

Developing Research Capabilities through Technology Enhanced Learning

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RESEARCH, STUDENT LEARNING AND TELRI

The TELRI project assists academic staff to develop research-based approaches to teaching, through the effective use of learning technologies. The team are aware of the highly politicised debate about supposed links between research and teaching, and aware also that, despite the generally inconclusive research evidence, a belief that research informs teaching persists. We believe that in research-led institutions it is more productive to help one activity to enrich the other rather than to see teaching and research as unrelated activities or as permanently opposed claims on academic time. Although the improvements in students' learning that the project seeks to bring about do not require a research-led environment, we believe that certain environments, of which research-led institutions are an example, are a particularly valuable potential resource for the purpose, if exploited effectively.

The focus of the TELRI project is on what research and teaching share - a culture of personal inquiry, the process of inquiry and learning. It is reasonable to suppose that those experienced in researching and other rigorous professional applications of a discipline will have developed a range of higher level cognitive skills. Their intellectual processes and methods of working provide a useful model for their students' own learning. It would clearly be beneficial if students were themselves to develop these skills, in a research-like approach to learning that could help them in their current studies and lay a foundation for future activity within and beyond the discipline. At present the potential benefit of academics' research expertise for student learning is not always exploited fully, and this will only change if a conscious effort is made that it should do so.

WHAT ARE RESEARCH CAPABILITIES?

One would expect a number of broad capabilities of a proficient researcher, including:

- being innovative
- working independently
- setting and solving problems
- analysing critically
- handling large quantities of information in a wide range of media

These capabilities require the presence of:

- a body of disciplinary knowledge
- techniques used within the discipline
- higher order cognitive skills

WHAT ARE HIGHER ORDER COGNITIVE SKILLS?

These include the abilities to:

- make meaning, by interpreting information, forming and applying concepts and principles, critical analysis, synthesis into coherent wholes,
- generate ideas, using innovative thought, creativity
- take decisions, using procedures, algorithms, strategies, heuristics and judgements about applicability
- reflect on own purposes and processes, including justifications for judgements and decisions,

possibilities of transferability

Crucially for this discussion, such capabilities can be viewed as two, essentially complimentary and mutually supportive learning methods. The first, adoptive learning, is essentially a reproductive process and is appropriate after a situation has been defined. It requires the application of well-understood knowledge, techniques and procedures. Adoptive learning can produce immediately impressive results but may be less transferable to other situations. Adaptive learning is a generative process that requires higher cognitive skills and produces innovation and creativity. An accomplished researcher will be skilled in adaptive learning and potentially will be well placed to help others to develop similar expertise.

THE IMPORTANCE OF TRANSFER

At the heart of contemporary discussion on transferable skills is a wish to identify capabilities that have a wide application and to develop them through the curriculum. Cognitive skills are particularly important in enabling the transfer of capability from one situation to another, both because they are less context-dependent than some other human abilities often referred to as skills, and because they can themselves aid transfer. Some might be termed "skills of transfer". There would be wide agreement that they are transferable, at least within a discipline. For example, mathematicians would probably agree that a set of abilities to "think mathematically" would be developed through a degree course. Transfer beyond a discipline is more problematic, and it is probably safer to say that transfer is more likely in direct relation to the degree of similarity between contexts.

TELRI seeks to identify and develop those aspects of expertise that have widest applicability within and beyond the discipline. For this reason the team's interest is at two levels: the broad research capabilities listed above and, more fundamentally, the cognitive skills that inform them. We believe that, whilst disciplinary knowledge and techniques are vital and must be taken into consideration, they do not need reinforcement through the work of the project, since they are self-evidently important and are explicitly taught. In contrast, cognitive skills are rarely developed explicitly.

WHAT THIS MEANS FOR THE CURRICULUM

A curriculum should develop not only disciplinary knowledge and techniques but also the higher level cognitive skills that are essential for their development and use. The potential for may be maximised if the curriculum is designed to provide appropriate course processes and assessment approaches that emulate the research environment.

The following are offered as guides for the design of a curriculum to encourage the development of broad research capabilities and of cognitive skills:

- Activities should prompt the concentrated development and use of cognitive skills.
- Expertness, as distinct from competence, derives from the capacity to engage in novel thinking in complex and uncertain situations. Therefore:
 - Students should be encouraged to set as well as solve problems.
 - Open tasks are better than closed tasks
 - Problem-based learning is more beneficial if the student has a part in defining the problem.
- Students should be encouraged to reflect on their learning processes.

WHAT LEARNING TECHNOLOGIES CAN CONTRIBUTE

It is easy to find examples of the use of learning technologies to make research tools, data and information available, thus contributing to students' disciplinary techniques and knowledge. However, learning technologies are less often used to develop higher cognitive skills. There are many potential contributions. What we value highly in researchers is creativity and originality. Both are difficult to define, but it can safely be said that those who work in open situations, with the greatest autonomy, who are required to identify and set as well as solve problems, are most likely to be creative because of what they are required to bring to the situation themselves.

Therefore TELRI is concerned with the integration of C&IT tools to support learning that takes place in "open" settings. Researchers characteristically deal with large amounts of complex information, and require the skills of analysis, the ability to make and discern structure. Therefore C&IT tools that require learners to give meaning and value to information are particularly useful. Research requires considerable precision and intensity, C&IT tools that demand a high degree of focus, particularly on meaning, are therefore valuable. Finally, the ability critically to reflect on working processes is vital, and so tools that make apparent the processes of learning are useful. All of these tools are more effective when they offer immediate feedback to the learner. These links may be summarised thus:

Desired Research capability	What C&IT should offer
Ability to be original, creative, innovative	Tools that present and offer resources for open situations
Tools that present and offer resources for open situations	Tools that support the learner in evaluating, analysing, selecting and structuring
Ability to work with precision and intensity	Tools that permit a high degree of focus on a particular skill
Ability to reflect on working processes	Tools that make working purpose and processes transparent
Ability to form justified discipline-based judgements	Tools that enable discussion of reasoning, judgements and decisions

HOW THE TELRI TEAM SEEK TO SUPPORT STAFF

Working with the TELRI team does not necessarily mean changing one's educational purposes or, necessarily, one's approaches to teaching and assessing. The team offer assistance in translating the course's true purpose into a transparent form. The process allows one to be more analytical about what one seeks to achieve and more deliberate about how one sets about it, making use of educational technologies where they can provide a clear benefit.

The team's way of working is to clarify the capabilities and cognitive skills that are to be the focus of attention; review existing approaches; develop, in conjunction with the staff involved, appropriate approaches to teaching and assessment; and establish and use a means of evaluating the effectiveness of the intervention.

TELRI has employed this approach to support staff in ten departments within the universities of Warwick and Oxford in implementing technology-enhanced learning. The team will produce case studies detailing the context, the technological tool and the capabilities and skills developed. A second phase will extend the approach to further departments in several other research-led universities, including Durham, Birmingham and Southampton. A third phase will provide staff development workshops and consultancy across the HE sector.

DEMONSTRATING EFFECTIVENESS IN TELRI

In evaluating the implementation of TELRI in courses, the team aims to demonstrate how the technological approaches identified provide effective ways to:

- support course activities of relevance to research processes, and
- enhance the development of higher cognitive skills in students.

Important aspects of the case studies will include evidence that students are:

- motivated and enjoying this way of learning
- willing to take risks

- exchanging ideas
- interpreting ideas
- reasoning and justifying concepts
- beginning to think intuitively.

All of these attributes are centred around the process of creativity. It is, therefore, a fundamental assessment requirement that an "expert" in the discipline is needed in order to recognise a student's development of research capabilities

The TELRI pack is available via the [TELRI web site](#):

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