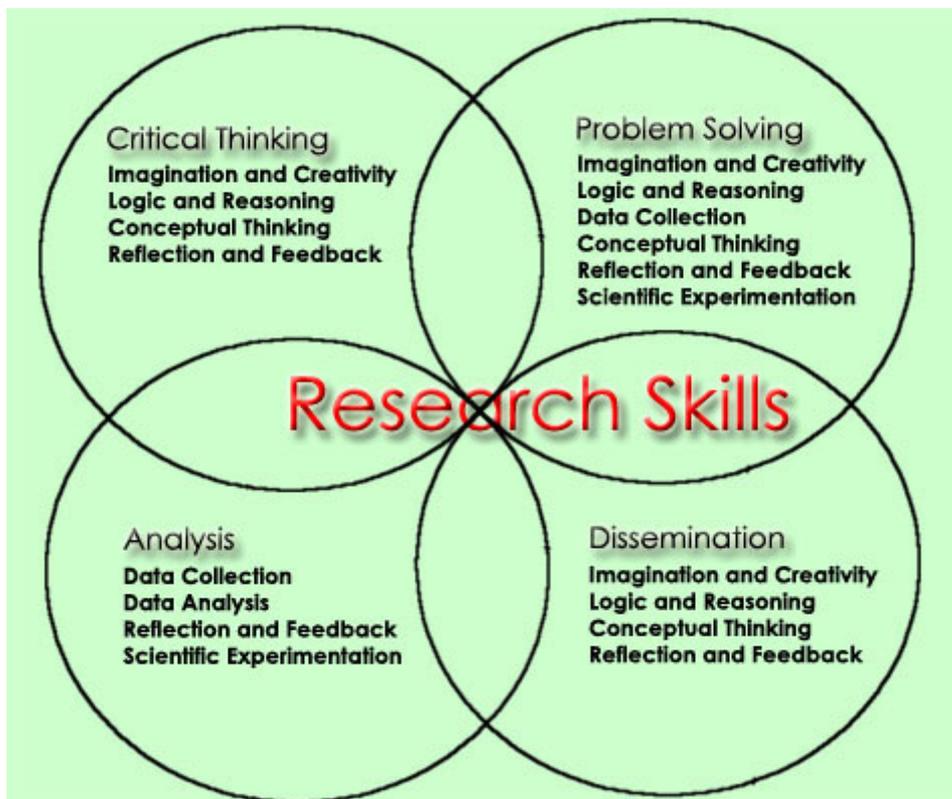


## Developing Research Skills

Research skills are important because they help the researcher to create new knowledge and understanding through **Critical Thinking, Problem Solving, Analysis and Dissemination** of facts. Research skills are wider than finding out a fact and more focused than reading widely around a subject.

Researchers will be able to create new knowledge and understanding through the process of research and inquiry. The following diagram and associated text describing research skills has been reproduced as it is for the benefit of reader from:

[[http://sydney.edu.au/science/uniserve\\_science/projects/skills/jantrial/research.htm](http://sydney.edu.au/science/uniserve_science/projects/skills/jantrial/research.htm)]



### **Critical Thinking**

Critical thinking is accepting nothing at face value, but rather examining the truth and validity of arguments and evaluating the relative importance of ideas. Critical thinking includes evaluating and weighing different sides of an argument, applying reason and logic to determine the merits of arguments, and drawing and evaluating conclusions from logical arguments and data analysis. Critical thinking requires background skills such as imagination and creativity, logic and reasoning, conceptual thinking, reflection and feedback.

## **Problem Solving**

Problem solving is the ability to identify, define and analyse problems, to create solutions and evaluate them, and to choose the best solution for a particular context. It requires imaginative and innovative thinking to find new ways to approach a problem, analytical skills to examine the consequences of a particular solution, and reasoning skills to weigh one solution against another. A common form of problem solving in science is experimentation. Problem solving involves the background skills of imagination and creativity, logic and reasoning, data collection, conceptual thinking, reflection and feedback, and scientific experimentation.

## **Analysis**

Analysis is the ability to gather relevant data and information and apply methods of synthesis, critical thinking and data reduction to locate and understand patterns or connections in that information. Scientific analysis often requires mathematical techniques to manipulate data, such as graphing experimental results or using statistical tests to examine differences between sets of data. Analysis requires the background skills of data collection, data analysis, reflection and feedback, scientific experimentation

## **Dissemination**

Dissemination is communicating to others the purpose and outcomes of research. It requires the ability to summarise information, explain the aims, motives, results and conclusions of the research, and tailor the communication to the needs and knowledge level of a particular audience. Dissemination requires the background skills of imagination and creativity, logic and reasoning, conceptual thinking, reflection and feedback.

## ***Background Skills***

### **Imagination and Creativity is:**

- searching for different approaches to a problem or situation (such as adapting technology for a novel purpose like using medical technology on plants)
- Looking for alternatives to common or accepted methods and solutions.
- Trying to examine issues from a different point of view (such as seeing an argument from another person's perspective).

### **Logic and reasoning is:**

- understanding the structure of logical arguments, including deductive and inductive reasoning
- assessing the logical basis for scientific claims and conclusions (such as deciding whether you agree with the conclusions drawn in a scientific paper, based on the evidence given)
- Drawing conclusions from scientific arguments or analyses (for example, making valid generalisations or predictions from experimental data).

**Data collection is:**

- gathering data (for example through carrying out experiments, surveys, focus groups, interviews, literature reviews)
- Designing a data collection tool (for example, planning an experiment or constructing a survey)

**Data Analysis is:**

- Identifying an appropriate method (mathematical or otherwise) for interpreting and manipulating data
- applying techniques of statistical analysis, including using statistics in research and the statistical analysis of surveys (such as identifying and applying an appropriate statistical test of significance)
- awareness of the limitations of analysis techniques (for example, understanding the assumptions behind a statistical analysis, and examining whether your data fit these assumptions)
- Forming appropriate conclusions from results of analysis

**Conceptual thinking is:**

- breaking a big issue into smaller, manageable parts (for example, breaking an experimental investigation into a series of smaller measurements)
- identifying concepts and ideas relevant to a problem, synthesizing concepts and available data to construct a solution
- Making judgements about the value and relevance of ideas and information (for example, deciding to ignore a particular factor because it contributes only a small amount to the overall problem)

**Reflection and feedback is:**

- thinking about what you have done, what you might have done differently, how you feel about it, and how you might change it to improve your learning (for example, reflecting on the outcomes of a research project and deciding on a different course of action for next time)
- Using insight gained through reflection to improve your own or others' work or situation (for example, watching others perform and offering feedback on the way they are tackling a problem)

**Scientific Experimentation is:**

- Identifying and designing an appropriate experimental procedure understanding the limitations and scope of an experimental design (for example, sample sizes and measurement uncertainties)

I recommend you to read the following attached pdf article that will immensely help you to develop your research abilities. Research Skills.

This article largely reflects the pattern in which the research skills are imparted to the students at M.S. Ramaiah University of Applied Sciences at postgraduate and the doctoral level.

**Prof. S.R.Shankapal**

# Griffith Graduate Attributes Research Skills Toolkit

## **(C) Innovative and Creative, with Critical Judgment**

1. Ability to use knowledge and skills to devise solutions to unfamiliar problems
2. Ability to analyse and critically evaluate arguments and evidence appropriate to their disciplines (e.g. collect analyse and interpret data and information, generate and test hypotheses, synthesise and organise information)
- 3. Knowledge of research methodologies in their disciplines and capacity to interpret findings**
4. Ability to generate ideas/products/art works/methods/approaches/perspectives as appropriate to the discipline

# Table of contents

---

Purpose of this toolkit.....	3
Why your students need research skills.....	5
Preparing students for research.....	7
Designing research tasks.....	10
Assessing students' research skills.....	13
Additional resources .....	15

## **Authorial Attribution:**

Webb, F., Smith, C., & Worsfold, K. (2011). *Research Skills Toolkit*. (Retrieved from the World Wide Web 4th April, 2011) <http://www.griffith.edu.au/gihe/resources-support/graduate-attributes>

NOTE: The URLs listed in this toolkit were current at the time of retrieval. However, please note these may change with time as websites update.

# Purpose of this toolkit

---

The Toolkits developed by members of the Griffith Graduate Project are intended primarily for academic staff. They offer an overview of some of the main issues related to developing students' graduate skills during their degree studies.

They draw heavily on existing literature and current practice in universities around the world and include numerous references and links to useful web resources.

They are not comprehensive 'guides' or 'how to' booklets. Rather, they incorporate the perspectives of academic staff, students, graduates and employers on the graduate skills adopted by Griffith University in its Griffith Graduate Statement.

Griffith University. (2009). *The Griffith Graduate Attributes*. (Retrieved from the World Wide Web 1st October 2010) <http://www.griffith.edu.au/gihe/teaching-learning-curriculum/graduate-attributes>

This Toolkit, *Research Skills*, focuses on how you can help students to gain knowledge of research methodologies in their respective discipline and interpret research findings.

This toolkit, together with others in the series (as shown in the following table) can be accessed via the Griffith Institute for Higher Education webpage, the URL of which is listed on the following page.

GRADUATE ATTRIBUTES	DESCRIPTOR	TOOLKIT
(1) Knowledgeable and Skilled in their Disciplines	Comprehensive knowledge and skills relating to their disciplines	n/a
	An interdisciplinary perspective	Interdisciplinary Skills
	Capacity to find, evaluate and use information	Information Literacy
	Ability to apply discipline/professional skills and knowledge in the workplace	Professional Skills
(2) Effective Communicators and Team Members	Capacity to communicate effectively with others orally	Oral Communication
	Capacity to communicate effectively with others in writing	Written Communication
	Capacity to communicate effectively with others using ICTs, multimedia, visual, musical and other forms appropriate to their disciplines	ICT and Other Discipline-Related Communication Skills
	Capacity to interact and collaborate with others effectively, including in teams, in the workplace, and in culturally or linguistically diverse contexts.	Teamwork Skills

<b>GRADUATE ATTRIBUTES</b>	<b>DESCRIPTOR</b>	<b>TOOLKIT</b>
<b>(3) Innovative and Creative, with Critical Judgement</b>	Ability to use knowledge and skills to devise solutions to unfamiliar problems	<b>Creativity and Innovation*</b>
	Ability to analyse and critically evaluate arguments and evidence appropriate to their disciplines (e.g. collect analyse and interpret data and information, generate and test hypotheses, synthesise and organise information)	<b>Critical Evaluation</b>
	Knowledge of research methodologies in their disciplines and capacity to interpret findings	<b>Research Skills</b>
	Ability to generate ideas/products/art works/methods/approaches/perspectives as appropriate to the discipline.	<b>Creativity and Innovation*</b>
<b>(4) Socially Responsible and Engaged in their Communities</b>	Ethical awareness (professional and personal) and academic integrity	<b>Ethical Behaviour and Social Responsibility*</b>
	Capacity to apply disciplinary knowledge to solving real life problems in relevant communities	<b>Problem Solving</b>
	Understanding of social and civic responsibilities, human rights and sustainability	<b>Ethical Behaviour and Social Responsibility*</b>
	Understanding the value of further learning and professional development	<b>Further Learning</b>
<b>(5) Competent in Culturally Diverse and International Environments</b>	Awareness of and respect for the values and knowledges of Australian Aboriginal and Torres Strait Islander First Peoples	To be developed
	Respect, awareness, knowledge and skills to interact effectively in culturally or linguistically diverse contexts	<b>Global and International Perspective and Awareness*</b>
	A global and international perspective on their disciplines.	<b>Global and International Perspective and Awareness*</b>

NB: \* Toolkit covers two sub-attributes. \*\* Toolkit development in progress

# Why your students need research skills

---

## Research Skills

Research activity, the systematic investigation of phenomena, problems, issues, questions, etc., to increase knowledge and understanding, is a core activity in universities. Research skills assist graduates to critically investigate issues and, where appropriate, generate and evaluate relevant data, form and test ideas, theories and hypotheses, and successfully navigate their way through the sea of information that characterises the 'information age'.

## Why teach students research skills

Research, and the subsequent creation, validation and dissemination of knowledge, are fundamental to the operation of a research-intensive university. The reason for developing students' research skills is to help them build strong intellectual and practical connections between research frontiers and their own learning. Student benefits of these outcomes include:

- Inducting students into the disciplines' values, practices and ethics;
- Ensuring course content includes cutting edge research findings;
- Increasing students' understanding of how their chosen discipline contributes positively to society;
- Developing and enhancing students skills' and capabilities including:
  - Generic skills such as critical and analytical thinking, information retrieval and evaluation, and problem solving;
  - Skills in conducting and evaluating research that are helpful to students' ongoing personal and professional lives;
  - Providing enhanced opportunities for teaching and learning approaches such as inquiry-based and experiential;
  - Methods that have been linked to positive learning outcomes for students.

Research Skill Development is a multi-faceted concept referring to a variety of learning and teaching strategies that link research and teaching. Good practice in teaching research may include:

- Research outcomes informing the curriculum;
- Research-process-based methods of teaching and learning;
- Learning to use the tools of research;
- Developing an inclusive research context for students to encourage their engagement in the research process (Blackmore & Fraser, 2007).

For more information about this see:

[http://www.griffith.edu.au/gihe/pdf/gihe\\_tipsheet\\_web\\_rbl.pdf](http://www.griffith.edu.au/gihe/pdf/gihe_tipsheet_web_rbl.pdf)

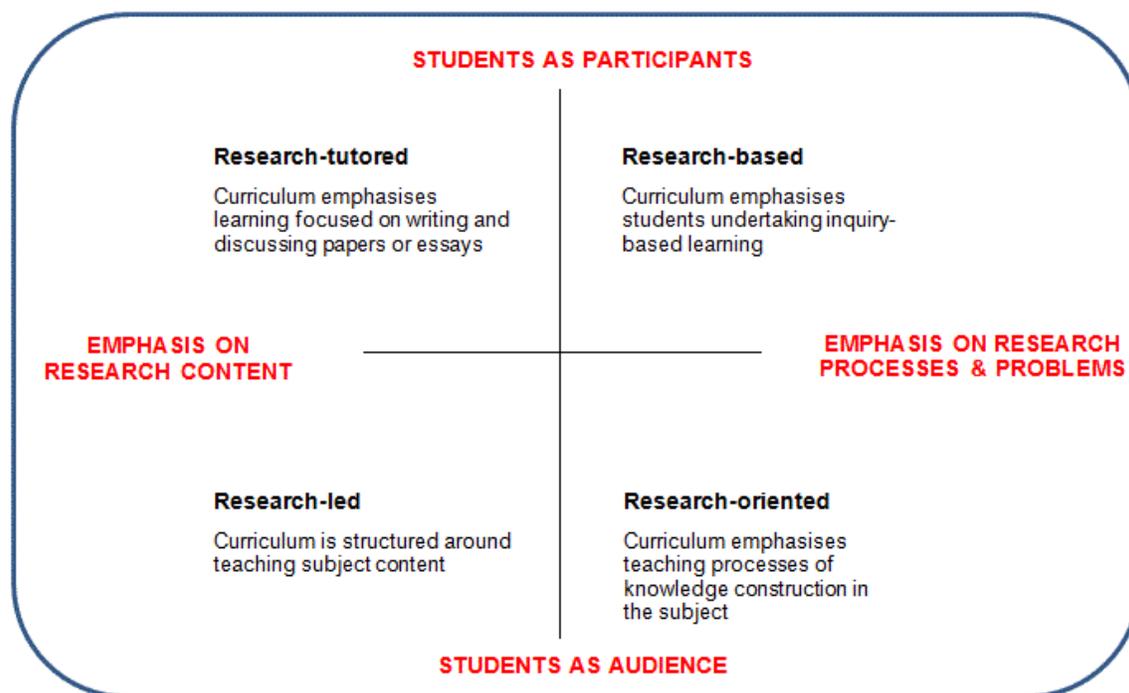
# Preparing students for research

---

It is recognised that the links between research and teaching can manifest differently between disciplines. Healey (2005) provides a diagram (fig 1) that illustrates four different orientations to the teaching-research nexus as they play out through varying curriculum designs. It is a “four-fold typology ... based on the extent to which learning is student or teacher-focused and the extent to which emphasis is placed on research content or research processes and problems” (2005, p. 75).

You can use a scheme such as Healey’s to design you own research-focused classroom activities. Another approach is given in the following section.

**Fig. 1 Curriculum design and the research teaching nexus**



Based on Healy (2005a, 70)

Table 1 provides an overview of the stages in the research process. This has been designed with a view to having the students engaged as participants with an emphasis on research processes and problems. However, as a course designer you have the option to choose the extent to which you would have the student participate in research and the emphasis you would place on the research process or content. For example you may choose identify the research task as well as the readings from which the students will create a paper. This has the student actively participating in research activities but focussed on the research content rather than the research process. Alternatively, you may choose explicitly teach research methodology and processes whereby the student is passively engaged in learning research skills through a strong emphasis on the processes and techniques.

**Table 1: Stages in the research process**

Typical Stage	Example approaches to engage students at each stage
Identify the task	Either present a defined research task or ask students to identify their own.
Define the task	<p>Ask students to represent the question, hypothesis or problem in their own words; define key terms and concepts. Students should ask themselves questions such as:</p> <ul style="list-style-type: none"> <li>• What do I know already about this problem or question?</li> <li>• What do I need to know to effectively address this problem or question?</li> <li>• What resources can I access to determine a proposed solution or hypothesis?</li> <li>• What tools do I need to collect the information I need?</li> </ul> <p>In this stage, a very focused research statement is needed, though that statement will go through a series of changes as new information is accessed and processed.</p>
Selecting research methodologies	Help students with defining their approach to the collection of data whether it be via experiment, survey or literary search etc.
Locating information about the research task	<p>Direct students to the library and also give them advice on how and where to find information e.g.:</p> <ul style="list-style-type: none"> <li>• searching with keywords</li> <li>• helpful sites and databases</li> <li>• newspapers and journals</li> <li>• original material online</li> <li>• people and organisations</li> </ul>

<p><b>Selecting resources to address the research task</b></p>	<p>Ask students to determine what information will be relevant, useful and absolutely essential for addressing the research topic; retrieve information from print, web and other sources; classify and categorise relevant information.</p> <p>It is important to advise students of what is considered a reliable resource. You can provide students with tips to help them with this process such as:</p> <ul style="list-style-type: none"> <li>• reading efficiently e.g. skimming the table of contents or scanning the text for specific words</li> <li>• questioning what they read i.e. <ul style="list-style-type: none"> <li>○ Is there a clear opinion about the topic provided by the author?</li> <li>○ Is there evidence supporting their ideas or is it just opinion?</li> <li>○ Is emotive or persuasive language used by the author?</li> </ul> </li> <li>• identifying bias e.g., identifying the purpose and motivation of the author in the providing the resource content.</li> <li>• evaluating websites eg identifying the website source (reputable organisation), and date it was last updated</li> <li>• primary and secondary resources.</li> </ul>
<p><b>Selecting and/ or designing the research tools (if required)</b></p>	<p>Either present the tool that the students will be using or ask the students to use the resources they have selected in helping them to select and design their data collection tools eg in the design of interview questions or experiment.</p> <p>You may wish to talk specifically about qualitative and quantitative data and how to interpret the data once they have been collected.</p> <p>It is important to ensure that all tools and research tasks comply with ethical standards. The ethics scope checker will assist students in identifying this.</p> <p><a href="http://www.griffith.edu.au/or/scoper/">http://www.griffith.edu.au/or/scoper/</a></p>
<p><b>Writing up the research results</b></p>	<p>Ask students to submit regular progress reports or updates to ensure deadlines are met; require submission of a draft structure of their assessment</p>
<p><b>Evaluate the final solution</b></p>	<p>Ask students to evaluate their research results from multiple perspectives (e.g., with a focus on generalisability; reliability; validity; public benefit; usefulness; contribution to the field) ) to test its validity and utility in a range of contexts.</p>

Adapted from [http://www.slv.vic.gov.au/ergo/research\\_skills](http://www.slv.vic.gov.au/ergo/research_skills) and the “*Problem Solving Skills*” Toolkit. (The ‘Information Literacy’ and ‘Critical Evaluation’ toolkits also contain relevant guidelines on developing research related skills).

# Designing research tasks

---

The following strategies provide a guide for incorporating research skills development into courses and programs helping students to learn the research and inquiry skills relevant to the discipline, to learn to interpret research findings and to identify how research informs practice. There is overlap between categories and some suggestions are more appropriate in some disciplines than in others, at some year levels and in some teaching and learning contexts than in others. These strategies give a range of options that will be most effective if tailored to your particular context and student cohort. (For each strategy we indicate in parentheses where it might be situated in the Healey scheme (Fig 1 above)).

## Strategies for successfully linking teaching and research

- 1. Draw on personal research in designing and teaching courses (Research-led).**
  - Incorporate current research directly into the curriculum as the focus of an entire course.
  - Refer to your own experience of tackling 'real world' problems in your research as illustrative examples to help students understand ideas, concepts and theories.
  - Illustrate the values, practices and ethics of your discipline by having faculty members, including postgraduate students, discuss their current research projects.
- 2. Place the latest research in the field within its historical context in classroom teaching (Research-led).**
  - Contextualise discussions of current research findings by referring to some of the discredited theories of the past and the passionate debates of the present.
  - Demonstrate the provisional nature of knowledge and its dynamic and evolving nature with an historical perspective showing how current policies and practices have evolved from earlier practices.
- 3. Design learning activities around contemporary research issues (Research-tutored)**
  - Ask students to explore cutting-edge research problems or to suggest solutions to current real issues world problems based on their knowledge of the fundamentals of the discipline. Variants of this activity include asking students to:

- Investigate the reporting of the status of a current research question in the discipline by comparing media reporting of a study with the official report.
- Analyse the methodology and argument presented in a journal article setting out recent research findings.
- Conduct a small-scale literature review, leading to a conclusion about the current state of knowledge and further questions to be addressed.

**4. Teach research methods, techniques and skills explicitly within programs (Research-oriented).**

- Develop students' understanding of research methodologies during laboratory classes.
- Design research methodology courses that provide opportunities to apply research skills to authentic research problems.
- Design assessment tasks within subjects that provide students with opportunities to learn different methods and skills associated with key contemporary research issues.

**5. Build small-scale research activities into undergraduate assignments (Research-tutored or Research-based depending on the emphasis on either research content or research processes and problems).**

Students at all levels can benefit from small-scale research activities that can often be carried out in groups. This mirrors the research culture of working in research teams rather than conducting individual research.

- Ask students to analyse research data from existing 'real world' projects.
- Provide students with a research question which requires them to conduct a small-scale literature review, decide on methodology, gather data, write up results and reach conclusions.
- Offer capstone courses that focus on a major project utilising the research skills and disciplinary knowledge acquired in previous semesters.

**6. Involve students in departmental research projects (Research-based).**

- Give students a self-contained project within a larger project.
- Organise students to act as research assistants to research higher degree students or faculty members.
- Organise site visits to university research centres.

**7. Encourage students to feel part of the research culture of Departments (Research-led).**

- Inform undergraduate students about the research interests and strengths of staff in the Departments in which they are studying.

- Refer to colleagues' areas of interest and achievements and, where possible, invite them to speak to students about their work.
- Encourage undergraduate and postgraduate students to attend research seminars by visiting scholars, give papers at conferences, and host student conferences.

#### **8. Infuse teaching with the values of researchers (Research-oriented).**

Encourage students to understand and aspire to researchers' values such as objectivity, respect for evidence, respect for others' views, tolerance of ambiguity, and analytical rigour, by:

- Modelling researchers' values in classroom interactions;
- Talking about the process that researchers go through before their work is published and the number of revisions typically involved;
- Providing structured learning experiences that require students to develop these values, such as, providing research articles presenting opposing arguments on the same topic and asking students to analyse their validity and draw a conclusion.

Adapted from: [http://www.griffith.edu.au/gihe/pdf/gihe\\_tipsheet\\_web\\_rbl.pdf](http://www.griffith.edu.au/gihe/pdf/gihe_tipsheet_web_rbl.pdf)

# Assessing students' research skills

---

Willison and O'Reagan (2006) identify two variables as the basis of a conceptual framework through which to understand the development of student research skills. They are the level of student autonomy and facets of enquiry. The framework (Research Skills Development Framework) provides a comprehensive "conceptual tool for diagnosis and planning, promoting understanding and interpretation of both potential and realised student research skill development" (<http://www.adelaide.edu.au/clpd/rsd/explanation/>).

You can find out more about the Research Skills Development (RSD) Framework by visiting <http://www.adelaide.edu.au/clpd/rsd/framework/>

Within the framework you can see examples of the criteria, the nature of the task, the discipline, the year level as well as full marking criteria from where the example is from and the degree of student autonomous engagement in research activities.

The examples provided in the framework illustrate one way to apply assessment criteria to research skills which could be utilised in the following examples of discipline tasks. These focus on the students' ability to move through the facets of inquiry identified by Willison & O'Reagan (2006) i.e. their ability to:

- determine the need for knowledge;
- find and generate the information;
- critically evaluate the information;
- organise the information;
- synthesise, analyse and apply the new knowledge; and
- communicate the knowledge (Willison & O'Reagan, 2006).

## Examples of discipline based assessable tasks

- Psychology students design a questionnaire, administer it and collate and analyse the results using SPSS software. They present the study in a research report that relates findings to existing research, interprets the data and discusses its implications for theory and where applicable for practice.
- Chemistry students conduct laboratory experiments where they collect scientific data, carry out appropriate statistical data analysis to assess its validity and interpret and evaluate their results in a scientific report including reference to other research.
- Education students develop a research question and choose an appropriate research methodology for examining the effectiveness of different classroom management techniques on hyperactive children. They present and discuss

the pros and cons of their chosen methodologies referencing existing research.

- Business students develop focus group and survey questions regarding appropriate marketing strategies for innovative mobile phone technology. They collect data from friends and family and compare the usefulness of the contrasting methodologies in addressing the research question in a report.
- In a class presentation criminology students, using existing research, critique the use of a variety of psychometric and non- psychometric tests to calculate the effectiveness of educational interventions with medium security prison inmates in reducing recidivism.

# Additional resources

---

## Print resources

- Baldwin, G. (2005). The teaching-research nexus: How research informs and enhances learning and teaching in the University of Melbourne. Melbourne: The University of Melbourne. Available in electronic form from: <http://www.cshe.unimelb.edu.au>.
- Blackmore, P. and Fraser, M. (2007). Researching and teaching: Making the link. In P. Blackmore & R. Blackwell (Eds.), *Towards strategic staff development in higher education* (pp. 131-141). Maidenhead, UK: McGraw-Hill International.
- Healey, M. (2005a). Linking research and teaching: exploring disciplinary spaces and the role of inquiry-based learning, in: R. Barnett (Ed.) *Reshaping the university: new relationships between research, scholarship and teaching* (Maidenhead, Open University Press), 67–78.
- Huggins, R., Jenkins, A., & Scurry, D. (2007). Undergraduate research in selected US universities: Report on us visit - institutional case studies. York, UK: Higher Education Academy. Retrieved 18 January 2010 from: [http://www.heacademy.ac.uk/resources/detail/undergraduate\\_research\\_in\\_select\\_ed\\_us\\_universities](http://www.heacademy.ac.uk/resources/detail/undergraduate_research_in_select_ed_us_universities) Oxford Brookes University February 2007
- Wood, W. B. (2003). Inquiry-based Undergraduate Teaching in the Life Sciences at Large Research Universities: A Perspective on the Boyer Commission Report. *Cell Biology Education [Electronic Resource]*, 2, 112-116.
- Willison, J., and O'Regan, K. (2006). *The Research Skill Development Framework*. Accessed from <http://www.adelaide.edu.au/clpd/rsd/framework>

## Web resources

- State Library of Victoria. (2010). *Research Skills*. Retrieved 15 April 2010 from [http://www.slv.vic.gov.au/ergo/research\\_skills](http://www.slv.vic.gov.au/ergo/research_skills)
- Council on Undergraduate Research. *Learning Through Research*. Retrieved 15 April 2010 from <http://cur.org>
- Griffith University – Office for Research. *Ethics Scope Checker*. Retrieved 15 April 2010 from <http://www.griffith.edu.au/or/scoper/>
- Griffith Institute for Higher Education. *Good Practice Guide*. Retrieved 15 April 2010 from [http://www.griffith.edu.au/gihe/pdf/gihe\\_tipsheet\\_web\\_rbl.pdf](http://www.griffith.edu.au/gihe/pdf/gihe_tipsheet_web_rbl.pdf)
- The University of Adelaide. *Research Skill Development for Curriculum Design and Assessment*. Retrieved 15 April 2010 from <http://www.adelaide.edu.au/clpd/rsd/index.html>
- Macquarie University. *Undergraduate Research in Australia*. Retrieved 15 April 2010 from [http://www.mq.edu.au/ltc/altc/ug\\_research/index.htm](http://www.mq.edu.au/ltc/altc/ug_research/index.htm)