of Southern Queensland and Victoria University to adopt and apply the RSD.

Transfer of RSD usage from the disciplines named in the project proposal to new disciplines has occurred frequently, particularly at partner universities. For example, Oral Health course coordinators at The University of Adelaide pioneered the use of RSD to assess the use of Wikis as a research process and student posters as a research product; this use has been adapted by Dentistry, Veterinary and Animal Science, Graduate Certificate in Higher Education, and Human Biology course co-ordinators. RSD rubrics have been informed by pre-existing rubrics from as many as five different disciplines.

Over the course of the project, the project team has developed an understanding of the need to consider the affective realm of research. Two substantial affect-promoting elements have been added to the generic RSD framework to emphasise its efficacy and relevance. These are:

- the extension of the original framework from five to seven levels, with levels 6 and 7 covering early- and mid-career researchers
- the addition of an explicit affective realm into the predominantly cognitively-oriented framework.

Evaluation of these elements in dissemination workshops suggests that they are more effective in inducing academics to consider taking up the RSD than the original version of the framework. The extended RSD7 has the potential to assist teaching academics, course co-ordinators and others in embedding the RSD at program level.

The Research Skill Development Handbook has been available since the earliest seminars and workshops of this project. It was evaluated through its use, modified, and the next version provides more substantial guidance to academics about what project academics have done, as well as outlining multiple alternative approaches that have emerged during the life of the project.

3.2 Project deliverables

The project's list of deliverables from the original proposal was:

1. workshops to be run twice per year in the schools housing courses involved in the project across the four original universities, and potentially in other universities also
2. an interactive web portal presenting examples of practice and assessment of RSD in a minimum of eight disciplines
3. peer-reviewed articles by some involved lecturers on discipline-based RSD approaches, as well as related conference presentations, accepted for publication one year after the project's completion.

All of these deliverables have been achieved.



3.2.1 Workshops run twice per year in schools housing courses involved in the project across the four original universities, and in other universities

A total of 50 seminars with workshops or other follow-up have been run over the course of the project.

Twenty dissemination seminars followed up with workshops or one-on-one support were run at The University of Adelaide in ten schools, two centres, one faculty and at the Barr-Smith Library. There were also five cross-disciplinary seminars and one for all heads of school. Seven more schools are planning to run RSD seminars in 2010.

Eleven combination seminars and workshops were run at other partner universities: three at Monash University in the Faculty of Business and Economics; one in a research education group; one in a library and academic language support group; two at The University of Melbourne; two at Macquarie University; and two at the University of South Australia.

Seventeen combination seminars and workshops were run by invitation at universities not connected to the project. The University of Southern Queensland held three; Queensland University of Technology, two; James Cook University, two; and Trinity College Dublin, two. One combination seminar and workshop each were held at Victoria University, the Royal Melbourne Institute of Technology, Griffith University, Bond University, Curtin University of Technology, Edith Cowan University, the University of New South Wales, and the University of Wollongong in Dubai.

One combination seminar and workshop was run at a state conference, and one combination seminar and workshop was run at an international conference, the International Consortium of Academic Developers conference in 2008.

Finally, one online seminar sponsored by the Education Research Group of Adelaide was run in November 2009, suggesting a useful, cost-effective way to run further nation-wide dissemination events in the future.

3.2.2 Interactive web portal presenting examples of practice and assessment of RSD in a minimum of eight disciplines

The RSD website was established at <http://www.adelaide.edu.au/clpd/rsd> in 2006 and currently attracts between 90 and 160 unique visitors each week. Approximately 20 per cent of visitors each week are return visitors.

The site is organised to allow visitors to locate and access examples of RSD-based assessment tasks and rubrics from more than eight disciplines. This will increase to 20 disciplines in the future with the addition of a searchable database of example rubrics (currently in beta-testing).

3.2.3 Peer-reviewed articles by some project team members on discipline-based RSD approaches, and conference presentations, accepted for publication one year after the project's completion

Members of the project team have authored three journal articles (two published and one in-press), five peer-reviewed conference papers and 15 conference presentations focussing on the RSD framework and their use of it in teaching.



4 RESULTS AND ANALYSIS

Four data sources were utilised to evaluate the effectiveness of RSD approach used in the project. These were:

- pre-course and post-course questionnaires requiring students to self-assess their research skills
- academics' assessment of student research skills
- interviews with students one year after completing RSD-based courses
- interviews with the academics using RSD approaches.

4.1 Pre-course and post-course questionnaires

Students were given identical questionnaires at the start and end of each semester-long RSD-based course. The questionnaires comprised 15 Likert scale items and two open response questions. The first nine Likert scale items made statements about the students' research skills, while the remaining Likert scale items made statements about the nature of research in the discipline. All items required a response, ranging from strongly disagree (1) to strongly agree (7).

The questionnaires were piloted in 2008. They had high internal reliability scores as measured by Chronbach's Alpha (> 0.84), evident in both a Masters course and an undergraduate course (Willison, Schapper and Teo, 2009); however, some questions were identified as ambiguous, and were subsequently redesigned. Likert scale items 2 to 9 were rewritten to focus on research skills in specific discipline contexts, rather than research skills in general, as shown by the following questions from the Oral Health 2009 questionnaire:

1. My general research skills are good
2. My research skills in Oral Health are good
3. I am able to frame research questions in Oral Health
4. I can devise procedures in Oral Health to find information relevant to my inquiry
5. I can effectively evaluate the credibility of sources of information in Oral Health
6. I organise information from multiple sources effectively in Oral Health
7. I am able to analyse information effectively in Oral Health
8. I can clearly communicate in writing what I understand from my research in Oral Health
9. I can clearly communicate in oral presentations what I understand from my research in Oral Health

Items 10 to 15 were designed to elicit information about students' attitudes to research:

10. By researching Oral Health, I am more able to understand it.
11. I would like to be more involved in research
12. My studies at university require me to do research
13. Oral Health research is an activity that has trustworthy outcomes
14. Research is an activity which influences practices in my discipline
15. The ability to research will be important to my career

The two open-response questions were:

1. What do you think research involves?
2. Up to now, what has helped you to develop your research skills, and what has been a barrier?



The post-course questionnaire was identical to the pre-course questionnaire in each case.

4.1.1 Scores

The internal reliability of scores for the 10 pre-course and post-course questionnaire sets analysed to date was high, with questionnaire response scores having Chronbach's Alpha scores of 0.82 or more. The Mann-Whitney U test was used to determine the probability of changes in Likert scale scores for seven courses, and Student's T tests for the three courses from 2008, marked with an asterisk in Table 1. The significance level used was $p=0.05$. Statistically significant changes in scores, item by item for pre-course and post-course questionnaires, are indicated in Table 1 (see page 24) in bold for each of the 10 courses, and only these scores are considered in this analysis.

4.1.2 Analysis

Statistically significant, positive change occurred in students' perceptions about their ability to research in the discipline (Q2) in all 10 courses. However, in four of these courses, students did not perceive commensurate improvements in their general research, suggesting that the discipline-specific and general research skills do not necessarily go hand-in-hand from students' perspective. Data from student interviews (see Section 4.3: Student Interviews) suggests that, across the six disciplines interviewed, students perceived that their skills were developed primarily within the course context, so it seems for the six courses where both discipline-specific and general research skills were perceived to increase, it is more likely that improved discipline-specific research skills led to improvements in students' perception of their general research skills. The other four courses in which students provided data that their self-perceptions of general research skills did not increase, require further analysis. For example, in-depth analysis of Business Law students' perceptions (Willison, Schapper and Teo, 2009) indicated the possibility that strongly nuanced research skills, such as those required for researching aspects of tax law are not necessarily perceived as enabling general research skills. This may have implications for *when* in university studies research skills are emphasised to enable the greatest benefit; possibly in courses with less specialised knowledge, earlier in programs.

The discipline-specific research skills were manifested, in nine out of 10 courses as a perception of an improved capacity to pose research *questions* (Q3) and suggestive that the RSD framework is a viable tool to enable academics to help students to develop this skill. In eight out of 10 courses students perceived an *improved capacity to find relevant information* and in the same number of courses students' perceptions of their ability to critically evaluate information increased. Academic participants in RSD workshops have consistently indicated that student reliance on sources of dubious credibility is a concern, so it is an important finding that, in the majority of courses, students perceived their ability to find relevant sources increased and that they were able to determine the credibility of those sources.

In seven courses, students perceived that their *ability to communicate research outcomes in written formats* improved, and in six of these seven and no others, students perceive their ability to *communicate research findings orally* improved. This is suggestive of a coupling between oral presentation skills and written research skills, but requires further investigation, as it may merely indicate the focus of some courses and not others.

The results listed above show that the RSD can help to develop students' skills in posing questions, identifying relevant information to address these, and evaluate to ensure the use of valid and credible sources; students' written and oral communication may also be developed. These results show substantial outcomes of use of the RSD by academics to inform the development of students' ability to identify, evaluate and use valid sources. However, more in-depth analysis is needed in the areas of evaluation and communication skills, to explore the effects of disciplinary, pedagogical, and resourcing factors (eg student-to-staff ratios and types of learning environment) on student research skill. Student



perceptions of skills associated with *organising* (Q6) and with *synthesising* (Q7) only increased statistically significantly in four courses. This raises questions, including why some skills seem to be developed in most or all courses, and others not so widely developed, from the students' perspective, as determined in these pre and post questionnaires, and in their long-term consideration provided in their year-later interviews (see 4.3).



Table 1

Statistical significance value for the difference between pre- and post-course questionnaires, item-by-item, in ten courses with RSD intervention.

Where $p < 0.05$, the p value is in bold. ($n1$ = no of students completing pre- questionnaire, $n2$ = post; $a1$ = Chronbach's alpha for pre- questionnaire, $a2$ = post.)

Item	1st Year Vet and Animal Science	1st Year Human Biology S1	1st Year Human Biology S2	1st Year Dentistry	1st Year Oral Health*	1st Year HR Management	2nd Year Year Tourism	3rd Year Business Law*	Masters in Business ethics*	Masters Software Engineering	Total # courses with stat. sig scores
1	(n1=83, a1=0.84; n2=67, a2=0.81)	(n1=222, a1=0.88; n2=144, a2=0.89)	(n1=157, a1=0.85; n2=78, a2=0.86)	(n1=72, a1=0.87; n2=66, a2=0.89)	(n1=29, a1=0.82; n2=24, a2=0.82)	(n1=118, a1=0.85; n2=115, a2=0.89)	(n1=22, a1=0.94; n2=34, a2=0.82)	(n1=38, a1=0.84; n2=22, a2=0.95)	(n1=23, a1=0.90; n2=34, a2=0.87)	(n1=15, a1=0.84; n2=17, a2=0.95)	6
2	0.016	0.266	0.000	0.527	0.010	0.000	0.011	0.218	0.000	0.089	6
3	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.012	0.000	0.024	10
4	0.047	0.023	0.006	0.020	0.000	0.000	0.000	0.006	0.000	0.455	9
5	0.004	0.010	0.002	0.411	0.461	0.000	0.000	0.002	0.000	0.008	8
6	0.211	0.047	0.004	0.206	0.001	0.000	0.001	0.029	0.016	0.022	8
7	0.095	0.852	0.002	0.343	0.271	0.000	0.000	0.301	0.005	0.202	4
8	0.075	0.451	0.006	0.069	0.300	0.000	0.002	0.559	0.016	0.278	4
9	0.009	0.641	0.025	0.132	0.030	0.000	0.001	0.002	0.024	0.261	7
10	0.022	0.729	0.026	0.094	0.052	0.000	0.007	0.003	0.000	0.123	6
11	0.952	0.028	0.971	0.240	0.356	0.083	0.979	0.999	0.045	0.176	2
12	0.303	0.750	0.754	0.819	0.316	0.441	0.056	0.246	0.416	0.766	0
13	0.192	0.260	0.271	0.754	0.999	0.426	0.851	0.557	0.125	0.682	0
14	0.007	0.942	0.123	0.268	0.287	0.023	0.140	0.025 (-)	0.052	0.433	3
15	0.086	0.295	0.574	0.458	0.999	0.027	0.806	0.340	0.115	0.350	1
16	0.871	0.003	0.361	0.755	0.803	0.453	0.266	0.114	0.148	0.682	1



In contrast with the skill development evident is that the pre and post questionnaires did not show any trends across courses to changes in attitudes to research. Question 13 (research in this discipline has *trustworthy outcomes*) showed statistically significant changes in three disciplines (Veterinary science, Human Resource Management and Business Law) with the change in Business Law being negative. These results are very difficult to interpret, as student perceiving research to produce more trustworthy outcomes after a semester may suggest that, having understood research processes, they find they make sense and produce believable results; those seeing research as less trustworthy may be considered to have learnt, in the process to be more critical. Student interviews (section 4.3) do not cover any of these disciplines, and so do not shed any light here. Moreover, interviews one year later give very different perspectives to questionnaires conducted in the course. Further research is necessary to delve into shorter term attitudinal changes. *I would like to be more involved in research* (Q11) and *My studies at university require me to do research* (Q12) showed no statistically significant changes for all courses. The semester-length engagement in numerous disciplines in explicit development of students' research skills, which students themselves tended to perceive was actually effective in terms of skills developed, provided little evidence of substantial improvements in attitude. This is in stark contrast with the findings from the interviews conducted one year after a student had completed a RSD course (Section 4.3). However, before considering the student longer-term more considered perspective on what these courses achieved, academics' assessment of students' research skill development will be discussed.

4.2 Academics' assessment of student research skills

4.2.1 RSD score generation and preliminary analysis

The RSD-based marking rubrics generated by project team members reflected the scope for autonomy given to students in each assessment task. Tasks were marked according to the extent to which they operated successfully with that scope (see Appendix 4). For example, at the start of each semester in Human Biology, students were given diagnostic assessment tasks that were highly structured, and allowed only a limited scope for choice; the marking rubric contained only levels 1 and 2 of the RSD framework, allowing for students to be assessed at level 1, level 2 or no level (if no evidence or irrelevant evidence was provided). At the end of the second semester in the follow-on subject, students were given an open inquiry task, with limited structure provided; the rubric for this task incorporated levels 1 to 4 of the RSD framework, with individual student achievement being assessable at any of those levels for each facet.

Analysis of consecutive assessments can therefore track students' research skill development in each course though the comparison of student results for each facet in both tasks. The interpretation of scores, however, is not straightforward. Not only does the scope of inquiry increase by an average of one level of autonomy between tasks, but the degree of conceptual difficulty—the degree of rigour, and often the breadth and depth of knowledge—required to operate successfully also increases. A higher score in the summative task can indicate successful engagement with research work at a higher level with more autonomy. However, one issue with interpreting scores this way is the creation of a 'false ceiling': a high score for any given facet in a diagnostic assessment may be an inaccurate measure of a student's ability, because the student might have the ability to score at a higher level if given greater scope.

Preliminary analysis across disciplines, of scores generated by RSD-informed rubrics, suggests that student research skills increase during a semester. This agrees with the students' self-assessment of research skills as discussed in Section 4.1 above. However, more comprehensive analysis needs to be conducted for each facet, and this result compared to the questionnaire results to gain a clearer picture of how and in what areas student research skills develop.



4.2.2 Comprehensive analysis of scores

A comprehensive correlational analysis of student results was conducted for first year Human Biology courses from 2003 to 2007. The results of this analysis may be treated as a best-case scenario in that the course has been utilising RSD approaches since 2005; it represents two consecutive semester-long courses coordinated by the same academics; all assignment tasks in the courses are RSD-based; and students have provided substantial feedback each year on how to improve the RSD-based tasks and rubrics used.

From 2003 on, Human Biology students were given a literature research assessment in late semester one and a field-based open inquiry in semester two. In 2005, the coordinators of the two courses, Dr Peirce and Dr Ricci began to reframe assessment tasks using the RSD, including the open inquiry, which was given an RSD-based marking rubric using level 4 of the RSD framework. In 2006, several more assessments were reframed, including the literature research assessment task, the rubric for which used level 3 of the RSD.

Before the RSD was introduced in this course, a standard assessment scheme was used to allocate marks. After the introduction of the RSD, marks were allocated by adding together the RSD levels achieved in each facet. Pearson's Product moment (r) was used to determine the correlations outlined in Table 2.

Table 2

Correlation between marks for end of semester one Literature Research Task and end of semester two Field Research Task, 2003-2007 (Willison, Peirce and Ricci, 2009).

	2003	2004	2005	2006	2007
Correlation of Literature Research Task & Field Research Task (number of students)	0.20 (n= 104) $p < 0.1$	0.40 (n=117) $p < 0.01$	0.48 (n=79) $p < 0.01$	0.55 (n=97) $p < 0.01$	0.57 (n=95) $p < 0.01$

The correlation of 0.2 in 2003 indicates that if students performed very well in the literature research task in semester one, they may perform very well, average or poorly in the open field research task of semester two. However, by 2007, the increased correlation of 0.57 indicates that if students performed well in the literature research task, they were likely to perform well in the open field research task also. This implies that as students developed the explicitly-taught literature research skills in semester one, the skills associated with open-ended research in the field were also being developed (Willison, Peirce & Ricci, 2009).

The factor that changed between 2003 and 2007 was the extent to which the course co-ordinators made the process of developing students' research skills explicit. From 2005 to 2007, the number of assessment tasks that were accompanied by an RSD-based marking rubric increased steadily. Making the process of developing students' research skills explicit and clear seems to be one factor that enabled the increasing correlation of performance on the semester one and semester two tasks.

This correlation is significant for the sciences, engineering, social sciences and other disciplines in which field research is conducted, because it implies that the skills associated with field research may be developed to some extent before field experiences. This will allow significant pedagogical advantages, in keeping with studies of the benefits of structured research tasks (Chaplin, 2003) and literature research tasks (Hoskins et al., 2003) on student research skills. In addition, the correlation permits effective targeting of remedial resources: students who do not perform well in the literature research task could be identified as being 'at risk' in the field research task, and remedial resources were targeted at them. For in-depth data and analysis of this, see Willison, Peirce and Ricci (2009).

This depth of analysis is not currently possible for the other courses involved in the project.



4.3 Student interviews

4.3.1 Interview protocol

To obtain student perspectives on their research skill development and the RSD framework, students from 6 courses were interviewed a year after completing an RSD-based course. A semi-structured interview protocol that could be adjusted to suit the disciplinary context of each interview was piloted in 2006 and 2007, and used in interviews in 2008 and 2009. See Appendix 8 for a copy of the interview protocol. Students were not asked about any specific skill, just research skills in general, so that student understanding of specific research skills may emerge through their reference to them.

Forty-six students were interviewed from six disciplines selected to represent the major faculty groupings. Interviews were conducted a year after the completion of an RSD-based course in order to obtain long-term, considered opinions about the RSD and the teaching processes of these courses. Interviews were recorded, and lasted from 40 minutes to an hour, with participants given compensation for their time, in the form of the choice of a \$20 photocopy card, two movie passes or a \$20 iTunes recharge card.

The pilot of the interview process with Human Biology students in 2006 and 2007 showed that the students who came to interviews could introduce a 'self-selecting bias', despite the project team's attempts to select students of a range of abilities (Willison, Peirce & Ricci, 2009). In both 2006 and 2007, students who had improved the most were more likely to attend interviews. In 2008, the project team therefore invited only Human Biology students who were performing under the average on their RSD tasks. For most other courses the range of students interviewed was representative of a range of abilities. However, only stronger English students were interviewed.

4.3.2 Analysis of interview transcripts

The data gathered during the interview process enabled a third perspective from which to address the project's two key research questions:

- What are the advantages and disadvantages of explicitly developing students' research skills?
- What factors support student research skill development, and what factors hinder its development?

In the initial analysis of the 2008 interviews, the project team used these questions to guide the categorisation of comments. Four categories of response were identified:

Category A—Advantages of explicitly developing research skills

Category B—Disadvantages of explicitly developing research skills

Category C—Factors that support research skill development

Category D—Factors hindering research skill development

Each of these categories was subdivided into key elements. These are listed in Tables 3, 4, 5 & 6.

Interview transcripts were analysed using these categories and elements by several readers. In order to avoid giving undue weight to a single idea repeated several times in any one interview, however, comments were counted on a 'unique-to-student' basis: each category was recorded only once for each student, no matter how many times it was mentioned in their interview.



4.3.3 Categories A and B: Advantages and disadvantages of explicitly developing research skills

Two hundred and ninety-two unique-to-student comments were made about the benefits of having their research skills explicitly developed, and 21 comments were made about the disadvantages of explicitly developing student research skills.

Students identified an average of six advantages, except in English, where they identified an average of eight; however, as noted above, the sample of students interviewed for English was skewed towards high performers.

Table 3

Percentage of comments about the benefits of explicit research skill development.

	Total comments for each category (46 students, 6 disciplines)	% of students who made this kind of comment
Total comments	292	100
Transfer to employment	41	89
Transfer to other courses	35	76
Developed facet B: find/generate information	33	72
Developed facet C: critically evaluate	24	52
Develop critical thinking	19	41
Transfer to society	18	39
Developed facet E: synthesise/analyse/apply	18	39
Spark further research interest	17	37
Fulfil higher tertiary education (e.g. Honours)	17	37
Developed facet F: communicate	14	30
Developed facet A: embark/determine need	14	30
Motivation	13	28
Awareness of RSD framework in early stage led to incremental autonomy	13	28
Employability	11	24
Developed facet D: organise information	4	9
Improved marks	1	2

As the final category 'Improved Marks' shows, students were not focussed in the year-later interviews on achieving improvements to their grades through explicit research skill development. This may be because they were less concerned with grades for a course completed one year previous, or because learning rather than a grade was viewed as the substantial course 'deliverable'.

All but one of the positive comments, then, focussed on substantial educational benefits gained from explicit research skill development. In terms of perceived skill development, 72 per cent of students reported that a research skill developed was the ability to *find information and generate data*—a skill that students may consider to be a defining feature of research when they are first entering university (Homewood et al., 2008). Fifty two per cent also stated that they developed skills in the evaluation of data and sources. These two results agree with the findings from the questionnaires, where eight out of 10 courses



showed significant changes in both of these skills. As teaching academics are often concerned about students' ability to identify and assess credible sources, this is a substantial finding. Thirty per cent of students stated that their abilities to *synthesise* information improved (four of 10 courses indicated this in the questionnaires). These findings in regards to skills are in keeping with the pre-course and post-course questionnaires, providing a stability in findings from two data sets separated in time and different in methodology.

However, only 30 per cent of students stated in interview that their ability to *frame research question improved, yet eight of the 10 course questionnaires showed significant improvements*. It is possible that students were over-assessing themselves in their post-questionnaires (or under-assessing in their pre questionnaires), or were less aware of this skill one year later (no specific skills were directly solicited in interviews), or even that this skill had been less necessary or dormant in their subsequent year of study. Another difference in the data sets, similar to the above is shown in terms of the category *communicate the results of their research*, with 30 per cent of students noting this in interviews, yet statistically significant perceived changes in seven of the 10 courses. It is worth further research to determine if some skills are not explicitly (or implicitly) developed or assessed in subsequent years, these skills may atrophy, or at least diminish in importance in students' minds.

Only 9 per cent of students reported that their ability to *organise information or data* had improved due to their explicit research skill development one year previous. This does raise questions about why students are so unaware of this skill compared to all the other skills. Is it seen as an add-on, trivial, not a part of research? Or is it not clearly facilitated, awkward for academics to develop? Of the four courses that showed statistically significant changes in the questionnaires for *organising information*, three are business-related courses, and the fourth was the second semester of Human Biology, which followed a previous semester of explicit research skill development. Disciplinary and context-specific issues may well be at play here.

In considering components of interviews other than specific skills, 75 per cent of the students interviewed stated that research skills they learned in RSD-based courses were useful in other university courses, and 89 per cent stated that those research skills were relevant for the workforce (yet only 24 per cent of students stated that research skills would make them more employable). Forty one per cent of students stated that they had developed their critical thinking skills during RSD-based courses and 39 per cent stated that research skills were also applicable to social situations and life skills. Taken together, this suggests that these students' long-term perceptions are that the teaching in content rich courses can develop in students both useful academic research skills and skills that are applicable to employment.

Thirty seven per cent of students interviewed stated that the explicit development of research skills in their RSD-based courses sparked their interest in further research, as compared to no significant changes in interest demonstrated in the questionnaires conducted early and late in a course. This suggests the value of a longer-term, considered perspective to complement the perspectives of the immediate response of the post-course questionnaires discussed in Section 4.1. The same percentage of students (37 per cent) stated that RSD processes would help them to fulfil higher levels of tertiary study, such as honours.

With 21 unique-to-student comments made about downside of research skill development, the positive-to-negative comment ratio was 14:1. This suggests that students saw substantial benefits and very few downsides to explicitly developing their research skills.

4.3.4 Factors that support or hinder develop student research skills

While students seemed to value the explicit development of their research skills, they were more critical of the processes used to achieve this, with 327 unique-to-student comments made about factors that supported the development of their research skills and 219 about factors that negatively affected their development.



Comments could be broken down into three main categories:

- the use of the RSD
- the course in general
- factors outside of the course.

Of 331 unique-to-student comments about features that supported student development of research skills, 147 (44 per cent) were attributed to elements of RSD use, 124 (38 per cent) were attributed to the course more generally, and 60 (18 per cent) to factors outside the course. Of the 224 unique-to-student comments about features that hindered the development of their research skills, 89 (40 per cent) were attributed to elements of RSD use, 56 (25 per cent) were attributed to the course more generally, and 79 (35 per cent) to factors outside the course.

Table 4

Number and percentage of comments made about use of the RSD in ways that either support or hinder research skill development.

Category	Support research skill development	Hinder research skill development
Useful feedback provided by the process	40 (87%)	17 (37%) (lack of clarity) 15 (33%) (lack of use): eight said lack of clarity too
RSD framework made clear and explicit the purpose	36 (78%)	13 (28%) (complexity) 3 (7%) (lack of specificity)
Forward planning was enabled with clear assessment criteria	30 (65%)	7 (15%) (unable to forward plan) 9 (20%) (no guidance to move between levels)
Framework – for incremental autonomy	21 (46%)	9 (20%) (autonomy not what was expected)
Use of RSD framework in generating marking criteria	17 (37%)	16 (35%) (lack of awareness of RSD and assessment relationships)

Of all unique-to-student comments made, 147 of the positive effect comments (44 per cent) stated that the ways in which the RSD was used were beneficial to their development of research skills, and 89 of the comments about hindrances (40 per cent) stated that the ways the RSD was used were detrimental to their development of research skills.

While 87 per cent of students indicated that the RSD processes provided useful feedback, many also indicated problems with the process—some said that it appeared useful in hindsight, but that they had not used it during the course. One student said ‘I treated these as a bit of a joke actually. But now I look at them I can see what they were trying to do’. Similarly, some students stated that, with hindsight, the feedback looked useful, but that they didn’t find it clear during their courses. This connects to a recommendation made by the external assessor at the end of the first year of the project—that it is more important to guide students to use feedback, than to merely provide it.

Similarly, while 78 per cent of students reported that the RSD structure helped to make the purpose of assessment tasks clear, 28 per cent indicated that they found the marking criteria too complex to be helpful, and seven per cent indicated the criteria were not specific enough (with some students offering both positive and negative comments about this).

While 65 per cent of students indicated that they were able to forward-plan in assessments using RSD-based criteria, 15 per cent stated that they were not able to do so, and 20 per



cent said that a lack of guidance of how to move between levels was a hindrance to developing their research skills. This demonstrates that, even though teaching academics can use marking criteria to articulate to students requirements that are otherwise often left implicit, students will not always understand what is required of them, and may not be able to use the criteria as leverage to move up levels. There is no substitute for classroom dialogue about the meaning of these criteria, for practicing the use of them, and facilitating the student response to feedback; without these, the criteria for many students are just more words on a page.

While 46 per cent of students stated that the RSD-based rubrics helped them to work autonomously as courses progressed, 20 per cent also indicated that the requirement to work autonomously was not what they expected, and that they found it a hindrance. This demonstrates the importance of developing shared understandings of course requirements.

With regards to shared expectations, 37 per cent of students stated they were aware that the RSD was being used to structure assessment tasks, and that they found this was helpful, but 35 per cent said that they were not aware of this, and that this lack of awareness may have hindered their development of research skills. One aspect the project has struggled with is that students frequently saw the RSD itself for the first time in interviews and expressed a wish that they had seen it early in their course, but also realised that it might prove to be too much to process at that point. Finding a balance between effective awareness raising and providing too much information continues to be a challenge.

The above information clearly shows that the use of RSD is not, in the external assessor's term, a 'silver bullet' for facilitating the development of student research skills. It suggests that:

- some approaches used by lecturers may need to be improved (many were only completing their first iteration, so this is not surprising)
- even well-developed RSD approaches are not likely to suit all students
- the RSD as a guiding framework may need to be improved
- the assessment-first orientation used in this project has weaknesses, in that students may perceive it prioritises being successful in assessment over real learning.

In addition to these aspects of the uses of the RSD, some of the interview comments were about aspects of the course in general. One hundred and twenty-seven unique-to-student comments (38 per cent of comments about positive factors) discussed aspects of specific courses that were beneficial to student research skill development. Fifty-six comments (25 per cent of comments about detrimental factors) focussed on aspects of specific courses that hindered student research skill development.



Table 5

Number and percentage of students who provided unique-to-student comments related to elements of courses that either support or hinder research skill development.

Category	Support research skill development	Hinder research skill development
Classroom dialogue	30 (65%)	8 (17%)
Practice/experience/number of assignments	24 (52%)	9 (20%) Pressure of assignment – lose interest
Assignments with similar structure (1, 2, 3 etc.)	11 (24%)	
Autonomy (e.g. enjoyed working freely, appreciated degree of scope etc.)	11 (24%)	9 (20%) too much scope
Use of support resources in course	9 (20%)	4 (9%) Support resources – lack of use
Relationship of lecture/assignment to practical elements	8 (17%)	
Examples of assignments	4 (9%)	2 (4%) (lack of examples)
Awareness of support	24 (52%)	
Linked/related assignments	4 (9%)	
Understanding of courses	2 (4%)	
Mismatches between evidence provided and ability		14 (30%) – mismatch, where marks did not match perceptions of own ability
Lack of discipline content knowledge		7 (15%)
gap between completion of assignment and receipt of feedback		3 (7%)

Sixty unique-to-student comments (18 per cent of positive factors identified) pointed out aspects outside of the course domain that had a positive impact on their research skill development, while 79 (35 per cent of negative factors identified) discussed aspects outside of the course domain that had a negative effect.

The 46 students were evenly divided between those who found that motivation was a factor in helping them develop research skills (39 per cent), and those who found that a lack of motivation to research hindered their research skill development (39 per cent). Eighteen per cent considered their previous experience of research (at high school, at work or in other courses) to be useful for the process of researching; for others this previous experience was a hindrance, or they had no such experience (29 per cent). Only 9 per cent stated that work in other courses helped them to develop their research skills; one Masters by Coursework student stated that this was the first university course that he had ever done that focused on research skills. Furthermore, 67 per cent of students indicated that previous experiences at school, or university courses or elsewhere lacked helpfulness to develop research skills, or actually were obstacles that needed to be overcome.

In conclusion, students identified many factors supporting their research skill development that lie within the control of teaching academics, and can be responded to at course level, with a total of 82 per cent of unique-to-student comments focussing on within-course factors. They also identified many factors hindering their research skill development that lie within the control of teaching academics, with 65 per cent of comments focussing on these. The students perceived RSD-based courses as potentially having a strong impact—both positive



and negative—on their research skills. These results suggest that, from students' perspective, teaching academics can have a strong impact on student research skill development at the course level.

4.4 Academics use of the RSD and interviews with these academics

4.4.1 Ongoing RSD use by academics

An important measure of RSD effectiveness is the extent to which it is used, and to which its use is continued, by course co-ordinators. Of the 12 original project team members who are still in academic positions, ten have expanded their use of the RSD, either by increasing the number of RSD-based assessments in a given course, increasing the number of RSD-based courses they teach, or both: for example, the Nursing program aims to use RSD-based rubrics in a minimum of four courses in 2010, expanded from one in 2007. Ongoing data will be gathered from the final project team at yearly intervals from 2010 onward regarding the number of RSD-framed assessment tasks in courses, and the number of RSD-based courses being run.

There are three main advantages to using RSD-based marking rubrics. These are that:

- they establish a familiar structure that can be repeatedly revisited
- they allow their developers to draw on an increasing range of examples
- the RSD framework, as a conceptual model, is designed to do much more than just inform rubric construction.

The benefits of the RSD as a familiar structure that can be repeatedly revisited were indicated by a project team member from the humanities in this statement:

Recent research I have conducted has led me to the view that the most important aspect of feedback is how students use it. At the moment, I am not convinced that many know how to use it constructively. Any approach that offers the opportunity to *stabilise the format* [italics added] in which feedback is given has the potential to maximise students' chances of learning to interpret, use and act on feedback appropriately. It is still better if that approach offers the opportunity to explicitly map a coherent developmental trajectory so that students know what it is they are meant to achieve through their studies. The RSD framework offers just such an opportunity.

Academic in the project team

As a stable format, the RSD-based rubric provides students with both a predictable structure for information and feedback, and a coherent, explicit trajectory for the development of their research skills. In a course using such rubrics, what should be new to students is, for example, not the idea that the course convener would expect them to evaluate the quality of their sources, but the information that they gather and the new understandings that they derive from the sources they identify and evaluate in response to the rubric.

There are also clear benefits to rubric developers having the ability to access a large bank of examples which have a common framework but are adapted to individual purposes. It makes the development of new rubrics—always a difficult process—easier, because the developers can use analogous assessment tasks and rubrics as inspiration or as the basis for their own adaptations of the RSD format.

Finally, the fact that the RSD framework, as a conceptual model, is designed to be used for more purposes than just informing rubric construction has several benefits for academics who adopt it. The most important of these is that it allows them to use the RSD to develop complementary approaches to student research skill development, such as the Queensland University of Technology's portal to support modules (see Appendix 7), and others of the ten approaches informed by the RSD that have emerged so far (see appendices).



4.4.2 External Reviewer's Interviews with Academics

The external reviewer interviewed project team members about their use of and perspectives on the RSD framework in both 2008 and 2009. In 2009 the team members interviewed were located at:

- The University of Adelaide: Electronic Engineering, Nursing, English, Software Engineering, International Bridging Program, Animal Sciences, Media Studies, and Oral Health
- the University of South Australia: Introduction to Tertiary Learning
- The University of Melbourne: Business Law
- Monash University: Business Ethics, Tourism, and Human Resources Management.

In excerpts from the external review (see Appendix 10 for full document), the reviewer stated that:

Many university teachers have begun to use the RSD framework to inform their teaching. They talked to this reviewer with insight and enthusiasm about how they were not only initiating new teaching strategies but also reconsidering the nature of research in general and in their disciplines.

.....

The greatest strength of this project is that it is shifting focus from teaching to learning, to what are the students able to do as a result of their studies.

.....

This reviewer truly enjoyed studying course materials. People who have been supported by this project are doing some wonderful curriculum development. Their creativity and commitment is inspiring. The RSD framework is supporting e-sim activities, wiki projects, and several different types of coherent, scaffolded assessment regimes, as well as helping in the development of rigorous marking rubrics.

.....

In 2009 the reviewer met a teacher who 'inherited' assessment rubrics based on the RSD framework. It is unusual for one academic to find the teaching materials of another congenial, and very rare for those materials to be helpful. These assessment rubrics 'worked' even though the new person knew nothing about the RSD framework until roughly halfway through term.

.....

What was impressive in some interviews in the second year was the testimony of teachers who said that, almost inadvertently, they found themselves thinking differently about the nature of research within their disciplines, the necessity for students at all levels to appreciate how research is conducted and to be initiated into the process themselves, and about how to inject these new perspectives into their teaching strategies.

.....

One academic talked about his realisation that design of one's whole curriculum can be deeply affected by focussing on assessment strategies and clearly defining criteria. Another said that she suddenly realised that students did not know where the material in her lectures came from, that they seemed to think it was just there for her to tell them about; they did not recognise the years of research in the field, the teacher's own research to enable her to present that knowledge, or that they themselves are engaged in a research process when they attempt to learn.



.....

In the second year interviews, a number of teachers talked about how the RSD added clarity and structure to their goals as teachers and made it possible to articulate aspirations which they already held but rarely expressed explicitly.

.....

The above excerpts show that there was a diversity of types of advantages perceived by academics, including: benefits to their students, such as course clarity of purpose and insight into research processes that build the discipline; benefits to themselves, such as enthusiasm, appreciation of the primacy of assessments, and changes in understanding of teaching and of research; and sustainability of change, that may persist when a key person leaves.

4.5 Summary of analysis

The data from students' pre-course and post-course self-assessments, academics' assessments of students' research skills, student interviews and interviews with project team members indicate that across the disciplines, use of the RSD framework allowed students to explicitly and coherently develop discipline-specific research skills, which students found useful for both subsequent study and employment. While students and project team members have indicated the need for improvements in many cases, the overall process had multiple indicators of success; academics' and students' perceptions that some key research skills were genuinely developed, especially question posing, finding relevant information, evaluating information and communicating information; students perspective that these skills were useful for subsequent studies and employment; and academics perspectives that the process was motivating, sustainable and led to surprising but useful outcomes, such as changes in perception about research in the discipline.

This substantial evidence of benefits to students and academics, from four different data sets emerging from multiple disciplines, year levels and universities, however, needs to be understood in the contexts in which it was generated. Before generalisations can be drawn, three issues must be considered. The first issue is that, the academics in the project team are not representative. The evidence above suggests that once RSD is embedded in a course's assessment regime it tends to stay in place. However, there is also evidence that transfer to other courses in the same program is 'patchy' and problematic. The project team members could be characterised, by and large as 'early adopters' or 'first generation innovators'; their use of the RSD therefore may not accurately predict how the RSD would be used by the majority of teaching academics.

A second issue is that these academics have had substantial support, especially with the start-up of this RSD approach and writing rubrics, as well as the benefits of being part of a project team, which may have a kind of 'Hawthorne effect', generating more positive results due to enthusiasm resulting from innovative behaviours.

A third issue is whether the benefits that students gain from RSD-based courses are sustained into life after graduation. Some of the data above suggests that some skills may atrophy, or be perceived as diminished in importance if they are not explicitly developed or assessed in subsequent years of study. If explicit research skill development is embedded in only one or two courses in a whole program of study, its effects may not persist. At the same time, however, if explicit and coherent research skill development were mandated across a program, academics might find themselves obliged to develop students' research skills and required to report on this, which might prove to add to an administrative burden and be, ultimately, counterproductive. These program-sized issues need to be addressed before any sort of policy on research skill development in context-rich courses could be formulated on an evidence basis.

5 UPTAKE OF RSD APPROACHES

5.1 Sustainability

The research skill development (RSD) framework has proven to be sustainable both within and between courses.

Of the 14 original project team members, 12 are still using the RSD framework to frame assessment tasks and marking rubrics (one has left academia). All of these 10 have expanded their use of the RSD during the lifetime of the project, either by adapting more assessment tasks to the RSD format, or by incorporating RSD approaches into more courses. The 14 additional project team members have also maintained or increased their initial use of the RSD format and approaches in their teaching.

The sustainability of the RSD format is also shown by an instance in which a project team member moved from the University of South Australia to the University of Canberra. In accordance with the University of South Australia's assessment policy, her RSD-based rubrics were retained for the course and the teaching academic who took over the course was required to use them. She reported recognising and appreciating their effectiveness before having any contact with the RSD project team, and after making contact with the project team went on to become a member.

5.2 Reproducibility

Over the course of the project, 12 academics and two library staff in addition to the original project team adopted the RSD for use in their teaching. They did so because of their awareness of project team members' work with the RSD, and their perception that it had the potential to be effective in their own teaching contexts. Many of these contributed data to the analysis in Section 4. Numerous other Australian universities, plus some in Ireland and Canada are currently planning how to incorporate RSD into courses and programs of study.

5.3 Efficiency

Project team members indicated that the amount of time initially required to adapt assessment tasks or courses to RSD format and develop RSD-based marking rubrics was substantial. However, they also reported that once these tasks were completed, they were able to mark student work as quickly as, or more quickly than, when using other marking regimes.

Additionally, project team members reported that when marking student work using RSD-based rubrics, they: gave students more detailed and substantial feedback; received fewer student queries about assessment tasks before the due date; and received fewer complaints after marks were returned.

Finally, sessional staff members working with project team members on RSD-based courses indicated that use of the RSD provided them with clear marking guidelines, and offered a greater degree of potential for inter-marker reliability than other marking regimes.



5.4 Variety of approaches

As the project team members and other academics engaged with the RSD framework, they developed 10 substantially different approaches to using it:

1. *Assessment rubric scaffolding*: the main approach discussed in this report (see Appendix 4 for details). This approach was used by most members of the project team.
2. *Level-by-level scaffolding*: in this approach the course co-ordinator determines in advance the scope of research appropriate for each assessment task, and grades within that level. This approach was applied in Nursing, Dentistry and Human Resource Management.
3. *Curriculum re-shaping*: in this approach, all available assessments, laboratory tasks, field components, etc., are shaped by the RSD. See www.adelaide.edu.au/clpd/rsd/ for examples of how The University of Adelaide's Human Biology course used this approach.
4. *Resource module structuring*: this approach was developed at Queensland University of Technology to organise existing, interactive online modules for developing facets of library research skills along a continuum of four levels (see Appendix 9).
5. *PhD bridging program*: this approach, developed at The University of Adelaide, uses the newly developed RSD7 (see www.adelaide.edu.au/clpd/rsd/rsd7 and Appendix 5) to structure a marking rubric for draft research proposals written by PhD candidates who are new to the university. In this approach, students self-assess their work and supervisors assess the proposal using the rubric, which then forms the basis for a discussion of differences and expectations.
6. *Analysis of existing assessment or curricula*: this approach was used to assess the problem-based learning curriculum of a medical school to determine the degree of autonomy students were required to achieve during their degree.
7. *Point of departure*: this approach was developed in the Faculty of Humanities and Social Sciences at The University of Adelaide. In it, the RSD framework serves as a basis for developing structured methods for marking analytic works, but its structure was then modified to meet the demands of individual disciplines.
8. *Inspiration for frameworks for related purpose*: for instance, the Work Skill Development Framework developed and being evaluated by Sue Bandaranaike at James Cook University (See Appendix 7).
9. *Development of student-negotiated marking criteria*: in this approach, students in a school of education were given specific marking criteria for three facets of the RSD, but were required to write and negotiate criteria for the other three facets, which were then used to assess their research assessment.
10. *Policy guidance*: Universiteit Maastricht in the Netherlands has embedded the RSD into their Dutch-language policy document.

Four of these—4, 6, 8 and 10—are initiatives developed by academics in non-project universities.



6 DISSEMINATION

The Research Skill Development (RSD) project used a variety of methods to disseminate both the RSD framework itself and the project's findings. These were:

- a comprehensive project website
- an ongoing series of workshops and seminars introducing the RSD framework at universities across Australia and internationally, which were conducted by the project leader and various members of the project team
- papers and conference presentations written by members of the project team
- word of mouth.

6.1 Project website

www.adelaide.edu.au/clpd/rsd/

The RSD website has been operating since 2006. It provides academics with access to copies of the RSD and RSD7 frameworks, discipline-specific examples of RSD use, and the RSD handbook. During the project's lifetime, the website's remit was expanded to include comments and testimonials from academics using the RSD, published papers discussing the RSD, and links to related websites and organisations. A searchable database of RSD examples is currently being tested and is available for use.

At the start of the project, the website had an average 15 to 40 unique visitors per week, and an average of three to five returning visitors. Over the lifetime of the project, this has climbed to 90 to 160 unique visitors per week, and 15 to 30 returning visitors, with spikes in usage regularly occurring before or after RSD seminars.

6.2 Seminars and workshops

Between 2007 and 2009 a series of RSD dissemination workshops and seminars was run at The University of Adelaide, other project team universities and universities outside the project (see Appendix 1).

Seminars ran for between one and one-and-a-half hours. They followed a general format of:

- outlining fundamental features of the RSD
- examining some discipline-specific examples
- engaging participants in a discussion of their current practice in terms of the framework.

Workshops typically ran for two hours, and were designed to give participants the opportunity to work in small groups based on their own interests or ideas for RSD implementation. Typically one or two groups would work on assessment rubric creation, whilst other groups would speculate on RSD use at program level.

The formats of both seminars and workshops were, however, always in a state of evolution, with regular changes made in response to feedback from participants and from the project's external assessor, and the RSD usage within the project: for instance, as nine additional approaches to using the RSD framework emerged (see Part 5 above), these were incorporated into the seminar format to present participants with other possibilities. The inclusion of the RSD7 framework and the affective realm helped to create higher levels of engagement in workshops and seminars run in Semester 2, 2009, including statement of intent to use the RSD.



6.3 Papers and conference presentations

Members of the project team have published papers discussing their use of the RSD, and given presentations at local, national and international conferences (see Appendix 2 for a full list).

6.4 Book manuscript

A full book proposal is with Routledge UK, with most of the original members of the RSD project team involved as authors of chapters. The author list also includes academics from the Republic of Ireland, Scotland, England and Canada.

6.5 Word of mouth

Although no systematic records were kept of word-of-mouth dissemination, anecdotal evidence from private communications and conversations suggest word of mouth was a significant means of dissemination, with individual contacts between project team members and other academics being likely to increase interest in engaging with and applying the RSD framework.

7 CONCLUSION

The RSD framework has enabled academics to explicitly and coherently develop students' research skills in undergraduate and Masters by Coursework courses.

When project team members used RSD-based marking rubrics to frame assessments in a course, students and academics perceived improvements in discipline-specific research skills such as posing research questions, critically evaluating data or readings, and communicating the results of their research.

A substantial majority of students interviewed indicated that the RSD was a positive factor in their education a year after completing RSD-informed courses. They were aware that working with the RSD had developed skills that were relevant to study and future employment.

Uptake of the RSD framework has remained predominantly at the level of individual academics and/or courses. Further research is needed to determine how the RSD framework can be integrated into programs of study in various disciplines and areas, to enable the explicit and coherent development of student research skills across the curriculum.



8 RECOMMENDATIONS

The project team offers the following recommendations to the ALTC and to academics and administrators who intend to use the Research Skill Development framework at course or program level.

The project has confirmed that implementation of the RSD at course level has advantages for both students and academics. However, this usage does not guarantee long-term benefits to either students or academics. The positive results gathered to date may be skewed by the fact that all of the project team members were early adopters of the RSD framework, rather than representative users, and the potential for RSD usage to provide coherent research skill development across a program is untested.

It is possible that a different approach to using the RSD may be needed at program level. However, a combination of new or currently existing approaches is more likely to enable effective development of student research skills in discipline-specific and interdisciplinary contexts than is a uniform approach.

Recommendation 1

The project team recommends that RSD approaches be trialled and evaluated at program level, and the optimum use and value of the RSD for students and faculty be determined, both through whole programs of study and from program to program.

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There is currently substantial interest in the implementation of the RSD approaches at the course level. Well-informed support is necessary to enable academics to start using the RSD effectively while avoiding common pitfalls.

Recommendation 2

The project team recommends that the RSD website be further and more substantially developed, to better provide for the needs of the academics visiting the site and to develop interactive and networking components that will enable the community to share and circulate resources. These processes should mirror as closely as possible the collaborative rubric-making processes used successfully in the project.

If subsequent evaluation of RSD approaches at program level shows generally positive advantages, then consideration may need to be given to broader academic development issues.

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As the external assessor found, explicit and coherent student research skill development using the RSD framework can blur the boundaries between teaching and research in the university environment, allowing academics to rethink the nature of research in their discipline, and reconsider and what should be taught in their courses. This development may speak to numerous university agendas such as the development of graduate attributes, evidenced by student interview comments revealing awareness of research skills' relevance to employment. The RSD has frequently been used by academics to clarify or reinvigorate their course outcomes or objectives, and has enabled assessment regimes to provide high quality but efficient feedback. It has the capacity to help build universities' research profiles through capacity development from first year. Universities in Canada and the Republic of Ireland are considering the RSD as an effective way to consolidate multiple agendas.



Recommendation 3

The project team recommends that the RSD framework be explored by universities as a way to support a consolidating agenda and pull together the sometimes conflicting agendas of teaching and research. The RSD framework may assist in bringing together multi-pronged teaching and learning agendas, including policies for well-framed course outcomes, mapping of program graduate attributes, and assessment and feedback policies.

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As the RSD describes a continuum of autonomy, it would be inappropriate for academics to be compelled to apply it as a matter of policy. During the project's lifetime, the project team's openness to new approaches and respect for individual autonomy have allowed academics to develop new, effective uses of the RSD for specific purposes.

Recommendation 4

The project team recommends that academics and universities adopt a practice-driven approach to use of the RSD framework, where policy supports the emergence of context-orientated practice. As a conceptual framework, the RSD can provide individual academics, departments, schools and universities with a vision for action, and the role of policy in this case may be to support academics' initiatives.

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Many of the courses involved in the project were first year courses. Diagnostic assessments in some of these often reveal a substantial proportion of students who struggle with basic research skills. If the pedagogical relationship between high schools and universities were more coherent and developed, the skills relevant to research at all levels could be explicitly taught and developed much earlier in the education process. Schools of education are pivotal in this process, as they have the capacity to both develop teachers' (those in-training and those in-service) research skills, and enable teachers to pass on those research skills explicitly to primary and high school students.

Recommendation 5

The project team recommends that special consideration should be given to supporting schools of education in adopting and teaching RSD approaches, due to the potential long-term benefits of enhancing the researching ability of students in all faculties at university.

