MACQUARIE
UNIVERSITY

RESEARCH ENHANCED LEARNING AND TEACHING

Learning through scholarship

Contents

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Introduction

Our teaching is founded on the theory and practice of our disciplines which means we implicitly embed research enhanced learning and teaching in our approaches. However surveys of graduates show that few realise they have been exposed to any research through their undergraduate study.

Research enhanced learning and teaching (RELT) has been used explicitly in some disciplines for a long time – chemistry and psychology spring to mind – but now it is increasingly being taken up as a recognised teaching practice in a wider range of disciplines. Part of its popularity is because it can contribute to meeting expectations that graduates should be able to demonstrate creativity, resourcefulness, and the capacity to manage complexity and uncertainty. Development of these skills through engaging students collaboratively, critically and meaningfully can be achieved by involving students as participants in the research and inquiry process.

Higher education is moving from an emphasis on the acquisition of knowledge and skills to *becoming*; that is, the student becoming a graduate who has knowledge, skills and professional capabilities. Some students will become researchers in their own right, but all graduates will need the ability to interact with research and research results. Developing these capabilities through a research-enhanced approach to learning and teaching in undergraduate degrees will build up students' research potential as well as their graduate skills.

Research is a vital component of undergraduate education, and can play a key role in students' learning, their higher education experience and general skills development. Students can be engaged in research and inquiry within their main discipline and across different disciplines, within the curriculum and in their extra-curricular activities. While we all use research in our work life, many students may be unaware that we apply research in our teaching, or realise that they are learning research skills or engaging in research tasks. In essence, RELT can be seen as having three main branches:

- Using research results in teaching
  - your own results and methodologies
  - research of others at Macquarie or in your field
- Developing students' own research capabilities and creativity
- Research on learning and teaching (often known as the scholarship of learning and teaching).

The integration of RELT into curricula develops a spirit of inquiry, which is fundamental to the creation of a just and open society. Engaging undergraduate students in research and inquiry provides them with a higher education that is meaningful and which develops important graduate capabilities. It prepares them for the world of work, where knowing how to inquire and how to generate and evaluate knowledge is vital. More than that, it gives them fundamental life skills – the ability to think critically is essential for the development of adaptable and effective citizens. We need our graduates to be able to solve a range of unforeseen problems so they can cope with the ambiguity and complexity of today's society. They in turn need to be able to generate and clearly communicate knowledge in order to contribute to their chosen professions in significant ways.

The aim is to guide students through research and to give them an increased awareness of its importance, to enhance their employability as well as their potential to progress to higher degree research. Significantly, RELT involves shifting some of the focus on research from academics and postgraduate students to undergraduate student learners and their learning experiences.

What is research?

Before going into greater detail about RELT, we will lay some foundations about what research is. A simple outline is that:

Research has complex meanings that differ depending on the discipline but for the purposes of providing a simple definition, more as a point of departure rather than a conclusive statement, research can be defined as a means of generating, testing, validating knowledge and making it public. It is a systematic process of investigation, the general purpose of which is to contribute to the body of knowledge that shapes and guides academic and/or practice disciplines[1].

What is undergraduate research?

The Council on Undergraduate Research[2] provided a useful definition of undergraduate research and inquiry to begin to think about the role of undergraduate research in universities. However, it required some amendments in order to fit with the Australian context and here is a refined version:

[An] inquiry or investigation *or a research-based activity* conducted by an undergraduate student that makes an original intellectual or creative contribution to the *discipline and/or to understanding[3]*.

These amendments allow for the integration of research-based activity within the curriculum and deliberately leave vague whose understanding is being developed, that is, the student's understanding of the discipline, and/or wider understanding within or outside of the discipline.

Before you begin to design research-led and enhanced tasks for your students it is worthwhile thinking about these, potentially opposing aspects of research:

Student, process centred	⟷	Outcome, product centred
Student initiated	⟷	Faculty initiated
HDR, Honours students	⟷	Undergraduate students
Curriculum based	⟷	Extra-curricular, co-curricular
Collaborative	⟷	Individual
Original to the student	⟷	Original to the discipline
Multi- or inter-disciplinary	⟷	Discipline-based
Campus/community	⟷	Professional audience[4]

What about scholarship?

Perhaps the most well-used and clearly defined concept of scholarship is that provided by Ernest Boyer and the Carnegie Academy for the Scholarship on Teaching and Learning (CFATL)[5]. Boyer's definition encompasses and reflects the wide spectrum of academic activities and leads to four scholarships:

* The scholarship of discovery – contributing to the stock of human knowledge and the intellectual climate of a college or university
* The scholarship of integration – making connections across disciplines, drawing together, interpreting and bringing new insights about original research
* The scholarship of engagement – the application of knowledge to particular problems
* The scholarship of learning and teaching – engagement with how to teach knowledge, how knowledge is taught and how students learn.

In addition, addressing the quality of how work is conducted and produced is essential for undergraduate research:

* The scholarship of quality – ensuring high quality in the way student work is conducted and produced through standard practices of the university and/or discipline.

Within this overall framework, it is clear that undergraduate research is a fundamental component of Boyer's four scholarships and quality assurance in the process of scholarship. Much of what we do in teaching is cultivating students as scholars within this framework. Undergraduate research offers the opportunity to enhance the scholarship and quality of students' learning experiences in the first years of university studies.

1   From Brew, A. (2001). *The Nature of Research: Inquiry in Academic Contexts*. London: RoutledgeFalmer, p. 21.
2   See http://cur.org
3   Following Beckman & Hensel, 2009, p. 40, additions in italics; from Brew, A. (2010). An Australian perspective on undergraduate research. *CUR Quarterly*, 31 (1), 37-42.
4   Adapted from Beckman, M. & Hensel, N. (2009). Making explicit the implicit: defining undergraduate research. *CUR Quarterly*, 29 (4) pp. 40-44.
5   Adapted from Boyer, E. L. (1990) *Scholarship reconsidered: priorities of the professoriate*. New Jersey: Carnegie Foundation for the Advancement of Teaching.

Is there a difference between research and inquiry?

You may be asking yourself this question: whether there is indeed a distinction between research and inquiry is a point of contention and confusion, and we have been using both terms interchangeably here. You may see differences in whether students are using research and inquiry to explore existing knowledge, or to create new knowledge; or whether the question is generated by the teacher or by the student/s. Inquiry-based learning (IBL) – clearly a related concept – may already be an integrated part of your teaching, but it is seen by many as independent of research-based teaching and learning.

This is, however, an overly limited conception of research, particularly in regards to undergraduate research. Healey and Jenkins (2009), for instance, challenge others for failing to see IBL forms of teaching practice and curriculum design as facilitating students' transition into the worlds of research. In RELT, the collaboration between students and staff triggers the learning process that is an essential ingredient of IBL, which can then lead to the production of research.

The basic idea of learning as inquiry is the same as the idea of research; even though advanced research occurs at advanced levels, undergraduates beginning in the freshman year can learn through research[6].

In this guide

We have set out to give you a brief overview of research enhanced learning and teaching in undergraduate studies so that you can enhance both your teaching practice and students' learning experience. You will also find case studies from Macquarie University of ways in which RELT is being applied in practice to promote a dynamic and engaging classroom experience for both teachers and students. We have included case studies from a range of disciplines, because forms of research can differ between them: for this reason, rather than setting out precise steps we have provided a selection of authentic examples. The section on "Managing RELT" gives some general guidance on working with RELT and we have included a section on assessing student learning. The section "If you want to know more" provides details of a number of useful publications and links if you need more information for applying these techniques in your classroom.

The focus of this guide is on understanding what RELT is, why it should be used, and how to use it in your unit of study. Research enhanced learning and teaching can be used with informal learning activities, collaborative group assignments, as well as assessment-based research activities.

World class research

Researchers are heroes and heroines in the eyes of their students. The research reputation of a researcher, research team and the university are strong drivers for the recruitment of international students for all courses as well as for local PhD students.

So include your research and the research of your colleagues explicitly in your undergraduate teaching. Encourage students to become part of the research community by attending seminars and being inducted into your research team. Look out in particular for opportunities for the inclusion of students doing capstone courses.

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6   Boyer Commission (1998) *Reinventing undergraduate education: A blueprint for America's research universities*. Stony Brook, NY: Carnegie Foundation for University Teaching, p. 17.

Case Study 1

Indigenous Studies – using IBL to build towards research-based teaching and learning

In Warawara, the Department of Indigenous Studies, significant change has occurred across the department, its degree programs and units of study. The whole undergraduate program has significantly shifted towards research and inquiry. Undergraduate units of study are now embedded with research-oriented and research-led learning and assessment tasks. Initially undertaken within an ALTC research project, I have enhanced assessment practices within the department through my research-based initiative. I have also completed a major review and research process was completed of the department's assessment practices.

The review process entailed collecting unit outlines and mapping the types, weighting and frequency of assessment tasks and creating a matrix which provided data at a glance. Closer attention to the unit outlines revealed a duplication of tasks across the different units, an over-representation of essays, and a large weighting of a final essay. Even more troubling was the prevalence of unassessed learning outcomes, and learning outcomes and assessment tasks that were not properly aligned.

Through constructive alignment, staff collaboration, leadership and peer reviews of units of study, I have facilitated a research-based approach to teaching and learning. This approach has trickled down into the students' own research engagement and learning experiences. In the first year the focus is on foundation concepts and basic research skills such as searching databases. Second year is a dense exploration of the different theoretical frameworks that support a critical deconstruction of concepts and discourses. Then in third year, students are supported in applying and modifying these theories and considering how Indigenous Studies can contribute to the development of decolonising theory. The first week of each semester at each year level is "training week", where students learn research skills such as journal searching, or using databases, or the features of the LMS (Blackboard). The process also encourages increasing autonomy and collaboration among students.

In first year we give them one thin, almost generic, reading and they need to find one other that is relevant to that specific weekly topic. They need to correctly reference the reading and then in no more than five bullet points explain why the reading is relevant to the week's topic. By third year they are responsible for building up their database by finding and annotating their own readings for each topic.

These learning experiences culminate in a third-year capstone unit, ABST300 Pathways in Indigenous Studies. The assessment tasks for this unit are very much research based and are inclusive of the students in the research community. Assessment one in the unit is an ongoing research task. Students are allocated marks for the accurate citation of the reading that they research themselves from a designated library journal database, as well as on the quality of their notes on the collective database of readings. This task creates a database that doubles as an annotated bibliography that can then be drawn upon to research other assessment tasks, both in Indigenous Studies and related units of study. When they finish the unit, the students will all have access to the collective annotated bibliography as a database for inclusion in their portfolio, thus demonstrating what and how they have learnt by doing a major in Indigenous Studies.

Assessment two is a seminar presentation plus a written report of a research paper. Students present their research project to gain feedback from their peers and the teacher. The research papers are submitted one week later. The marking criteria include the quality of exploration of complexities and diverse theoretical perspectives; specifically, the students' ability to apply and modify theoretical perspectives and consider how Indigenous Studies can contribute to the development of decolonising theory.

Kristina Everett
Department of Indigenous Studies

Case Study 2
Student projects in applied statistics

STAT270 is an introductory second-year statistics unit. While it is a requirement of several degrees, for many students this course will be the only time they will undertake study in this discipline area. In order to enhance student engagement I have adopted a project-based, problem-based collaborative approach to teaching and learning. By emphasising authentic problem solving relevant to real-life situations, student autonomy and active and collaborative learning, I hope to encourage deeper learning and increased satisfaction amongst the students. In the first tutorial students participate in "icebreaker" activities which provide them with an opportunity to get to know their fellow classmates. An example of one of these is a group task where students are asked to create a model of the research process using plasticine and pipe cleaners. I believe it is more important that students spend the first class getting to know each other rather than being provided with an overview of the course content, as this increases their engagement and interest from week one.

The main vehicle of learning is a group project which is undertaken by students during the semester. Following the first tutorial, students are asked to form groups (with two to three students per group). They have the freedom to choose which classmates they would like to work with, and to choose a topic they would like to investigate. Students have full responsibility for organising and carrying out the research project from beginning to end. The role of the teacher is that of a facilitator, rather than a lecturer who "transmits" knowledge to students via "traditional" lecture formats; my role is simply to provide the necessary information and tools for students to complete the project themselves. Phases of the project include deciding on a topic, devising research questions, collecting data, cleaning data, investigating and analysing the data, and writing it up. This practical focus of the unit is complemented by relevant theory presented in the lectures. Lecture topics reflect stages of the project as they occur, for example ethics, collecting and cleaning data, data analysis and report writing.

While students are required to undertake a final examination, the main assessment is a group report on the project. Students are also required to submit an individual reflective analysis on the project, addressing issues such as the usefulness and benefits of the project for the university, wider community or other groups; aspects of the project that worked well; and the shortcomings.

The benefits of adopting research-based approaches to teaching and learning in statistics are reflected in the student evaluations. Feedback has been overwhelmingly positive, with students valuing the opportunity to develop a self-directed approach to learning, experience teamwork and the practical application of statistics theory to practice.

Peter Petocz
Department of Statistics

Research Enhanced
LEARNING AND TEACHING

Research enhanced learning and teaching is a complex notion, and consequently is based on different understandings and practices across disciplines, institutions and countries. In its basic meaning, it is the bringing together of research and teaching with the aim of enhancing student engagement and learning.

There are two major aspects to RELT that we can look to for understanding. First is the way that you as a teacher use research to inform your own teaching practice; that is, in the content of your lectures and other materials, how you regularly use ideas and examples from your own research or that of the department or faculty. In this view of RELT the research is not made explicit, but rather it is embedded within the resources that are presented to the students. However, this concept and practice of RELT does not go far enough:

What is required is a student-focused perspective where links between what is being taught and research are made explicit. The task of bringing research and teaching together potentially affects all the ways in which we think about the university as a site of scholarly practice[7].

This expanded and student-centred concept can foster student engagement and learning by making the research base explicit; and lead to collaborative projects involving academics, colleagues from other disciplines and students.

The second important factor is the way in which you enhance their learning experiences through research and inquiry-based practice, that is, the goal is to directly involve the students in the practice. Of course, sometimes there is no distinction as the two aspects can complement one another; that is, you can use your own research to inform and embed research and inquiry-based principles and practices in your unit of study. They can also be used in tandem, by sharing your research with your students while at the same time developing research activities for them on topics and methodologies related to your own research (see also "Managing RELT" and the case studies).

The following principles can be thought of as underlying both your own practice as a researcher and as a teacher:

- Learning outcomes: although RELT practices vary in the types of tasks and assessment that students complete across various units of study, the learning outcomes share commonality in regards to enhancing students' graduate attributes – research, analytical, critical thinking and communication skills.

- As pedagogy: combines teaching and research into one integrated practice, a shared process of teaching and scholarship which is collaborative.

- Discipline-based and/or interdisciplinary: the processes and content of your approach to RELT will be largely defined by the standards of practice of your discipline. At the same time, taking an interdisciplinary approach can extend the boundaries of your own and your students' research.

- Collaborative: not just collaborative between students, as opposed to competitive, but also fostering collaboration between staff and students, and including creating networks to support undergraduate research efforts.

- Knowledge-producing: not necessarily original to the discipline, but it can be original to the student as they engage in the process as participants in research and inquiry.

- Student-centred: engagement and inclusiveness are central concepts; students as participants in the process of research, inquiry and scholarship.

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[7]   From Trigwell, K. (2010) *Research enhanced learning and teaching* website. Available at: http://www.itl.usyd.edu.au/projects/RLT/issues/starting.htm

What are the benefits?

There are many benefits for students through participating in research and inquiry tasks, and they include:

- ✓ Positive student perceptions of the teaching and learning process
- ✓ Deeper student engagement: coursework is more stimulating and interesting
- ✓ Positive experiences with problem-based learning
- ✓ Development of research skills: bibliographical searching, framing a research question, organisation of data, experimental skills, interpretation and analysis of data, use and understanding of primary and secondary sources.
- ✓ Opportunity to learn in a collaborative group setting
- ✓ Improvement of self-regulated and self-directed learning as students become more familiar and comfortable with research processes
- ✓ Fostering of deeper approaches to learning
- ✓ Opportunity to collaborate with academics
- ✓ Contribution to building on existing knowledge and participation in a community of practice
- ✓ Personal and professional gains: graduate capability development, self-confidence, critical thinking, a commitment to lifelong learning, experience with teamwork, communication skills, and better understanding of how knowledge is constructed, conveyed and contested

- ✓ Greater likelihood of pursuing higher degree research
- ✓ Career clarification and preparation
- ✓ Improvement in undergraduate retention rates and progression, with the greatest improvements for low-achieving students from disadvantaged backgrounds

There are additional benefits for academics and professional researchers:

- ✓ Interactive, flow-on improvements for their own research
- ✓ Graduate students can gain teaching and mentoring experience through supervising and tutoring undergraduate students.
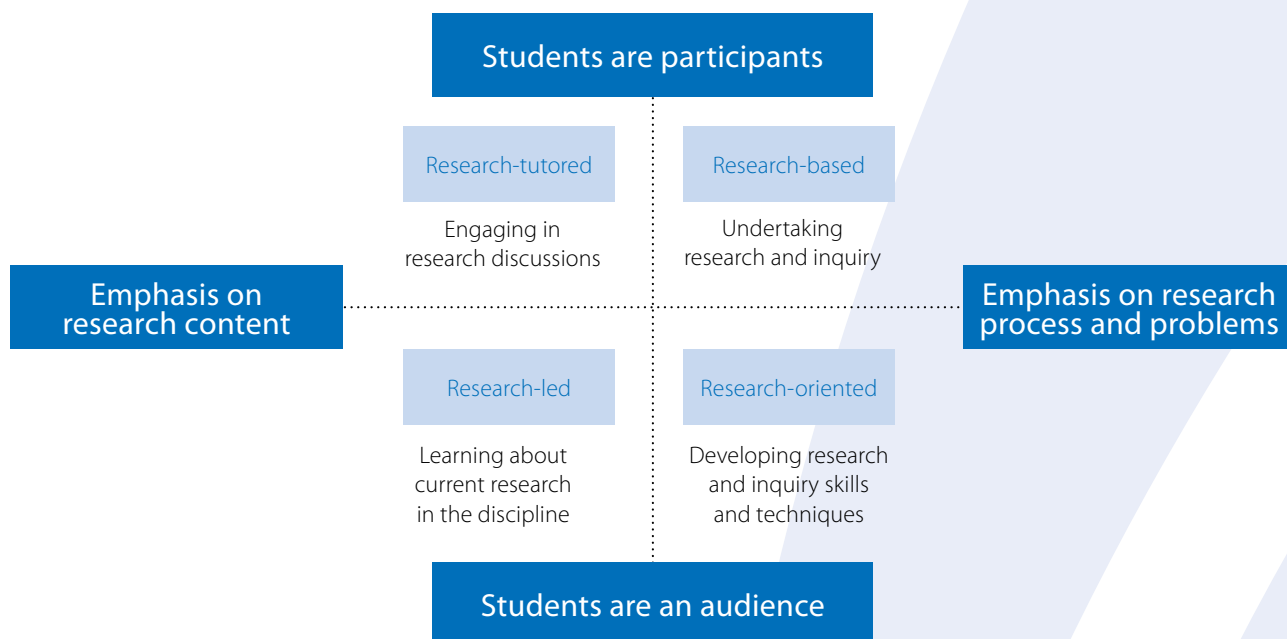
Strategies for engaging students with RELT

Although the importance of undergraduate research experiences for the retention of students and the development of key graduate capabilities is widely recognised, we also know that students can often feel excluded and alienated from the research culture of their chosen discipline. This diagram illustrates differences in the styles of research between a few disciplines, as perceived by students. We have added a column for you to fill in with your ideas of how students would view research in your discipline.

Students' experiences of research in different disciplines[8]

	Physics	Geography	English	Your discipline
What is research?	Breaking new ground; moving forward; exploration and discovery	Gathering information in the world; answering a question	Looking into; gathering; putting it together; a focus of interest	
How visible is it?	Laboratories and machinery (i.e. 'tools') but often 'behind' closed doors	Most visible 'in the field'	Not tangibly visible, but apparent in the dialogue	
Where is it located?	Out there; at a higher level	Out there in the field	In the library; in the head	
Who does it?	Lecturers	Lecturers and (increasingly over time) students	Lecturers and students	

8 From Robertson, J. & Blackler, G. (2006) Students' experiences of learning in a research environment. *Higher Education Research & Development*, 25 (3), p. 226

Students are participants

Research-tutored	Research-based
Engaging in research discussions	Undertaking research and inquiry

Emphasis on research content .... **Emphasis on research process and problems**

Research-led	Research-oriented
Learning about current research in the discipline	Developing research and inquiry skills and techniques

Students are an audience

If we want to encourage students to pursue postgraduate research and/or prepare them for their future professional work, then we need to involve and include them in the research process to give them practical experience in developing and undertaking a piece of research. The four categories of linking teaching and research in the diagram above[9] are a good place to start when thinking of strategies for engaging students in research and inquiry, and each category is associated with a different focus.

There are some guiding questions for academic staff themselves, the answers to which can be mapped over the diagram above:

1. What is my conception of research, teaching, knowledge and scholarship?
2. How appropriate is RELT for my students and their year level?
3. Do I use disciplinary research and scholarship when preparing teaching materials?
4. Are my students an audience for research, or are they actively engaged in research activity, or both?
5. Is the teaching emphasis on the content of the research, the processes of research, or both?
6. How accessible to students is the research carried out in my Department? For example, do students know about publications in scholarly journals or other research; are they invited to Department colloquia or seminars; are students invited to critique researchers' work?

Obviously, the culture of your discipline and your own conceptions of research, teaching, knowledge and scholarship within it will affect the way you approach RELT. For example, in the social sciences and sciences, undergraduate students can become junior members of research teams and engage in research that forms part of larger projects in the field or in the lab; or in the humanities, they can have the opportunity to work with primary materials, linking to their teachers' own research projects. In all disciplines students can form journal or other primary source reading clubs, present their work at student conferences or in journals, and analyse scholarly research output; or participate in internship programs. The case studies in this guide have been chosen to illustrate some of the ways in which RELT can be implemented in different disciplines and settings.

Celebrating undergraduate research

Macquarie University Student Journal of Research
Web address: www.studentjournal.mq.edu.au
Email address: student.journal@mq.edu.au

Macquarie University is setting up an online journal to publish undergraduate research and scholarship. There will be two editions per year and there will soon be a website. Please encourage your students to contribute their work! This will not be limited to written articles as the journal will support many formats.

9   From Healey, M. & Jenkins, A. (2009) *Developing undergraduate research and inquiry*. The Higher Education Academy, p. 7

Managing Research Enhanced
LEARNING AND TEACHING

You can involve your students in research and inquiry from the first year onwards. This is a significant time, as it forms a transition both socially and academically and can establish patterns for the rest of the course. Even in their first year your students can be involved in "research tasters", such as carrying out a selection of research tasks for an assessment, or exploring how academics generate research in particular disciplines.
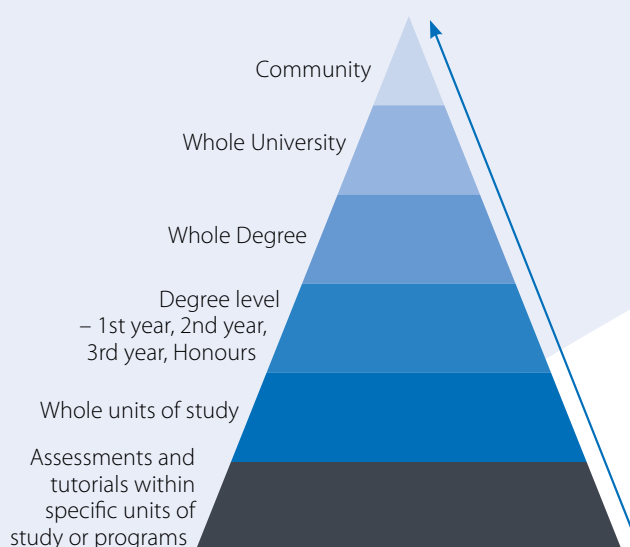
As we have seen, RELT comes in many different shapes. It can focus on your students developing their research techniques and methodology, and/or learning about current research in a particular discipline. Other forms can focus on students developing new knowledge, for instance through collaboration with other students and academic staff on unforeseen, open-ended problems. If your students are to be encouraged to develop the ability to deal with the complexity and ambiguity of knowledge generation, then it is this kind of research and inquiry that they must be engaged in.

As academics, we typically learn through a process of engaging in collaborative research groups and through peer review. Involving your students in such processes and communities can only enhance their learning and engagement.

We can think of introducing different kinds of RELT for students in a series of steps or stages[10] (as in the diagram), some of which may involve making changes to your unit of study and course curriculum. Individual teachers can start at the bottom level ("Assessment and tutorials"). RELT and learning tasks can easily be integrated into the curriculum and aligned with the unit of study's learning outcomes, graduate attributes and assessments of achievement and learning.

As you progress upwards, more students and/or staff become involved, which will require more coordination and collaboration across the Department, Faculty and University. Scholarship schemes might be within or outside the curriculum. A whole-of-institution approach provides an overall framework for developments. The case studies we have included should give you some guidance about how to implement RELT and learning at any level.

Undergraduate research – implementation

- Community
- Whole University
- Whole Degree
- Degree level – 1st year, 2nd year, 3rd year, Honours
- Whole units of study
- Assessments and tutorials within specific units of study or programs

Another way of looking at student research projects[11] is to place the development of research skills along a spectrum that can shape the development of materials and assessment:

Level 1	Level 2	Level 3	Level 4	Level 5
Students research at the level of a closed inquiry and require a high degree of structure/guidance	Students research at the level of a closed inquiry and require some structure/ guidance	Students research independently at the level of a closed inquiry	Students research at the level of an open inquiry within structured guidelines	Students research at the level of an open inquiry within self-determined guidelines in accordance with the discipline

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[10] Brew, A. (2008). Opening up spaces for research and inquiry. Keynote presentation to the joint conference of the Higher Education Learning and Teaching society of Southern Africa (HELTASA) and South African Association for Research and Development in Higher Education (SAARDE), *Higher Education as a Social Space*, Grahamstown, South Africa, 30 November – 3 December.

[11] From University of Adelaide (2009) *Research Skill Development framework*. Available at: http://www.adelaide.edu.au/clpd/rsd/

Case Study 3

Using research to develop skills in writing funding applications for neuroscientific research

PSY354 Clinical and Experimental Neuroscience is a new elective in Psychology that focuses on training students for higher degree research and research careers in the field of neuroscience. In the past few years Macquarie University has enhanced its research profile in the neuroscience arena that spans across the Faculties of Human Sciences and Science. This recent increase in expertise in neuroscientific research provided the perfect opportunity to develop a course to demonstrate and teach the breadth and possibilities of research in this area. This course is a collaborative effort of Psychology, Macquarie Centre for Cognitive Science (MACCS), the Australian School of Advanced Medicine (ASAM) and Brain, Behaviour and Evolution (BBE). The course is designed to expose students to state-of-the-art techniques in neuroscience, train them in grant writing for research funding, develop their oral communication skills for research presentation, and teach them theories and systems in neuroscience by experts in the field.

The unit is comprised of weekly 2 hour lectures focusing on the research of our academics and a total of 6 tutorials. The 6 tutorials consist of 2 grant writing workshops, 2 oral communication sessions, 1 practical session in transmagnetic stimulation techniques (TMS) and another practical session using the magnetoencephalograph (MEG) for brain imaging. All of the tutorials are led by postdoctoral fellows, which is particularly important for the grant writing workshops.

The novel aspect of this course is the workshops in grant writing to train the students in preparing applications for research funding. For the first grant writing workshop, the postdoctoral fellow introduces their field of expertise and facilitates the use of online databases (such as PubMed, Scopus) during class to help the students develop their understanding of the research field and possible areas for future research. Once the students have identified their research question of interest, they then work on their aims and experimental design. Prior to the second grant writing workshop (1 week later) they are expected to provide an expression of interest form (EOI) that is modelled on the forms provided by the University Research Office. While the EOI is not directly assessed, the postdoctoral fellows view these at the start of the workshop to ensure that the students are clear in the direction for their research proposal. The second grant workshop focuses on clarifying the design, building the background statement, and identifying the national benefit of the proposed study (including the use of National Health and Medical Research Council research priorities and website information).

The students are then allowed one month to prepare their grant form, which consists of 3 pages of single-spaced text and 1 page of references. The students are not expected to prepare a budget for their research. This application form is loosely based on the Macquarie University Research & Development grant form. While the students are encouraged to discuss their research ideas, each student submits an individual application of their own novel research proposal.

At the time of writing, PSY354 is only in its second year of offering. Feedback from the first instance has been very positive, with students stating that they would like to continue on in this field and that the grant writing experience, although challenging to begin with, has opened up a greater understanding of research careers and has stimulated interest in research degrees. Several students who have continued into Honours degrees for the following year have informed me that the grant writing assessment greatly helped with the design of their honours projects and their applications to ethics committees.

Jen Cornish
Department of Psychology

Assessment of
STUDENT LEARNING

Whether the curriculum is wholly or partially in the form of research and inquiry activities that students undertake, and/or contains discussions of your research in lectures, it will usually need to be assessed in some way. The beauty of engaging students in research and inquiry is that the distinction between learning and assessing tends to break down.

Students learn through carrying out the research and the processes and the outcomes of that research can be assessed. The classic example of this is the student essay which requires research and hence learning and results in a product. The assessment *is* the learning.

When students engage in research, there are often products which can be assessed through the same kind of processes used to evaluate our own research. Criteria for student assessment may focus on a broad range of graduate capabilities, or may focus more specifically on a range of research-based skills and competencies. In thinking about how to structure students' engagement through different facets of inquiry, a number of academics have found the Research Skills Development Framework to be useful[12]. The framework provides ideas for assessment criteria and standards; in turn, these suggest the kinds of outcomes and artefacts that students may be asked to produce.

Types of assessment artefacts

The following table gives some ideas of the kinds of artefact that students might produce depending on the kind of outcome that is desired. Of course what is appropriate will depend on the level of the students and what you hope to achieve. These research-based activities replace or supplement conventional examinations and multiple choice tests, which tend to contradict the spirit of undergraduates engaging in research and inquiry. The activities can be used on their own or in combination. For example, before students write a full report, you may wish them to generate some hypotheses and you might assess these. They then may engage in a bibliographic exercise leading to notes or bullet points on key articles. Then, following feedback, they may progress to questionnaire design, and so on.

Suggestions for assessing research and inquiry based learning

Research attributes (from RSD Framework http://www.adelaide.edu.au/clpd/rsd/) and activities that students may engage in	Indicative assessment products
Students **embark** on inquiry and **determine a need** for knowledge/understanding. They may do this through: • Responding to given questions • Generating research questions • Specifying hypotheses • Bibliographic exercises • Evaluation of literature • Writing research proposals	• Choice of a research question the student wishes to pursue and reasons why chosen • List of important questions on a topic (perhaps generated by a group) • Note-form summaries/key ideas of (specified) articles • Key ideas from articles put in a specified framework • Annotated bibliographies • Critical bibliographies • Online discussions • Research proposals
Students **find/generate** needed information/data using appropriate methodology. Activities include: • Designing & implementing questionnaires/ interviews etc • Applying for ethical approval • Carrying out experiments • Quantitative and qualitative data gathering of various kinds	• Students' questionnaire designs • Interview schedules • Participant information statements • Log books • Experiments • Ethics applications • Comparisons of different methodologies • Analysis of one methodology

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[12] See http://www.adelaide.edu.au/clpd/rsd/

Students **evaluate** information/data and the process to find/generate that information/data. Activities include: • Synthesising and analysing given (pre-existing) data • Statistical analyses • Qualitative data analyses of various kinds	• Database designs • Experimental designs • NVivo coding • Review/reflection on process of own data gathering • Online discussions of data • Summaries of findings
Students **organise** information collected/generated. This can be done either individually or in groups through: • Website creation • Team working • Abstract writing • Structuring information	• Written summaries or abstracts of articles • Wikis, blogs • Videos • Pie charts • Labeled drawings • Field notes • Spider/web diagrams combining ideas/data • Group participation
Students **synthesise** and **analyse** and **apply** new knowledge. This may involve: • Discussing ideas in the light of the literature • Drawing conclusions • Writing reports • Contributing to public inquiries, juries, debates	• Terms of reference for a public inquiry • Report for public inquiry from a particular viewpoint – e.g. community group, NGO, employers • Media articles • Online discussions • Laboratory reports • Reports on how well objectives are achieved • Lists of implications of findings
Students **communicate** knowledge, understanding and the process used to generate it, with an awareness of ethical, social and cultural issues. Ways to do this include: • Seminar presentations • Posters • Conference presentations • Journal articles	• Peer-reviewed publications • Conference presentations • Posters • Laboratory conduct • Reflective report/self-assessment schedule. • Portfolios • Group participation • Online including 2nd life discussions

Boud[13] suggests that any assessment carried out in higher education should prepare students to assess their own and their colleagues work in later life, that is, when they are working as a professional after the degree. He calls this "sustainable" assessment and suggests that assessment for longer term learning assumes that:

• it must contribute to students' learning in a positive way

• it needs to take account of how the student is to take forward what is learnt into the future, that is, when the course, or unit of study is over

• it should develop students' ability to judge what constitutes good work

• students must be active learners

• students must be engaged in some form of practice.

Research enhanced learning and teaching and lends itself to this kind of assessment. Essentially research is a process and this process should be as much about the assessment as the learning. In other words, assessment must be authentic; that is, it must match, or be consistent with, the process of research. There are a number of resources to assist in assessing research enhanced learning and teaching on the Undergraduate Research in Australia website[14], and if you want some more ideas about assessment, the University of Technology, Sydney, (UTS) has a useful site[15].

[13] Boud, D. (2000) Sustainable assessment: rethinking assessment for the learning society. *Studies in Continuing Education*, 22 (2), 151-167.

[14] See http://www.mq.edu.au/ltc/altc/ug_research/resources.htm

[15] See http://www.iml.uts.edu.au/assessment-futures/

Standards of achievement

With any assessment we are required to grade our students' levels of achievement, for the artefacts and for the overall unit. We have developed a grading scheme – a rubric – that we have included here.

This framework has been developed from workshops with students near graduation to see the types of capabilities they demonstrated. We have organised these into conceptual, procedural and professional capabilities[16]. Conceptual knowledge is discipline-specific and/or skill-specific knowledge, *knowing that*; that is, concepts, facts, propositions. Procedural knowledge is discipline-specific knowledge, *knowing how*; that is, specific to strategic procedures. Professional knowledge is *knowing for*; that is, values, attitudes and capabilities,

related to practice. This last category implies that the goal of a degree is to develop graduates capable of entering professional employment, however this category also includes the capabilities of those who wish to proceed to postgraduate research and further study opportunities. Several writers have called this a *dispositional* or attitudinal/values dimension, but here we have chosen to use "professional" to encapsulate the concept of becoming a professional upon completing an undergraduate degree.

These outcomes are listed in qualitatively different levels aligned to the typical reporting of grades in Australian universities. We would not expect that a student would need to achieve the outcomes across all three dimensions to be awarded a particular grade.

Research Standards of Achievement – graduate capability[17]

	Conceptual	**Procedural**	**Professional**
	"Knowing that"	*"Knowing how"*	*"Knowing for"*
Level 4 HD	The research is linked and integrated with other relevant research, resulting in a new pattern of understanding. The depth and breadth of the research is understood in such a way that the individual is inspired to re-organise other concepts, and motivated to make creative and innovative applications and pose new research questions.	Demonstrates the capacity to create/develop new research methodologies or combine existing methodologies in novel ways. Techniques are applied in novel ways, or new rules are derived from deep understanding.	Demonstrates a strategic view to enable innovative outcomes in complex situations. Able to communicate the implications of the research, including the limitations of the results. Demonstrates an ethical mindset.
Level 3 D	The understanding of the research topic is broadened, appreciated from different angles, and this elaboration reflects in the ability to consider the research in other contexts and from different perspectives.	Demonstrates the ability to select appropriate research methodologies in a given context. Methodologies no longer need to be given.	Demonstrates the ability to adapt to new environments. Able to articulate ethical circumstances in the research.
Level 2 C	Some personal meaning has been extracted and their understanding reflects this internalised view. The research area has become a part of their knowledge. Nevertheless, it remains narrow and shallow and relatively disconnected from other areas.	Demonstrates the ability to apply given methodologies and analysis in a variety of contexts and to novel problems.	Can evaluate a research situation and identify key issues, such as the need for an ethical approach.
Level 1 P	Demonstrates the ability to describe and define the basic concepts of the research area, but has not demonstrated an ability to be able to elaborate or reflect on the meaning of the research.	Demonstrates knowledge of the methodologies and analysis techniques and can practice the rules of a given procedure and/or skill.	Demonstrates a basic understanding of processes and functions, but only basic understanding of the significance of these in research practice.
Level 0 F	Demonstrates inability to describe and define the basic concepts of the research and/or the research area.	Demonstrates no knowledge of methodologies and is not able to practice the rules of a given procedure and/or skill.	Demonstrates no understanding of processes and functions or the significance of these in research practice.

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[16] Adapted from Billett, S. (2009) "Workplace as a learning environment? Challenge for theory and methodology". *Keynote: Researching Work and Learning 6 (RWL6),* Roskilde University, Denmark, 1st July 2009

[17] The types of knowledge have been adapted from Billet, S. (2009) "Workplace as a learning environment? Challenge for theory and methodology". *Keynote: Researching Work and Learning 6 (RWL6),* Roskilde University, Denmark, 1st July 2009

Case Study 4

Psychology of appetite – How teaching informs and inspires research

I am the convenor of PSY352, a unit called "Appetite: The Psychology of Eating and Drinking". The course is unique in that it brings together all the elements of the research process in an applied way, embedding the research process within the unit rather than teaching it separately. An evidence-based approach is used to integrate the discipline materials, research methods and statistics. The various elements of research are often taught in a disconnected way to undergraduate psychology students, leaving them unprepared for Honours and/or further postgraduate study; that is, research methods are commonly taught as a separate unit in undergraduate psychology with little opportunity for teachers to integrate discipline-specific content. This course attempts to address this gap by bringing together different elements of the research process and the requisite skills in order to prepare students for further study. It is important that students see a link between all the elements of research – from devising research questions, to choosing a research method, collecting and analysing data, and writing up results.

The unit's structure is a mix of traditional lecture format and tutorials. The objective of the tutorials is to get students practising experimental psychology as it relates to the study of investigative behaviour. Students generally guide the class with the tutor taking on a facilitative role. Typically in pairs, students explain a research problem, which is followed by a class discussion on how to solve it. After the tutorial students collect data and then bring it to the following tutorial, where it is analysed in class with the group drawing inferences are from the results. The repeat of this activity for five projects provides students with a broad exposure to research training. Assessment is designed to support the structure of the tutorials – for each project students submit a report, three during the semester and two at the end of the semester. They are also required to submit a "laboratory book" where they record their experimental endeavours, such as rough notes, calculations, summary data, and copies of questionnaires used. This type of approach allows students the opportunity to receive extensive feedback on the three reports submitted during the semester prior to the submission of their final reports and the final exam. Student feedback has been very positive, with the unit preparing them well for Honours, both in terms of the research skills developed and an enhanced understanding of how all the parts of the research process fit together.

In addition to the research training provided as part of the course, there are opportunities for students to apply for research internships (advertised on Blackboard). These internships are mutually beneficial for academics and students. For students, the opportunity to work in an active research team environment is highly engaging and such experiences often inspire their interest in research and the possibilities of future study. Many go on to become paid Research Assistants. Teachers also benefit as they are able to identify and recruit potential PhD/Honours students and research assistants. Research internships thus provide an important link between students and teachers.

I also incorporate my own research on eating-related behaviour, memory and perception by discussing it with students in lectures, which enhances student engagement by helping them make connections between the materials and real cutting-edge research. The experience of teaching has also inspired my own research endeavours. For instance, challenges in trying to explain concepts or theories to students can highlight logical shortcomings of the materials. Teaching thus acts as a trigger by allowing me to think about the material differently and by serving as a catalyst for new research projects.

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If you want to
KNOW MORE

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Websites

The Learning and Teaching Centre has a website that is designed to provide information and resources for people interested in RELT:
http://www.mq.edu.au/ltc/altc/ug_research/

Originally designed by Angela Brew, this University of Sydney website contains information and resources from the Strategic Project on Research enhanced learning and teaching:
http://www.itl.usyd.edu.au/projects/RLT/about.htm

Originally developed through an Australian Learning and Teaching Council grant, this website has a variety of information (including a handbook) on the development of research skills:
http://www.adelaide.edu.au/clpd/rsd/

For useful examples of the "teaching and research nexus", see this Australian website:
http://trnexus.edu.au/

The UK Higher Education Academy website, "Teaching and Research", provides links to numerous resources, centres, publications, websites and contacts with interests in integrating research and teaching generally, and undergraduate research more specifically:
http://www.heacademy.ac.uk/ourwork/supportingresearch/teachingandresearch

The UK Oxford Brookes University site, "Linking teaching and research in the disciplines", provides a guide for: the creation of generic support materials to further embed teaching/research links in disciplinary communities; five subject centres embedding teaching /research links in their communities; and a framework, ideas and strategies that will also support disciplinary communities worldwide in linking teaching and research:
http://www.brookes.ac.uk/genericlink/

Case Study 5
Consumer behaviour

We have developed a novel way of engaging students in the research and teaching process simultaneously – by involving them in a real-life research project. MKTG203 Consumer Behaviour students were asked to complete an online survey designed to examine their preferences for assessment rubrics. Best-worst scaling was used in the data collection; this is a conjoint analysis technique asking respondents to nominate their preferred option (best) and least preferred option (worst) from a set of choices. In this particular project students were asked to rate their preference for various types of assessment including exams and group work. The data were subsequently analysed by the lecturer (using hierarchical cluster analysis) and a range of assessment preferences were found.

The results of the survey were presented to students in MKTG203 and in another unit, MKTG202 Marketing Research. Many students undertake both these courses at the same time. By including students as subjects in the research project and using real data to demonstrate a cluster analysis, students were shown how to undertake marketing research; specifically, how to use the research technique and to present results. Examining choices about assessment also drew students' attention to the difficulties of providing a homogenous education to heterogeneous student populations. Students were made aware of variations in preferences based on features of the cohort (such as differences between international and domestic students) and of assessment trade-offs. Showing students the reason why particular assessment choices were made by the lecturer also encouraged reflective practice, since they thought about their own assessment preferences and how these related to the management of their own studies.

The research project was complemented by a mid-semester survey which collected data on students' views of the course. Again the results were presented to the students, with an emphasis on what the lecturer would do to address their concerns. End of semester feedback for this course has been positive and students have indicated they like being involved in the assessment process and appreciate that their feedback is "being taken into account". The lecturers also benefit as they get an idea of what assessment students prefer. This is important as class sizes for both units are very high (often 300 plus students) with a high proportion of international students. Another benefit for lecturers is a decrease in the number of grade appeals submitted by students following release of results.

The results of the online surveys have been incorporated into a textbook, Marketing research. The textbook contains links to the surveys so students can complete them during the course, gaining experience both as respondents and, later, as research analysts in analysing and drawing inferences from the data. This use of problem-based learning integrates students' understanding of course materials with market research, engaging them and increasing their interest. The book has been adopted by several Australian universities including the University of NSW, Newcastle, Adelaide and Australian Catholic Universities; we have also published a conference paper on the assessment choices study:

- Zikmund, W. G., Ward, S., Lowe, B., Winzar, H. & Babin, B. J. (2011). *Marketing research* (2nd Asia-Pacific ed.). Melbourne, Australia: Cengage Learning.

- D'Alessandro, S. & Winzar, H. (2010). Do students know best when it comes to assessment? A best/worst analysis of assessment choices. Paper presented at the *ANZMAC Annual Conference*, 29 November–1 December, 2010, Christchurch, New Zealand. Available at: **http://anzmac2010.org/proceedings/pdf/anzmac10Final00384.pdf**

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This booklet is one of a series produced for the Learning Excellence and Development (LEAD) program. The program brings together as a team a multi-disciplinary group of university staff – general staff as well as academics – working on projects to enhance student learning. The program is managed by the Faculty of Business and Economics.

The guides are available in hard copy from the Faculty of Business and Economics, or online at **http://www.mq.edu.au/ltc/resources/ FBE_resources.htm**

Other publications in the LEAD series include:
How to run a LEAD project – Learning through innovation
How to lead discussions – Learning through engagement
How to create exams – Learning through assessment
How to give quality feedback – Learning through dialogue
How to collaborate with peer observation – Learning from each other
How to teach with inclusive practice – Learning through diversity

Do you want to:

- introduce your students to the types of research in your discipline?
- share your own research with your students?
- encourage your students to do research themselves?
- collaborate on research projects with your students?

Then research enhanced learning and teaching is for you!

This approach can help students develop creativity, resourcefulness, and the capacity to manage complexity and uncertainty. Involving students as participants in the research and inquiry process enhances these skills through engaging students collaboratively. This guide presents a brief overview of research enhanced learning and teaching in undergraduate studies, and includes case studies from Macquarie University to give you some practical examples.