What Determines Perseverance in Studying Science?

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Abstract

This article explores the issue of university student recruitment and retention beyond the first and second year of studying science. The research investigated the 'image' students have of science, the demands they face in studying science and student self-efficacy, and the relative importance of these factors as perceived by 140 returning New Zealand year two science and engineering students, using questionnaires and focus group interviews. Results indicate that returning students are generally confident in their ability to cope with their science studies. However, a significant minority of students was unsure or not coping with issues such as course workloads, and findings suggest that during their first year science students need to be reassured that they are valued, and that their education is taken very seriously by the institution and their lecturers. Student commentary suggests this can be achieved by personalising lectures, ensuring personal contact with lecturers and monitoring how students are coping with the challenges and stresses that affect workload issues and subsequently their academic progress.

Keywords: retention, science students, transition, attrition

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The recruitment and retention of students beyond their first year of tertiary study is an area of growing concern for universities in New Zealand as well as internationally. The transition from high schools to universities is often difficult and stressful, with high drop-out rates reported before graduation (Parker, Summerfeldt, Hogan, & Majeski, 2004). This is an issue, particularly in science, where tertiary-level enrolments are declining (Leach & Zepke, 2006; OECD, 2006; Osborne, Simon, & Collins, 2003; Scott, 2005). The Organisation for Economic Co-operation and Development (OECD, 2006) reports that while there has been an overall increase in student numbers in science and technology among its member states, the overall increase in other tertiary studies exceeds that in science and technology. This is the case particularly in the physical sciences and mathematics. The OECD report highlights also that the initial decisions to study science are highly dependent on the 'image' students have of science and scientists. Similarly, a study by New Zealand's

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Ministry of Research Science and Technology (MoRST) indicates that factors influencing students' decisions to study science in year 13 and beyond include personal interest, decision-making perspectives, family background, positive learning experiences, school type and knowledge of potential careers (MoRST, 2006). Once a decision has been made by students to continue with tertiary study, the transition from high school to university is not necessarily smooth and can be very stressful indeed (Pratt et al., 2000). In the worst-case scenario a range of environmental and personal issues arising during the first few weeks of study can lead to early partial or complete withdrawal — an issue of concern in tertiary education (Braxton, 2000; Pascarella & Terenzini, 1991; Yorke, 1999; Zepke et al., 2005).

In New Zealand, an overall increase in student numbers in tertiary education has put government funding under pressure. As a result of this, relatively low retention and pass rates have raised questions as to whether the current system provides 'value for money' and how the funding system can incorporate measures of performance in terms of retention, pass and student satisfaction rates (Scott, 2005). Universities in New Zealand aspire to provide to high quality education, and express commitment to exceptional teaching and learning. For example, the strategic plans and teaching and learning guidelines of three New Zealand universities (Auckland, Waikato and Otago) outline that 'effective teaching and learning is based on research and innovation' and is 'responsive to the needs of diverse learners and underpinned by . . . pedagogical expertise' (University of Auckland, 2009, p. 1). The University of Waikato states that it is the university's role to promote 'more advanced learning' in order to 'develop intellectual independence' (2006, p. 1), and the University of Otago notes that 'this can be achieved by staff recognising the importance of the objectives relating to intellectual independence and lifelong learning skills' (2003, p. 8). Universities thus affirm the importance of teaching and learning. Student retention can be taken as a measure of the quality of teaching. However, it is essential that universities identify the sort of teaching and learning practices that lead to rewarding learning experiences (Coates, 2005).

The challenges of tertiary study: being and becoming a scientist

Contrary to popular belief, scientists work in collaborative teams. While their work requires replication of results it also involves the creative generation and collaborative validation of new knowledge. Progress in science relies on the rapid dissemination of ideas through the research community so that others can make use of them in an accumulative effort to increase knowledge (Louis, Anderson, & Campbell, 2007). Ideally, students are inducted into the scientific community and its ways of working through their tertiary education. In practice, however, higher education science teaching tends to be lecture-based, transmitting content to large numbers of students. Lectures are complemented by laboratory work designed to confirm, rather than explore, theory. This positions students as passive recipients of knowledge. It encourages a shallow approach to learning with a focus on memorisation (Mji, 2003). It also means that science students need to attend a number of lectures and lengthy laboratory sessions and so their on-campus time commitment can be considerably greater than for students in other disciplines. Thus, science students face substantial challenges in time management and the mastery of content and identifying with the culture of scientists.

Reasons for continuing to study

Research that indicates that the first year of university study is often a hurdle to students and that the highest drop-out rate occurs at the transition from the first to the second year (e.g., Lau, 2003). University lecturers often have very little, if any, formal training in teaching and their views on learning and teaching approaches are often intuitive (Sunal et al., 2001), which may affect the delivery of course content. Students have to adjust to a new academic and social culture and develop a new identity associated with the disciplines they are studying. The new identity that is being formed is dependent on developing new skills and knowledge (Chaiklin & Lave, 1996; Wenger, 1998).

In a literature review on student transition, attrition and performance, Evans (2000) reports that while there are commonalities across institutions, some of the problems are specific to institutions and the people within those institutions. As such, they are best dealt with within each institution. Factors relating to successful retention that were common across institutions include determination to succeed, ability to achieve set goals, and students' perception that they had chosen the right course. Institutions with success in retaining students are also reported to embody a culture that is built on the students' belief system about status of the degree, the level of difficulty in obtaining entry and the perceived status of the institution (Longden, 2004). In terms of personal factors, overseas studies report a strong relationship between active coping strategies and self-efficacy (Devonport & Lane, 2006).

In the New Zealand context, research on recent science graduates' reflections on their choices and experiences with their study found that while most students had a strong intrinsic motivation to study science, to do so was not an easy decision for them and one they felt at times unsure about (Koslow, 2005). Zepke and colleagues (2005) found personal problems were a key factor in student retention across the first and second year of study in New Zealand's tertiary institutions. The workload and ways to manage it were among the top issues for students who had considered full withdrawal. A feeling they might not be in the right course also played a part in student decision-making. Research also reports a relationship between students' ability to cope with study-related stress and levels of confidence in their ability to execute course-specific tasks (Devonport & Lane, 2006).

Focus and design of this research

Recruitment and retention are issues for all New Zealand universities. Fluctuations in student numbers affect funding income streams and increases concerns over retention. An OECD report on tertiary education in New Zealand (2008, p. 21) states that 29% of a university's funding comes directly from student tuition fees. This makes it essential for universities and their schools of study to maximise retention of students into second year and beyond. A study of factors that influence student retention from the first to the second year of science study seems timely and relevant.

Literature reviews on student retention (Evans, 2000; Louis, Anderson & Campbell, 2006) suggest a focus on motivational and learning factors in order to learn about students' experiences after their first year of science study. This would help to identify some of the reasons that influence students in deciding whether or not to continue to study science, and is an approach that was used in the study reported here. Institutional factors that reflect subject specific needs and requirements were also considered.

A questionnaire was administered in the A semester of 2006, between February and June, to 140 returning year-two science and engineering students at a New Zealand university. The questionnaire looked at students' confidence in their ability to perform successfully in a range of areas related to academic success. Seven of these students accepted a further invitation to participate in focus group discussions. The study was conducted in two phases:

Phase One

During the first few weeks of their study year, 2nd-year science and engineering students were asked to complete a written survey questionnaire. The survey, with a mix of qualitative and quantitative questions, focused on gathering data on the students' learning experiences in their previous year of study and their expectations for the year ahead. The questionnaire was organised into 10 sections: time management, resources, individual learning strategies, group learning strategies, lectures and labs, communication ability, degree information, staff information, assessment information and self-assessment. Students could respond using a 5-point Likert scale from *very confident* to *not very confident*, or *very important* to *not very important*. In addition, the scale was also marked with + and - symbols. The nature of the questions will be made evident in the presentation of the results.

Phase Two

Phase Two used three focus groups of returning 2nd-year students, and the participants were interviewed about their learning experiences. The sessions explored the process of the students' enculturation into the tertiary science and engineering learning communities. Of the seven students who took up the invitation, two were female and five were male; one had gone straight from school to university while the other six were mature students. The focus group interviews expanded on some of the factors identified in the questionnaire responses.

The results

The questionnaire was organised into 10 sections. Each section asked the students to rate their ability to cope with factors affecting their learning, their confidence in their ability to succeed, and the value they saw in certain strategies. Each section finished with a question, asking the respondents to evaluate overall how important the above issues were for success in studying science or engineering. At the end of the survey an open question asked respondents what qualities a successful science student had to have. During the focus interviews students were invited to explain the reasons why they had chosen to study science or engineering and to expand on the issues highlighted in the questionnaire. Students were asked to elaborate on any experiences that had affected their decision to continue with their studies. The findings are presented here within the framework of the ten sections in the questionnaire.

Time management

Beaubouef and Mason (2005) report that one of the issues for poor student transition from year one to two is time management. The authors link this to the students' lack of understanding of the extent of work necessary to complete assignments. This was also echoed in this study: while just over half (52%) of the students surveyed felt confident in their ability to manage their workload, with a similar proportion confident or very confident in their ability to remain enthusiastic (51%) and to balance private life with study (54%), just under half of the students were not confident in their ability to manage these aspects of university life. These results are summarised in Table 1.

Table 1

Students' Perceptions of Their Time Management Skills

	Likert scale (highest to lowest, %)					
Time management	+++	++	+-	- -	---	na
Ability to manage workload	12	40	41	7	0	0
Confident to stay enthusiastic	13	38	40	8	1	0
Balance between study and private life	14	40	33	11	2	0
Importance of time management	32	37	26	2	2	1

All the focus groups commented on their initial perception that workloads were extremely high, and the need to develop techniques to deal with this:

> I think it's overwhelming until you know how to do it. Cause there is a lot of information but you got to learn half way through the first semester. And you learn techniques and know it all. You know what kind of questions they are going to ask in the test and they have in the exams.

As this quote illustrates, students are also faced with demands of learning a very large amount of subject specific content. In this study, nearly 70% of all students considered time management as an important issue in their decision to continue with their studies in science. Other studies have highlighted that the ability to cope with the demands of tertiary study depends on a range of coping mechanisms, including how successful students are at managing their time (Devonport & Lane, 2006). This would seem to be an important issue for those studying science because of the requirements of laboratory work and the need to learn large amounts of subject content.

Resources

Being able to use resources has been reported to correlate significantly with academic performance (Watson, McSorley, Foxcroft, & Watson, 2004). This might be even more the case for science students because they have to participate in a wide range of practical courses that require both technical skills and knowledge. Over 70% of students in this study felt confident to very confident about their use of calculators and computers. There was a noticeable shift in confidence when asked about their ability to write essays, use lab equipment and use the library, with less than 20% of students reporting they were very confident in these activities, even after having already completed one year of study. (This is an area where international students who are not native English speakers are likely to be even less positive about their abilities.) Nearly 60% of the students thought that resource use was an important factor in continuing their studies (see Table 2).

Table 2

Students' Perceptions of Their Ability to Use Resources

	Likert scale (highest to lowest, %)					
Resource use	+++	++	+-	- -	-—	na
Ability to use computers	34	43	15	7	1	0
Ability to use calculators	35	42	15	7	1	0
Ability to write essays	9	44	30	14	2	1
Ability to use lab equipment	17	46	30	6	1	0
Ability to use library	14	43	25	14	3	1
Importance of resource management skills	22	34	32	9	3	0

Students' effective use of these tools is essential and is likely to influence how students perceive themselves being able to fit into the science community. Ultimately, they not only need to be able to use laboratory equipment but also communicate their work effectively to peers and the public via papers and presentations.

Learning strategies

This section of the questionnaire was organised into three parts: one on individual learning strategies, and two about group work, examining students' perceptions of their ability to communicate in a group. The combination of independence and collaborative work skills are essential for scientists (Louis, Anderson, & Campbell, 2007). Typically, 1st-year science courses provide opportunities for students to work in groups during tutorials and laboratory classes. The demands of assignments and end-of-course examinations mean that students also need to be independent learners if they are to be successful.

Overall the results show that students feel confident in their ability to work independently. The significance of time management was reiterated, this time in relation to personal learning strategies (see Table 3).

Table 3

Students' Perceptions of Their Individual Learning Strategies

	Likert scale (highest to lowest, %)					
Learning strategies — individual	+++	++	+-	- -	-—	na
Confident in ability to meet deadlines	31	46	18	5	0	0
Confident in ability to organise time	11	44	33	12	0	0
Confident in ability to work independently	28	44	25	1	2	0
Importance of individual's learning strategies	25	39	28	5	2	1

There was a strong acknowledgment of the value of group work in laboratories and tutorials, with students placing slightly less value on working in study groups (see Table 4). More students felt confident in their ability to communicate their knowledge to others, compared to their confidence in seeking support from other students.

Table 4

Students' Perceptions of Their Group Learning Strategies

	Likert scale (highest to lowest, %)					
Learning strategies — value of group work	+++	++	+-	- -	-—	na
Value of study groups	12	43	31	8	6	0
Value of lab work	41	45	10	1	1	1
Value of tutorials	22	46	24	5	2	1
Importance of group learning strategies	19	41	25	11	3	1
Learning strategies — ability to do group work	+++	++	+-	- -	-—	na
Confident in communicating knowledge to other students	11	50	29	8	0	2
Confident in ability to seek support from other students	16	39	30	12	2	1
Importance of ability to work in groups	12	35	33	13	6	1

Given that the students who continue on to become scientists will almost certainly work as part of a team, their involvement in and mastery of the skills of collaborative work, in the context of debating and investigating science, is essential. The ability to communicate is important regardless of whether or not a student will go on to become a practicing scientist. However, it is arguably even more important for members of a scientific research team.

Students working in a laboratory

Laboratory work sets science and engineering subjects apart from many other disciplines. Students at the university involved in this study receive a substantial lab-based education. It was therefore important to understand how well the laboratory teaching met the learning needs and expectations of students. Students responding to the questionnaire felt confident in their ability to communicate with staff running the labs, and to seek their help when necessary. This was supported to some extent by the focus groups, although there was some concern that graduate students assisting in the labs were not always chosen for their teaching skills. Focus group members placed high value on the presence of academic staff in practical sessions:

> I like it if the lecturer is there because you can ask them questions, 'cause your labs are always relevant to your lectures and you can ask them and you can say, "Aah that's what you said in class". And then you can get more personal with them as well. And it's not just a person in front of your lecture but a person you can actually talk to yourself.

While lecturers may not be available to teach all laboratory classes, teaching staff need to be prepared with the necessary content knowledge and pedagogical strategies (Wright, Sunal, & Day, 2004) and this would seem as important as aligning labs and lectures to provide pathways of continuity, coherence and connections to students (Cowie, Moreland, Jones, & Otrel-Cass, 2008).

The focus groups also identified the need for lab classes to have clear achievement objectives and for clear links between lecture and lab content:

> If they can pull out the learning objectives to tell you what you are trying to achieve so you see a reason for being there. I think that's pretty essential in these labs.

This last point has bearing on the need to help students see the 'big picture', which is discussed later. At the same time the focus groups made it clear that, overall, students enjoy and value the time they spend in practical classes. This was particularly the case when practical classes were doing project-style work with a clear aim. This made the work purposeful for them, and their teamwork was more focused on drawing on individual strengths and was subsequently perceived as being more authentic.

> As part of a team and following through from design right through, ironing out problems along the way.

Studying science in tutorials and lectures

Focus group students, as well as questionnaire respondents, were very conscious of the value of tutorials and stressed their importance as a strategy for successful learning. The students' advice could be taken into account by strongly promoting the value of tutorials in all first year papers.

> Yeah they [tutorials] are good. I think some people don't take advantage. They didn't realise how good they are but I went to most of them. They are just so good.

> If you want to be an A student or you are struggling tutorials are a fantastic resource.

Overall, students felt less confident in their ability to take useful notes — in both labs and lectures — and to access information that they might have missed in class. Just over a third (37%) were unsure about, or lacked confidence in, their ability to use laboratory equipment. For a significant minority (36%) these factors played an important part in their decision to continue with their studies.

Students generally feel capable of the study requirements when they attend lectures. In addition, they respond very positively when they perceive lecturers as placing high value on their teaching: in this context students recognise that the lectures are not a 'necessary evil' but provide up-to-date information that is otherwise not available to them, and extends their learning beyond what is available from textbooks. However, it was noted that the aims and purposes of a course need to be made clear to the students, and that ad hoc information that is not clearly connected to the content becomes an obstacle to learning.

> We had a course outline lecture notes and that and that was really helpful as well. You had lecturers who very much stuck to what was in there and they probably expanded on that and that was very cool. And then you had those where it sort of went off on a tangent and I didn't find that very easy to follow and that happened in an area I was weak in anyway. So it was even harder.

Staff attributes

Wilson, Wood and Gaff (1974) and Wilson et al. (1975), (as cited in Lau, 2003, p.133), identify several staff-specific factors as playing an important role in maintaining a supportive learning environment. These include one-on-one work with students, being accessible outside the classroom times, including targeted learning activities, providing feedback, being personable and approachable and taking initiatives (p. 133). Student perceptions of staff attributes and abilities may influence their enthusiasm for the subject, the decisions they make about which papers to study and possible future careers and — crucially for recruitment and retention — the feedback they provide to others. The need for support and encouragement from staff in tertiary institutions has been highlighted, particularly since universities have become market-oriented (Pritchard, 2005). In this study, over one third of respondents (37% and 40% respectively) were neutral to very dissatisfied with this area of the tertiary learning environment, while over half of all surveyed students felt happy about their teaching staff.

Table 5

Students' Perceptions of Important Staff Attributes

	Likert scale (highest to lowest, %)					
Staff attributes	+++	++	+-	- -	---	na
Satisfied with staff interest in students' needs	30	46	17	5	1	1
Satisfied with versatility of teaching approaches	31	31	30	5	2	1
Satisfied with staff catering for diverse needs	23	36	32	5	3	1
Importance of staff attributes on continuing with study	35	38	19	2	4	2

Students in the focus groups frequently commented that lecturer interest and enthusiasm made it easier to engage with the subject, and personal stories not only provided information about potential career paths but also increased student motivation. They all felt that lecturers should be passionate about and promote their subject:

> Some lecturers are really interested in what they are teaching and they are interested in teaching it and that makes it a lot easier than the ones who aren't — those are the hardest courses.
>
> One of the best [experiences] that I loved was how they give examples. You know, really amazing little things of weird little animals you never even knew about and you can actually go home and tell people, "Oh I learned this today" and that's really cool. I always tell at home what I learned and why things happen too. 'Cause I didn't know anything. I knew nothing in science and now I can talk about stuff.

Lecturing staff can also influence students' attitudes towards particular fields of science as potential career options. One student specifically commented on the importance of motivating students to go on to graduate and postgraduate study, noting that 'otherwise there won't be any students to Masters or a Doctorate and become lecturers'. However,

> . . . if they can promote themselves and . . . say this is actually an exciting field and you can do so much and when you leave university; these opportunities are available to you if you work in this direction; [this] is why some of the courses are there. You come out thinking wow this is really something that I [could] get interested in. Just because he spent these lectures describing what we will be learning, why we are doing it, and where it will take us.

Focus group interviews indicated that by the time students reach their second year, one of the things they are doing is assessing what it means to be a scientist in a particular discipline, and whether or not they want to be such a scientist. Their classroom experiences, and the attributes of teaching staff, were said to play an important role in this decision. Lecturers served as role models for what it meant to be involved in a particular field. One student explained:

> Yeah because we want to be kind of like them when we finish. . . . we really think about [this] . . . so it's really kind of cool to learn you know what they are doing cause we will be at that stage you know one day.

This student focus group commentary is consistent with OECD findings (OECD, 2006) that identified the importance of 'having direct contact with professionals' (p. 9) in influencing students' interest in potential career paths.

Students explained how much their choice of papers was influenced by their perception of lecturers. One focus group noted that they had asked both undergraduate and graduate students for advice on which papers to take.

> . . . when you have options you say these are the courses I ought to be doing and nail it down from there. Which ones are the ones [where] I actually am going to enjoy being there, because if you enjoy it it's a lot easier to learn. And when it comes down to a choice of two papers and everyone says, "Yes we did that and it would be handy", but everyone hates it, or "This one is really handy as well but everyone loves it and it was really great", you are going to take that one.

In addition, students noted the benefits of lecturers' teaching styles and of teachers being explicit about how content material fitted into the 'big picture' of the sciences.

> I liked the linkages. I enjoy the learning as a whole and the different examples . . . and seeing the links between things and how it all fits together. And so as you go through from one lecturer in chemistry and then to physics which will link to something in biology which links with something in the earth sciences and it all comes together.

The questionnaire showed that most students were confident in their ability to communicate with teaching staff (73%) and to ask their advice (75%), suggesting they perceived staff as approachable. Seventy per cent of respondents felt that these factors were important, or very important, in their decision to continue with their studies. Similarly, they felt that school staff provided up-to-date information in their fields of study (79%) and were fully informed about available support services (66%).

Table 6

Students' Levels of Satisfaction About Information Provided by Staff

	Likert scale (highest to lowest, %)					
Staff information	+++	++	+-	- -	---	na
Satisfied with staff providing up to date information	37	42	17	2	1	1
Satisfied with staff knowledge of support services for students	27	39	26	5	2	1

Students in the focus group stressed the importance of lecturer enthusiasm for their subject and their interest for passing on their knowledge.

> Good lecturers must be passionate about their subject and must be able to promote it. . . . Teach the lecturers how to teach.

Research reports that innovative university teachers may include formative assessment strategies like constructive and effective feedback, while acknowledging the challenges of doing so, as well as the importance of greater student tutor/lecturer exchange (Hounsell, McCune, Hounsell, & Litjens, 2008, Yorke, 2001). These recommendations were echoed by the participants in this study.

Assessment strategies

Assessment strategies in tertiary education have seen huge changes over the past decade or so (Brown & Glasner, 1999, Bryan & Clegg, 2006). Understanding assessment requirements is an important coping strategy for being successful. Results from the questionnaires showed that students felt quite happy with the level of information they received from the school, with 60% stating that information about assessment issues is an important issue for them.

Table 7

Students' Perceptions About Receiving Assessment Information

	Likert scale (highest to lowest, %)					
Assessment regulations	+++	++	+-	- -	-—	na
Confident that they will receive sufficient information	24	52	20	2	1	1
Confident that they will be informed about consequences	29	42	23	3	2	1
Importance of assessment regulations	22	38	27	7	5	1

Results from the questionnaires indicated that returning students have a strong intrinsic motivation to succeed with their studies. They recognise that to be successful they need to be capable of independent hard work, although they also see the value of peer support. This is particularly true for mature students, who appear to have high expectations of their courses and their progress — and who also expect value for money in terms of teaching quality and support for their learning.

Discussion

Tertiary study is a journey marked by a number of transitions, beginning with the change from secondary to the tertiary level and then from the first to the second and subsequent years of study. At the end of their formal education university graduates are expected to have developed the knowledge, skills and personal qualities that will allow them to gain meaningful employment and contribute to society. These expectations pose a considerable challenge to universities as they struggle to meet the needs of an increasingly diverse group of students in times of declining resources. While universities set up support services to address students' needs, this research suggests there may be a need to address faculty-specific issues. Studying science and engineering comes with specific issues that relate to the content and context of the study.

In this study the feedback from the questionnaire indicated that returning 2nd-year students felt that they were generally confident in their ability to cope with their science studies. This was also supported in the focus groups, where students were able to describe the skills they believed necessary for success in their studies in more detail, such as the ability to recognise the main objectives of a course (although they also commented that this was easier with guidance from lecturers). This supports findings from research elsewhere identifying student–lecturer relationships as important factors in retaining students in their chosen field of study (Lau, 2003). Such confidence is, of course, to be expected, given that these students had succeeded in their first year of study and decided to continue into second year. However, analysis of the questionnaire showed that there is a significant minority of returning students who are unsure or not coping with issues such as course workloads and academic writing skills. Communicating in science means an acquisition of science literacy skills, which is different from everyday use of language (Parkinson, 2000; Lemke, 1990) and this may become a particular obstacle when a student's first language is not English (Zeegers, 2004). This adds another layer of difficulty with regard to workload, including time spent on the preparation of assignments. This study also showed that time management is an important factor for science students, due in part to the time required for laboratory sessions. In at least some instances, these factors and how to manage their demands had some influence on students' decisions to return to their second year of science and engineering studies.

In general, students expressed the need to be reassured that they are valued, and that their education is taken very seriously by the institution and their lecturers. Student commentary suggests this can be achieved by strengthening the efforts of staff to personalise lectures, having lecturers attending laboratory classes, and ensuring that tutors are adequately prepared. This means that teaching staff should not just cover the content, but take other actions such as offering opportunities for students to ask questions during lectures. Students put much value on lecturers' being sensitive by ensuring personal contact and monitoring how students are coping with workload issues. This is not to say that some lecturers do not do this already, but rather that the student perception is very much that not all lecturers are so concerned with their learning. This student commentary is reminiscent of research that highlighted the value of staff and student relationships, particularly since the introduction of fee-paying tertiary systems (Pritchard, 2005). Tertiary providers are being cautioned that as they focus on globalisation and market trends they may be perceived as paying less attention to traditional values in tertiary education, including an interest for students and a demonstrated close relationship between research and teaching (Pritchard, 2005). While students may be aware of, and sympathetic towards, the increased demands on lectures to conduct and publish research they consider, not unreasonably, that universities and individual lecturers have an obligation to provide effective learning opportunities.

Universities cater for diverse groups of learners, and as a result it is impossible to make an objective judgment of, and meet, each individual's needs. Increasingly, 1st-year university students have different language backgrounds, diverse prior knowledge, and a range of existing personal commitments. Not all students begin their tertiary study with the goal of continuing onto a career as a research scientist, and pathways may change along the way. However, if students can see that institutions and their staff understand the needs and requirements of students studying within the field of science, and implement strategies that demonstrate good teaching practice, those students are more likely to have positive perceptions and experiences of study and of science itself.

A concern for informed and subject specific teaching approaches should, ideally, be supported through policy guidelines. While universities around New Zealand have a broad commitment to excellence and innovation for teaching there is a lack of subject-specific guidelines. Accountability systems, like course appraisals, should reward and honour teaching and learning practices (Skilbeck, 2001), particularly to identify subject-specific teaching achievements. The 1997 OECD report on 1st-year university teaching experiences noted that stronger leadership is needed at both the national policy and institutional levels to challenge the academic community to think more deeply about teaching, how learning happens, and curriculum, in relation to student learning in both the short term (gaining a degree) and longer term (being productive citizens). While high-level leadership is important, it is also desirable that departments incorporate structures that enable dialogue and consultation to foster and support more personalised and subject-specific teaching and curriculum development. Such moves would strengthen existing good practices and support staff in expanding their pedagogical knowledge in their field of expertise. Lecturer and student satisfaction with teaching and learning are likely to benefit from an environment that supports the notion of learning grounded in mutual interest in the subject. Lecturers who demonstrate interest in their own work are likely to spark a similar interest in their students.

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