CADQ Guide

Research informed teaching and enquiry based learning

The resource has been designed for colleagues who might be interested in redesigning their curriculum to utilise one or both of these approaches, whether at module or ideally course level, in line with the NTU Academic Foundation of *mutually-enriching relationships between teaching and research* as articulated in the NTU Strategic Plan. It is intended that this resource provide an overview of these two approaches as well as the synergies between them. Key headings are as follows:

Key points

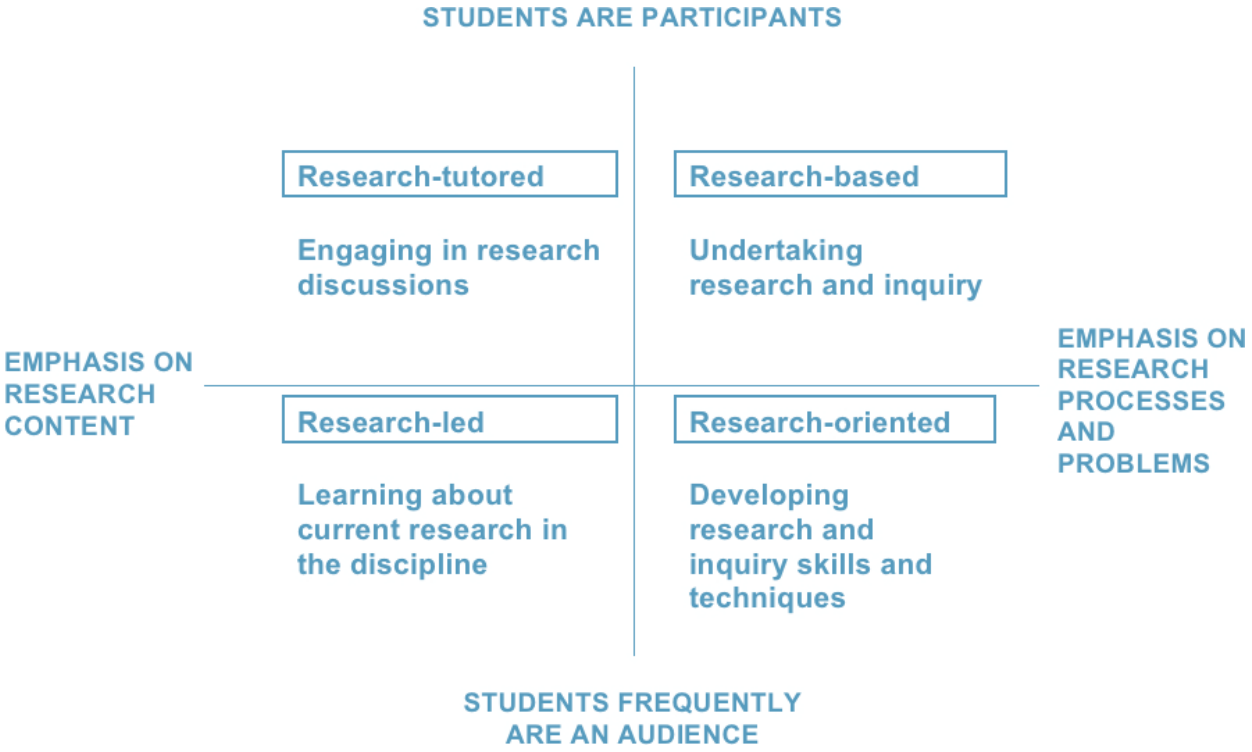
Student engagement with research and enquiry might involve students:

- undertaking their own original research
- learning 'in research mode' through enquiry-based activities

Such engagement can provide benefits such as greater achievement of higher order learning outcomes, enhanced transferable and lifelong learning skills, enhanced student employability, greater sense of academic community.

Definitions and characteristics of research informed teaching

For the purposes of this resource 'research informed teaching' is used as an umbrella term to describe curricula which integrates teaching and research practice in the ways indicated in the following typology (based on Jenkins and Healey 2009, p.7):



It is considered that providing a mix of such relationships within a curriculum can be an effective way to hone students' transferable skills and critical thinking skills whilst encouraging them to connect with their subject and view themselves as producers of knowledge during their time at university.

Healey and Jenkins identify a series of characteristics of central importance to undergraduate research:

- learning the epistemologies and forms of *discipline-based* inquiry;
- learning particular disciplinary research methodologies;
- linking the questions and forms of inquiry explicitly to academic staff research interests and current research foci in the disciplines; and
- producing work that mimics the forms of knowledge creation and dissemination in their disciplines and professional areas. (Healey and Jenkins, 2009, p.23)

Some examples of three different types of relationships as exist at NTU (based on interviews with NTU staff) are listed overleaf (research-tutored is not included as an earlier typology did not include the category – see Healey 2005, p70):

Research-oriented teaching	***Research-led Teaching***	***Research-based Teaching***
Reusable learning objects, e.g. pod-casts in journalism, staff-devised demonstration videos in the Business School	Use of key texts such as textbooks and cutting edge research papers in Science and Technology	Student participation in staff research, e.g. responding to questionnaire on Pacific Islands
Dissertation preparation modules in International Relations	Use of contextual examples from staff research, e.g. flood barrier research in Geosynthetics	Student research to inform practical work, e.g. undertaking literature review to inform practical tasks in Computing
Critical Studies modules in Advanced Design & Manufacturing	Use of staff-authored texts e.g. journalism staff teaching from own textbook and placing key chapters on the NTU Virtual Learning Environment.	Collaborative research between staff and individual students, e.g. research into property markets in Business School
Research equipment training, e.g. Quick Time Virtual Reality Panoramas in Geomorphology	Use of staff research as case studies, e.g. Human Rights Act (Law), evaluations of social intervention schemes (Social Sciences)	Collaborative research between staff and students embedded within courses, e.g. Fashionmap project in Art and Design, tandem tricycle project in Advanced Design & Manufacturing

Definitions and characteristics of enquiry-based learning

The characteristics described for Research Informed Teaching in the previous section may also be fully *or partially* present in certain forms of EBL. Hutchings' description of EBL distinguishes EBL from RIT in terms of the authenticity of the research experience, describing EBL as 'not so much research-led learning as research-like learning' (Hutchings, 2007, p. 21). Kahn and O'Rourke working at the Manchester CETL in enquiry-based learning identify EBL as encompassing a range of approaches as below (2004, p.5):

EBL Approach	Illustrative example
Case-based learning	A complex case is provided to students and followed with in-class discussion about content and concepts.
Scenario-based learning	Students participate in a 'scenario' designed to simulate a relevant issue or problem. The scenario may involve an element of role play.
Problem-based learning	An authentic problem is used to define and drive the student learning experience.
Project-based learning	Students work collaboratively to explore a problem or issue and create a presentation/product to demonstrate their learning.
Individual research project	A student explores a problem or issue through a structured process of enquiry – this may take the form of a research module or a dissertation.
Field work	A small-scale investigation is undertaken individually or in groups as part of a discipline related field trip.

From:http://www.academia.edu/460509/Guide_to_Curriculum_Design_Enquiry-Based_Learning

It is possible to make distinctions between different forms of IBL based on several key factors: the amount of scaffolding which is available (i.e. whether inquiry is structured, guided or open – see discussion of synergies between RIT and EBL); whether the emphasis is on developing students' understanding of existing knowledge or on creating new knowledge and the scale on which the teaching occurs, from activities within a class, to whole module or course design.

Discussion of synergies between RIT and EBL

The connection between EBL and undergraduate research as categorised within the rhetoric of research informed teaching is contentious. Jenkins and Healey argue that 'even if not identical […] they are certainly complementary and mutually reinforcing' (Jenkins and Healey 2009, p22). The authors consider that both EBL and RIT focus on learning through enquiry however Tosey and McDonnell (2006, p.5), raise two major objections to the merging of enquiry with research, these being: firstly, the acceptance rather than the challenging of current orthodoxies in research; secondly, while formal research training may be sufficient for new disciplinary-situated researchers they question whether it is adequate for the development of transferable skills more generally. They argue of EBL that, 'This process of learning draws upon research skills and study skills, but enquiry is not reducible to either research or study' (Tosey and McDonnell 2006, p. 2).

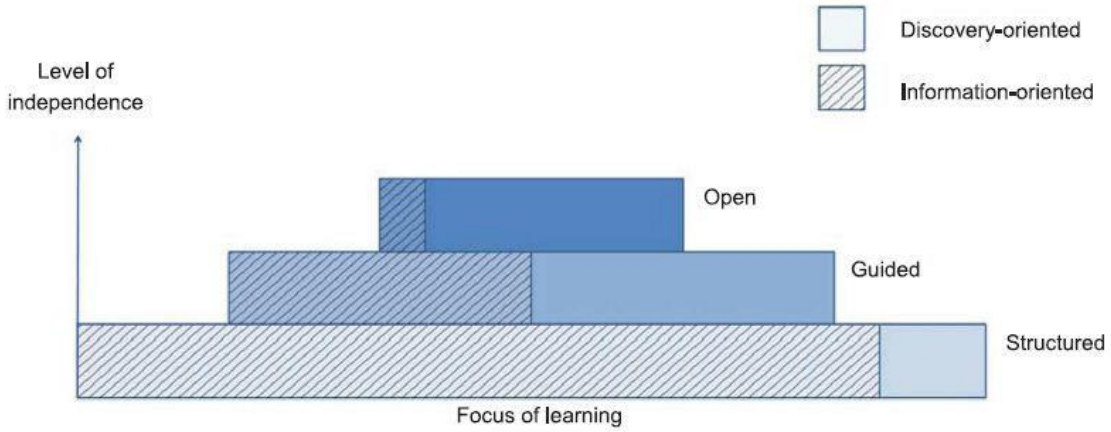
Spronken-Smith and Walker propose three categories of scaffolding or support which can be useful for understanding where RIT and EBL may sit on a spectrum of research and enquiry experiences:

- structured inquiry – where teachers provide an issue or problem and an outline for addressing it;
- guided inquiry – where teachers provide questions to stimulate inquiry but students are self-directed in terms of exploring these questions;

- open inquiry – where students formulate the questions themselves as well as going through the full inquiry cycle.

(Spronken-Smith and Walker 2010, p.727)

Work by Levy and colleagues at the University of Sheffield who were also working on developing a theoretical framework, brought similar issues to the fore. In light of this work, Spronken-Smith and Walker adjusted their three category framework. Their framework now takes into account whether students worked with knowledge in an 'information frame' which involved acquiring existing knowledge or a 'discovery frame' which involved building new knowledge (below)



Spronken and Walker's (2010, p. 736) elaborated model

Choosing a stepped model clearly illustrates the way that scaffolding is reduced across the three categories (Spronken-Smith and Walker, 2010). As scaffolding decreases, independence increases, as does the capacity for research and the development of community and strengthening of the research-teaching nexus (the latter indicated by the darker blue of the upper levels). Such an approach can facilitate the development of student research capabilities and understanding in a coherent and supported way.

Interestingly Spronken-Smith and Walker (2010) argue that 'IBL necessitates a student-centred approach by definition, even for more structured, information-oriented forms, while undergraduate research need not be student-centred'. The authors provide an example in which an undergraduate student may act as a research assistant for a staff research project. However, they argue that if the student is not involved in the research design then, regardless of the contribution which the student makes to new knowledge, the type of learning they experience should be considered to be structured or guided. This type of experience contrasts with the 'open' learning that many associate with undergraduate research.

For the sake of clarity we could argue that RIT always refers to discovery-oriented activity wherein students are undertaking original research and in doing so are participating to building disciplinary knowledge. EBL in contrast might refer to either discovery-oriented activity (in the case of open EBL) or information-oriented activity (structured and guided EBL) where students explore questions and gain knowledge which is already established but is new to them, the student (based on Spronken-Smith 2010, Levy 2009).

Benefits of RIT and EBL

Some have claimed that learning in enquiry mode is the basis of academic life, 'what should orient the university, and thus both the researcher and student, as well as society, is the pursuit of truth' (Simons, 2006). Related to this, a secondary purpose might be seen as preparing students to live and work in a world of 'supercomplexity' (Barnett 2000). Dangerfield (2008) has described the primary criterion of EBL to be, 'a maturation process from novice to experienced learner, from lay status to that of the newly qualified professional who is able to plan, implement, and justify her/his decisions'. The following benefits have been reported from adopting a RIT/EBL approach to learning:

- Greater achievement of higher order learning outcomes, e.g. critical thinking and evaluation skills from open discovery-oriented learning when compared with structured/guided information-oriented learning (Spronken-Smith and Walker, 2010)
- Preferable outcomes in the following areas 'learning outcomes, preparation time, time spent in the laboratory and student perception of the experiment' when compared with an expository version of the same activity, e.g. Chemistry laboratory experiment (Berg et al., 2003)
- Enhanced transferable and lifelong learning skills (Dangerfield, 2008)
- Enhanced student employability, 'it is very striking that the list of "employability" competence overlap quite largely with the competencies involved in the exercise of the modern research activity. Therefore, embedding research into the curricula through the HE curriculum, is likely to contribute to the development of those competencies that can be valued in many professional sectors other than professional research' (Commission of the European Communities, p.40 quoted in Simons 2006)

Some benefits cited by NTU students in a research survey include:

- Intellectual stimulation, "all aspects that promote student involvement that takes away the comfort zone of sitting in lectures and copying notes from the slides should stimulate learning" (Puntha 2011, p.35)
- Independent learning skills, "(research) takes you out of the classroom to do independent work and rely on yourself" (Puntha 2011, p.35) and;
- A sense of academic community particularly if students are undertaking enquiry / research in an area of staff expertise, "active involvement in research means you can learn from your own participation, from your peers and from experienced researchers like lecturers" (Puntha 2011, p.35)

Considerations for the use of RIT and EBL

Impact on students - According to Healey et al (2010) certain studies have suggested that students might become more instrumentalist in their approach as a result of their fee-paying status and that this might lead to students rejecting those aspects of curriculum which they find more academically challenging – generally those which are research-based, such as dissertations.

Resource - Campion and O'Neill (2005) discuss a review of PBL in their veterinary medicine and report that access to resources are important, in particular that facilities for small group work are available, including workspaces, whiteboards/flipcharts, and access to computers, photocopying and library facilities. They also reported that staff need increased

administrative support. McLoughlin (2005), discussing PBL in dentistry, also mentioned resource demands, citing his own course and studies in Holland. As this type of teaching is based on dividing the cohort into small groups of 8-10 students for seminars that there is an increased demand on staff time and facilities for small group work although he felt that this may call for a shift in emphasis of work rather than increased contact time. He recorded a need for increased administrative support, around timetabling and assessment and an increased demand on library resources.

Cost – PBL in particular is quite widely viewed as more costly than conventional courses. Finucane, Johnson and Prideaux (1998) refer to studies which indicated increased cost of PBL but they assert that any increase in cost is determined by class size. They identify the 'break-even' number of students, ie the number at which the cost of PBL and a traditional curriculum are the same, is with an annual student intake of around 40 or 50. They also report that the demand on resources, library and IT is such that an annual intake above 100 are not economically viable although they suggest that this figure may be subject to question with widespread technological innovation.

Case studies

- Numerous case studies are available from Healey, M. and Jenkins, A. (2009). Developing undergraduate research and inquiry. York: Higher Education Academy
- The University of Delaware has a web page on problem-based learning including a PBL Clearinghouse to view peer reviewed examples of problems and articles (access to the Clearinghouse is free but requires registration)
- The National Center for Case Study Teaching in Science contains several hundred case study examples complete with teaching notes as well as guidance on what makes a good case, the use of case study teaching to develop critical thinking, what not to do when teaching cases, cases and cooperative learning etc. Such examples fall into the category of problem-based learning and as such might provide useful scaffolding from which to progress to more student-led enquiry-based and research-based learning
- The Teaching-Research Nexus Website contains case studies organised by discipline groupings, year levels etc.

How to

- The CEEBL (Centre for Excellence in Enquiry-based Learning) at the University of Manchester has a comprehensive website including guides, case studies, resources, project reports and an evaluation questionnaire to use with EBL activities
- McMaster University has a web page on Inquiry-based learning which contains information about EBL and PBL, resources on introducing EBL into the curriculum and links to further external resources
- The University of Gloucestershire has produced an EBL Planner which can be used to focus discussion at curriculum design stage or to reflect on existing curriculum
- The University of Glasgow has a web page on enquiry-based learning which includes guidelines, resources and case study examples from various disciplines
- The website for the Education Technology Journal 'From now on' contains a Questioning Toolkit which describes different kinds of questions and provides different questioning tools

- The University of Lincoln organises its learning landscapes on the principle of Student as Producer . The website contains an explanation of the key features of Student as Producer, practice examples, articles and an evaluation framework
- Plymouth University has produced a series of disciplinary based resources to support academic staff to engage with research-informed teaching.
- The University of Central Lancashire has a Centre for Research Informed Teaching. The website for the Centre includes project information and publications

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