Challenges, Responses and Strategic New Directions

A summary from the **Learning Outcomes and Curriculum Development in Physics** *project, funded by the Australian Universities Teaching Committee (AUTC)*

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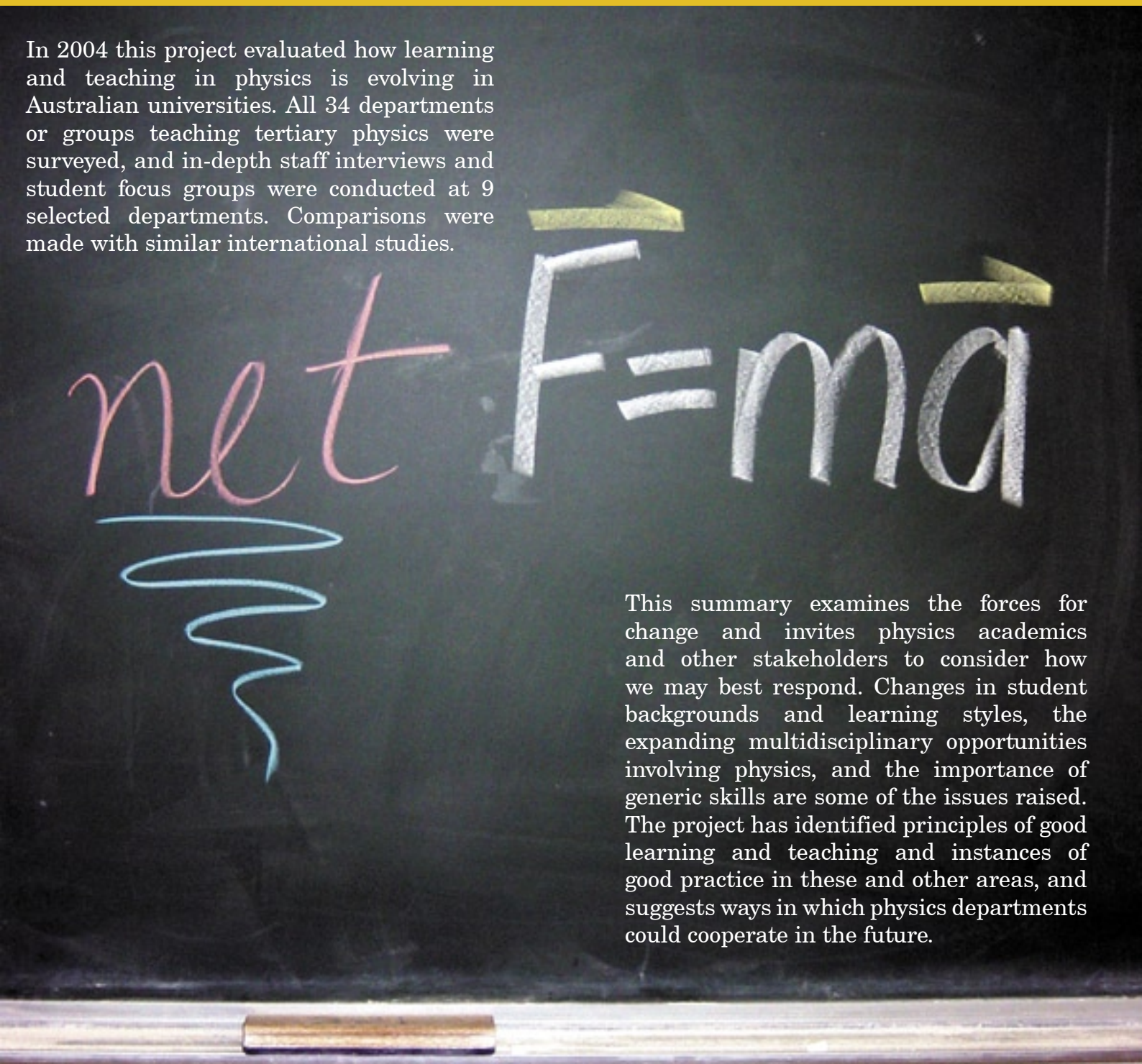
In 2004 this project evaluated how learning and teaching in physics is evolving in Australian universities. All 34 departments or groups teaching tertiary physics were surveyed, and in-depth staff interviews and student focus groups were conducted at 9 selected departments. Comparisons were made with similar international studies.



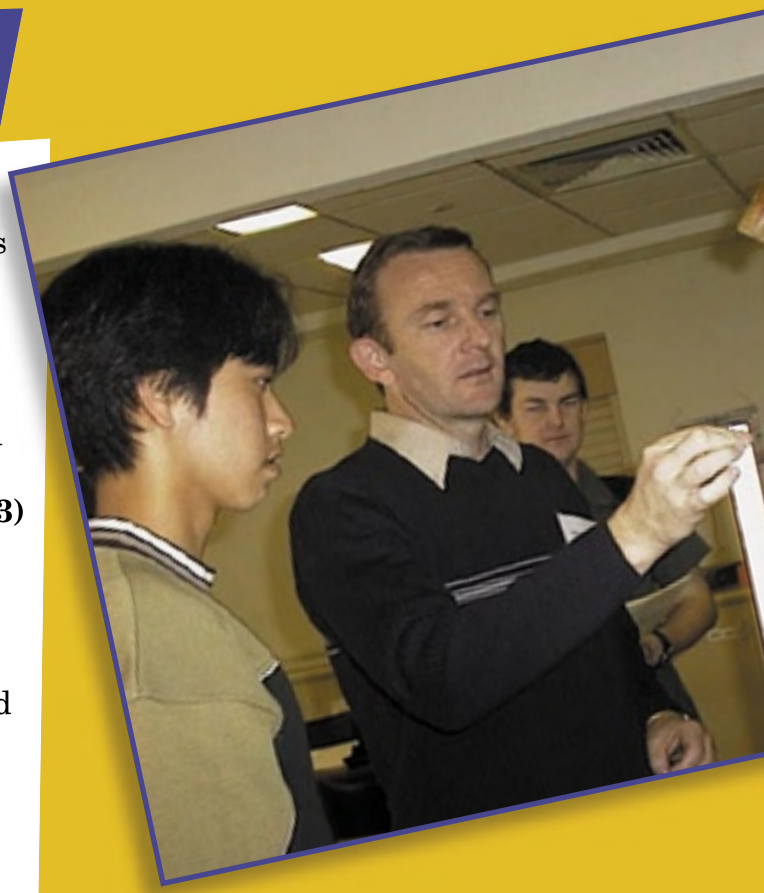
This summary examines the forces for change and invites physics academics and other stakeholders to consider how we may best respond. Changes in student backgrounds and learning styles, the expanding multidisciplinary opportunities involving physics, and the importance of generic skills are some of the issues raised. The project has identified principles of good learning and teaching and instances of good practice in these and other areas, and suggests ways in which physics departments could cooperate in the future.

Challenges faced by physics departments

What challenges have departments faced in physics learning and teaching in the last 3-5 years? The dominant responses were:

- declining staff numbers and the general downsizing of departments **(21)**
- the struggle to upgrade/upkeep laboratory and IT facilities and staff **(14)**
- counteracting the decline in student numbers **(13)**
- the loss of traditional service teaching areas and the need to find new ones **(13)**
- the large amount of degree and subject restructuring that has been required **(11)**
- the poor mathematical and physics background of incoming students **(11)**
- the increased teaching loads on staff **(10)**

Other issues identified are reflected in the recommendations below.



The frequency of the responses is provided in brackets, from a total of 34 departments.

Responses

Physics departments have responded to the challenges faced in a number of ways:

- restructuring laboratories and curricula **(14)**
- introducing new majors and new degrees (e.g. double degrees, nanotechnology) **(11)**
- introducing new computer technology in undergraduate teaching (e.g. WebCT) **(10)**
- reducing the number of subject choices **(8)**
- sharing service teaching with other departments **(7)**
- increasing the training and oversight of staff **(5)**
- employing part-time teaching staff **(5)**

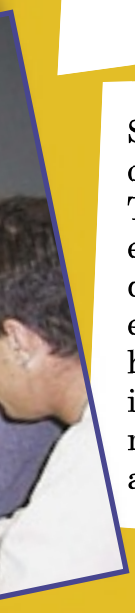
Strategic new directions being explored

Multidisciplinary and other creative initiatives have been pursued by many departments, particularly in nanotechnology. Photonics, biomedical physics, medical radiation, space and astrophysics have been developed over a longer timeframe. Larger departments have tended to keep their traditional breadth while small departments have specialised. Many departments have capitalised on their research-teaching nexus.

Departments have widely adopted on-line resources, primarily as a course delivery tool but with on-line assessment frequently used. Australian innovations using new technologies are isolated, perhaps reflecting the lessons learnt from the 1990s about the cost of developing software and questions of efficacy in some cases. Opportunities exist for sharing resources.

Physics education research has guided several developments in introductory physics teaching in Australia, which have in turn increased awareness of learning and teaching issues through conferences, and provided valuable resources such as the Workshop Tutorials and the Conceptual Understanding in Physics cooperative learning approach. Research projects are being widely used, in particular in the higher years.

Service teaching provides a large fraction of teaching income in many departments. The loss of service teaching, particularly for engineering, has been substantial in many departments, though this is partly offset by emerging areas including the biomedical and health sciences, and physics for agricultural industries. Departments report that they maintain the same quality in service teaching as for mainstream physics.



Departments are seeking to provide quality learning and teaching and to respond as best they can to the changing environment, in most cases demonstrating resilience and an ability to change direction. They continue to place high value on laboratory work, and seek sustainable approaches for their student to staff ratio, and at the same time improve their research output. However, the sharing of good practices and appropriate support from universities, the AIP and the government, could enhance the learning and teaching of physics.

Recommendations for the future of physics learning and teaching in Australia

In 2005 the Physics Project Team will work with physics departments to:

- highlight and disseminate good practices and available resources for demonstrator and tutor training
- identify academic staff with an interest in physics for bio- and med- sciences, and encourage them to collaborate in the production of common course materials appropriate for the Australian context
- cooperate with physics departments and the AIP in facilitating effective sharing of teaching resources and providing a database containing evaluations of (and advice regarding) resources

In designing undergraduate physics curricula, physics departments and staff should:

- include learning activities that cater for a variety of learning styles and contemporary technology
- recognise and value diversity of student background, work experience, gender and cultural background
- communicate their expectations of students clearly and explicitly
- involve younger academics and consult students in teaching and learning decision-making
- consult with, and take advice from industry and employers

In supporting learning and teaching, physics departments and staff should:

- ensure academic staff appointments address teaching capabilities alongside research, that new appointees have a good induction to teaching and learning, and that ongoing support is provided
- value the contribution that demonstrating, tutoring and sessional staff make to student learning and ensure adequate training and support, both in terms of physics content and learning and teaching issues
- provide time, and resources for staff who contribute substantially to innovative and quality teaching, recognise their contribution to retaining students, and support their promotion based on their teaching

Physics departments in conjunction with the AIP should:

- seek effective methods to ensure that graduates are highly competent in the key generic skills
- develop (together with industry) resources to help inform students of the value of physics in their future careers
- pursue strategies to ensure that service teaching to all disciplines is valued and promoted
- be more proactive in the training and professional development of physics and junior science teachers
- support and undertake research into the effectiveness of learning and teaching strategies
- promote and share good practice by strengthening and taking advantage of the network established by the Physics Education Group

The Carrick Institute for Learning and Teaching in Higher Education (which replaces the AUTC) should:

- provide support for research into effective physics learning and teaching in the Australian context

See the full report and other information on the project webpage at:
www.physics.usyd.edu.au/super/AUTC/autc

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