In 2004, a project entitled “Learning Outcomes and Curriculum Development in Physics” was commissioned by the Australian Universities Teaching Commission (AUTC) to answer, *inter alia*, these questions:

- How is the context and nature of physics education in Australian universities changing?
- What factors are constraining staff and departments in providing quality teaching and learning?
- How can we best share good practices so that physics education strengthens, is sustained and grows?

The current context for physics education in universities is indeed complex with quite dramatic changes occurring during the last decade within most institutions. These include changes to the nature and expectations of the student body, changes in staffing, infrastructure and resource allocations in departments, changes in employer expectations and emerging multidisciplinary areas. In response to these changes, departments have identified and employed various strategies to provide high quality physics teaching and learning. Individual, departmental and collective experiences captured in this project provide opportunities for sharing understandings of the current context and advancing the teaching and learning of physics in Australian universities in effective and efficient ways. Recent major studies in the USA and UK have informed and complemented this project.

The project aimed to capture the essence of physics teaching and learning in Australian universities, and map the path forward based on collective experiences, both successful and not so successful.

Several different procedures were used to gather data. These included accessing web pages, seeking questionnaire responses from physics departments, engaging in focus group discussions with students, and conducting interviews with individual department heads, curriculum co-ordinators, physics graduates and employers. More detailed data was obtained through interviews and focus groups at nine departments, selected to represent each state and capture the diverse types of departments.

The project focused on undergraduate physics education – 3 year and 4 year programs, service and multidisciplinary physics subjects, and double/combined degree programs.

The major findings of the project were presented in the Stage 1 Report “Learning Outcomes and Curriculum Development in Physics”. Copies of this report have been distributed to each participating university. Each major section of the report gave rise to a series of recommendation, some of which are discussed below.

The Executive Summary, containing the complete set of recommendations can be downloaded from the project web pages.

The findings and recommendations were grouped under six main headings:

- The changing nature of students: implications for teaching;
- Skills, capabilities and employment;
- What are we teaching?
- How are our students learning and how are we teaching?
- Staffing challenges and responses; and
- Future directions.

To give the reader a feeling for the kind of results contained in the Stage 1 report, the findings and recommendations of the first major section, concerned with the background of physics students, may be quoted here.
The changing nature of students: implications for teaching

Investigation of the changing nature of physics students gave rise to several recommendations related to appropriate teaching. Most departments have identified changes in the background of students commencing physics studies, and have adapted in a range of ways, as shown in Figure 1 (from ref 3, Figure 5.2).

**Figure 1:** Categorised and quantified questionnaire responses to “B7. Please make any general comments regarding student backgrounds entering physics, including effect of changes to high school physics or mathematics. How has your own department adapted to these changes?”

**Recommendation 3.1:**
That physics staff include in the curriculum learning activities that cater for a variety of learning styles and contemporary technology.

**Recommendation 3.2:**
That physics staff recognise and value diversity of student background, such as previous physics and maths studies, work experience, gender and cultural background in designing the curriculum.

**Recommendation 3.3:**
That physics staff acknowledge the competing demands on students’ time, including part time work, when designing learning and assessment tasks.

**Recommendation 3.4:**
That physics staff communicate their expectations of students clearly and explicitly.

**Recommendation 3.5:**
That physics departments involve younger academics and consult students in teaching and learning decision-making.

The project also sought answers to the questions *How are our students learning?* and *How are we teaching?*

In the face of a decline in staff numbers and in laboratory and information technology (IT) facilities on the one hand, and poorer preparation of our students on the other, departments are responding by restructuring the curriculum and laboratories, changing their subject offerings and introducing new learning activities and new technology.

The effectiveness of these responses was evaluated in part by asking students which activities are most helpful to their learning. The most common responses included interaction with helpful and knowledgeable lecturers, tutors and demonstrators, regular assessment, and worked examples in class.

Recommendations related to this section of the report arise from an awareness that the goal of improving learning and teaching quality in Australian physics departments depends on teaching staff having a better awareness of approaches and resources which have been evaluated and demonstrated to be pedagogically sound and efficient in terms of human and financial resources.
**Recommendation 6.1:**
That physics departments and the Australian Institute of Physics, through the Physics Education Group, support and undertake research into the effectiveness of learning and teaching strategies such as the use of IT and e-learning, the contexts and benefits of undergraduate research projects, and opportunities for optimising our investment in and commitment to laboratory experience.

**Recommendation 6.2:**
That further research into effective physics learning and teaching in the Australian context should be supported, with particular attention to Generation Y.

**Recommendation 6.3:**
That heads of physics departments and the Australian Institute of Physics cooperate in establishing improved mechanisms for promoting and sharing good practice, such as supporting academic exchange visits and contributing to the national clearinghouse, UniServe Science.

**Recommendation 6.4:**
That the AUTC project team identify academic staff with an interest in physics for biological and medical sciences, and encourage them to collaborate in the production of common course materials appropriate for the Australian context.

**Dissemination**
In 2005, the project team concentrated on disseminating findings, strengthening networking amongst the higher education physics community and developing strategies for sharing good practices. Among major initiatives in this stage of the project were the publication of *Snapshots* and development of the web page.

**Snapshots of good practice**
"Snapshot – Good Learning and Teaching in Physics" is a small booklet which provides descriptions of the range of good learning and teaching practices currently taking place across Australian institutions. Twelve themes are featured:
- Large Classes;
- Online Learning;
- Service Teaching;
- Distance Learning;
- Context-Centred Teaching;
- Tutor/Demonstrator Training;
- Laboratory Work;
- Interface to Employment;
- Small Class Activities–Tutorials;
- Communication Skills;
- Undergraduate Projects; and
- Teamwork.

The booklet features some 40 examples in addition to overview articles and has been widely distributed to Australian physics departments and learning and teaching centres at all participating universities.

**Project web pages**
A resources web-page has been set up so that academics can readily access the best sources for physics education research based teaching and learning materials. It includes links to teaching resources which have been developed or implemented at Australian universities, and to Australian publications related to research in physics education. This will continue to develop over time.

More complete information is available in the Stage 1 report and the *Snapshots* booklet distributed to all Australian physics departments, and via the project web pages:


**Acknowledgements**
The project has been funded by the Australian Universities Teaching Commission and the Carrick Institute for Learning and Teaching in Higher Education. The project team appreciates the support and input from physics departments, the physics community and the Expert Advisory Panel members.

**References**
2. Institute of Physics Inquiry into Undergraduate Physics, [http://policy.iop.org/UPI/index.html](http://policy.iop.org/UPI/index.html)