

# Causes of attrition in first year students in science foundation courses and recommendations for intervention

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## Abstract

This paper identifies research work undertaken in 2002 that examined the notion of why first year students leave university. Utilising a case study approach, this research identified students enrolled in three foundation year courses in science. To demonstrate the context of attrition at a regional university, student data were extrapolated and examined. Difficulty arose when defining the parameters of attrition as processes to enhance retention became fuzzier. The social and educational influences surrounding attrition were considered an important factor in persistence of academic work and study. The paper reinforces the seminal work done by Yorke (1998), and through recommendations identifies the interrelationships among the institutions, its staff, the pedagogy and student responsibilities within the learning journey.

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## Introduction

This paper examines research on a cohort of first year students enrolled in three foundation science courses conducted in 2002 at a regional university and questions the issues of attrition from macro and micro levels within the institution. From this exploration the paper seeks to find solutions that may be helpful to those involved in the first year experience. Whilst the paper aims to place student attrition within an institutional context, it also hopes to highlight issues at the local level where there is potential for improvement that would result in better outcomes for all stakeholders.

## Literature review

This literature review has two areas of focus. Firstly, it explores how responses to student attrition have become an institutional imperative; secondly, it considers those studies which have attempted to highlight outcomes-based strategies to ameliorate this. Undertaking studies of this kind illustrates the need for institutional research that analyses the complexity of attrition in order to persuade others that student attrition must be treated as a strategic issue.

In Australia, the system of government financial support for universities is in the form of the Higher Education Contribution Scheme (HECS). Basically, the government funds the institution using a formula based on expected and reported student numbers into each program of study. Enrolment figures are reported to the government at defined census dates each year. These numbers are used by the government to determine the funding distributed to the institution. If specified enrolment numbers are not reached by census date, the government reduces the funding allotted for a given program. The reduction is based on the enrolment shortfall. If a student withdraws following the census date, the institution retains the funding allotted even though the student does not benefit (Department of Education, Science and Training, 2005). Obviously, there are a number of factors that can cloud this issue; these are discussed later in this paper. It is important, however, that the reader has a basic understanding of some of the financial connections related to HECS and how institutions are funded.

The central focus for administrators in terms of viability and sustainability is university funding. Most researchers agree that a major dilemma for higher education institutions is that governments are increasingly making universities and colleges accountable for the finances that they receive from state coffers (Marginson & Rhoades, 2002). Yorke (1998, 2004) agrees and comments that institutions should be held accountable for their attrition rates as it is a loss of output in both human and monetary costs. This could be considered an economic rationalist perspective and one that drives universities to address student attrition from an enrolment perspective instead of taking a more holistic approach and addressing it as a student learning journey experience. This latter approach involves considering the social context as well as the learning context of students, including how students are instructed.

There are numerous studies which seek to place attrition within an institutional context and which discuss strategies (of varying success) that address the problem. Kember and McKay (1996) and Marginson and Rhoades (2002) comment that the educational strength of a university can be monitored only using multiple strategies. One of these avenues must be the examination of an institution's attrition rates. In that regard, one must then employ an analysis of the key factors which affect a student's decision to withdraw. One factor that is integral to this issue is the role of teaching.

Tinto (2005) as a seminal writer in this area explored the characteristics of student persistence in terms of "classrooms as communities". Tinto felt that there was not adequate documentation available relating to the critical linkages among classroom involvement (that is, the learning context), student learning and persistence. He asserted that a student's academic experience occurs within the broader social environment of the university and he concluded by suggesting that institutions make moves to operate their classrooms as places of both academic discourse and social interaction. He went on to hint that this provides a support system which addresses both the academic and the social concerns of every student involved and should ultimately lower attrition rates within these institutions.

In addition, there is a link between the quality of teaching and academics' perception of their jobs. Practices in higher education are often strongly influenced by conventions to which academics become so accustomed that perspective is lost (Kember, 2001; Kember & Kwan, 2000; McInnis, James & McNaught, 1995). Kember (2001) continues, suggesting that there is a need for some staff within these institutions to undergo a "perspective transformation", reaching a state of self-realisation where they transform their reality to that which includes the

students and their circumstances. Wallace (1999) reinforced this by commenting that staff lean towards the traditional view that students have to do all the adapting and that staff appear to assess teaching in terms of its abstract worth and its potential rather than its actual effectiveness. Clearly staff need to be encouraged to change some of their behaviours to a more student persistence-friendly mode.

Muldoon (1999) addressed student attrition by encouraging staff to participate in an annual training program before the arrival of first year students. Muldoon notes that staff are made aware of existing support programs and services and advised on why, how and when to refer students to these services, and when and how to devise alternative or complementary measures of support. This means that they provide immediate assistance to those students who may be 'at risk' and therefore encourage persistence before they get a chance to drop out. Placing teaching quality as a principal objective of improvement strategies will enable the institution to improve all of its support strategies for students through heightened levels of awareness and knowledge by its academic staff.

Yorke (1998, 2004) comments on how the culture of the discipline impacts upon the student experience and in some cases on the decision to leave. He suggests that there is always a tendency for one to take one's own disciplinary perspective for granted and not to question how it might affect those who are not yet members of it. Kochan and Pascarelli (2003) comment on the use of mentors to improve the student experience as a remedy to improve the disciplinary and university connection.

## **Case study approach**

The research conducted used a case study approach. To explore the case required obtaining a range of information compiled from a number of different perspectives.

### ***What is attrition?***

At a regional university a group of researchers including lecturers, students, counsellors, course advisors and student administration staff came together to examine the issue of retention and possible reasons for attrition in first year students. This case study involves a student cohort enrolled in three first year science courses offered in science and health degree programs within the university. All research members had their own anecdotal accounts of reasons as well as hypotheses why students make decisions to leave in their first year of study at university. Members of the group realised that their interest in attrition not only was founded in an institutional economic imperative but also reflected their personal concerns for student achievement in their learning and teaching.

Using the principle of shared wisdom, the group gathered together to brainstorm issues by highlighting and prioritising common factors in attrition. The group set about discovering some of the reasons why students make decisions to leave. It should be said here that the research team was interested in attrition (as a negative outcome of the experience) rather than focusing on retaining students. In a meeting during the early stages of the research, discussion centred on establishing a definition of attrition that would help frame the parameters of the research. In searching, the definitions used for attrition are listed in Table 1.

**Table 1: Attrition definitions**

- |  |
|--|
| <ol style="list-style-type: none"> <li>1. Students withdraw from courses – microlevel</li> <li>2. Students cancel their program of study – macrolevel and accepted for DEST reporting</li> <li>3. <i>Other Forms of Attrition Identified:</i></li> <li>4. Students who withdraw completely in courses but do not cancel</li> <li>5. Students who fail and do not withdraw (because they left the institution or failed to obtain marks to achieve a pass)</li> <li>6. Students who were offered a position and did not accept</li> <li>7. Students who accepted the offer and did not complete their enrolment</li> <li>8. Students who accepted the offer, enrolled and did not show to classes (these students would then be classified as Absent Fails and fit the criteria mentioned above)</li> <li>9. Of questionable nature are those students who do cross-institutional transfers for more suitable courses.</li> </ol> |
|--|

Source: Collated from Department of Education, Science and Technology (2004) (<http://www.dest.gov.au/NR/rdonlyres/8A245011-4F59-4D99-9D97-A1AD89D0C669/1043/1.pdf%3E>) and from staff in student administration

Students who transferred between courses and from program to program within the university could also be tracked in the system and thereby were not considered a ‘loss’ in the form of an attrition statistic. It can be seen from Table 1 that there are many forms of attrition adding to the complexity of the issue as there are many routes students take when they attrite. These various forms obviously blur the issues of attrition and retention. This case study could not identify all issues of attrition mentioned above; however, it has focused on (1), (2), (3), (4) and (7). Those remaining situations of attrition are related to enrolment issues and, although they were identified and considered helpful to the student administration group, they were considered separate from this case study.

From these definitions, the research team was able to decide the process of identifying key times that students may attrite. The team identified three foundation year courses (in one term) containing a large cohort of enrolled students. Within these courses there are compulsory laboratory times where class lists are taken weekly. From these lists students could be tracked and their progress monitored. The lists were examined every fortnight for patterns of attendance. When attendance lists identified continuous non-attendance, students were telephoned and interviewed. The interview consisted of open-ended questions about their situation. It was found that the responses were similar to those identified by Yorke (1998). The primary reasons for non-attendance were:

*Personal student issues - social and financial:*

- The issue of isolation from the student group through lack of, or poor, interaction in the induction phase to university
- Issues of being away from home and having to deal with a new environment
- The issue of accommodation and finding suitable lodgings
- The issue of transport – buses not running in the evenings for late classes
- The financial issue where the cost of living and establishment costs for university were more than the students anticipated or even knew how to plan
- A lack of knowledge about accessing institutional financial assistance.

*The program of study:*

- Not being what the student thought it was going to be

- The student enrolling in a program arranged by the parents of the student
- Workload of the program and courses within it
- The issues of new knowledge and little pre-requisite knowledge
- The issue of assumed independent learning when previous educational experiences did not promote this
- Not knowing student peers for support in program
- Fear of lecturers as not welcoming, sometimes punitive in comments
- Timetable too difficult to understand.

More specifically, the features listed below arose from the tracking and monitoring:

1. The timing of assessment pieces in any one course
2. The combination of the number of assessment pieces due in any one week
3. The HECS deadline or census date as a distracter to completing assessment items.

For the research group, these were obvious issues that needed to be investigated at the course and program levels. However, there were still those students who did not attend classes for other reasons (age, gender, geography, mode of study, skills, prior knowledge, and attendance patterns, to name a few variables).

When questioned about various issues with the program, members of the research team felt that one of the major contributing factors that students identified was the timing of assignments within the individual course and the combined impact within the student's program of study. Whilst it is not feasible to provide assessment timelines for every degree that has students enrolled in these courses, an example is given that demonstrates this point. A student who is enrolled in a biology degree would be required to enrol in four courses, two of which were those under study: Biology and Chemistry. It is important to bear in mind that students have a variety of other courses to choose from where a full study load is four courses. Students would be required to submit weekly laboratory reports for both Biology and Chemistry. When combined with other assignments and examinations in four courses, this adds up to a workload considered by the research group as large. Work demands, being new and adapting into an environment that is unfamiliar to a student create additional stresses. It is easiest to understand this situation when it is viewed in Table 2.

When combined with other science-based courses for the program of study like Biology, the number of laboratory reports, assignments and exams would to the average student show at least two to three pieces of assessment every week during term. The stress and strain of attendance, along with the psychological, sociological and economic factors, illustrate how attrition of students could occur with such timelines.

### ***Who are the students?***

In examining the reasons for students making decisions to stay or leave, the research went further to investigate some of the background student issues. This involved analysing demographic data. Following this, the research discussed the findings that led to recommendations of both a broad and a comprehensive nature which may have a positive impact on retention rates.

**Table 2: Assessment pieces and due dates**

<b>Date</b>	<b>Assignment and Exam Dates</b>
Orientation Week	
Week 1	Nil
Week 2	Biology Laboratory Report Due Chemistry Laboratory Report Due
Week 3	Biology Laboratory Report Due Chemistry Laboratory Report Due
Week 4	Biology Laboratory Report Due Chemistry Laboratory Report Due
Week 5	Biology Laboratory Report Due Chemistry Laboratory Report Due Chemistry Assignment 1 Due
Week 6	Biology Laboratory Report Due Chemistry Laboratory Report Due Biology Assignment 1 Due
<b>CENSUS DATE</b>	
Week 7	Biology Laboratory Report Due Chemistry Laboratory Report Due
Week 8	Biology Laboratory Report Due Chemistry Laboratory Report Due Chemistry Assignment 2 Due
Week 9	Biology Laboratory Report Due Chemistry Laboratory Report Due
Week 10	Biology Laboratory Report Due Chemistry Laboratory Report Due Chemistry Assignment 3 Due Biology Assignment 2 Due
Week 11	Biology Laboratory Report Due Chemistry Laboratory Report Due Chemistry Assignment 4 Due
Week 12	Biology Laboratory Report Due Chemistry Laboratory Report Due
Course Review Week	Nil
Examination Week	Examination for all courses

### **Student demographics within the courses**

Student demographics are an important aspect of any attrition study, as they allow the researcher to be able to gain an overall perspective of a student's decision whether to withdraw. Of the student numbers analysed, 51.8% were female and 48.2% male. This accorded with the university trends of enrolment by gender. The average age was 24.75 years for women and 26.0 years for men, with an overall average of 23.6 years. The overall range of ages was between 18 and 58 years.

### **Student attendance by mode of study**

The mode of study within the courses was either internal (full-time and part-time) or external (flexible). These figures are best considered within Table 3.

**Table 3: Mode of study**

Course Name	Mode of Study		
	Internal full-time	Internal part-time	External
Biology	63.9%	7.4%	28.7%
Chemistry	57.0%	10.6%	32.4%
Introductory Science	87.0%	11.3%	1.7%

Note: The external figures for Introductory Science were viewed as negligible and will not be counted within discussions of attrition by mode of study. Introductory Science was not offered as an external course although student numbers were logged in the system as such.

### Student OP Averages

Of those students analysed, only 41% had Overall Position (Tertiary Entrance Position ranked by the Queensland Tertiary Admissions Centre) from 1 to 24. The OP placement of 1 fields the best performing students and 24 the weakest. The average OP for the student cohort in this study was 11.75; women had an average of 11.05 and men of 12.6. The remainder of the cohort was admitted to the university through mature age entry or alternative entry criteria. Pre-requisite requirements for entry to science were required. Therefore school leavers were required to have undertaken high school science. Interestingly, this pre-requisite was not required for mature aged and alternative entry students unless they obtained an OP ranking. Given the average age of students highlighted earlier, this was seen as an attrition factor.

### Attrition rates of the cohort within this study

Once the definitions of attrition were known to the research group, they began examining the selected cohort from a number of angles. The first of these was attrition within the courses up until census date, excluding those students who withdrew because they had been granted exemptions). The group then stated the total attrition rate, which included those students who withdrew from the courses after census date combined with those who withdrew beforehand. Finally, the group described the attrition rates by mode of study for Biology and Chemistry to illustrate variation between internal and external studies. The results are presented below in graph format:

**Figure 1: Attrition rates**

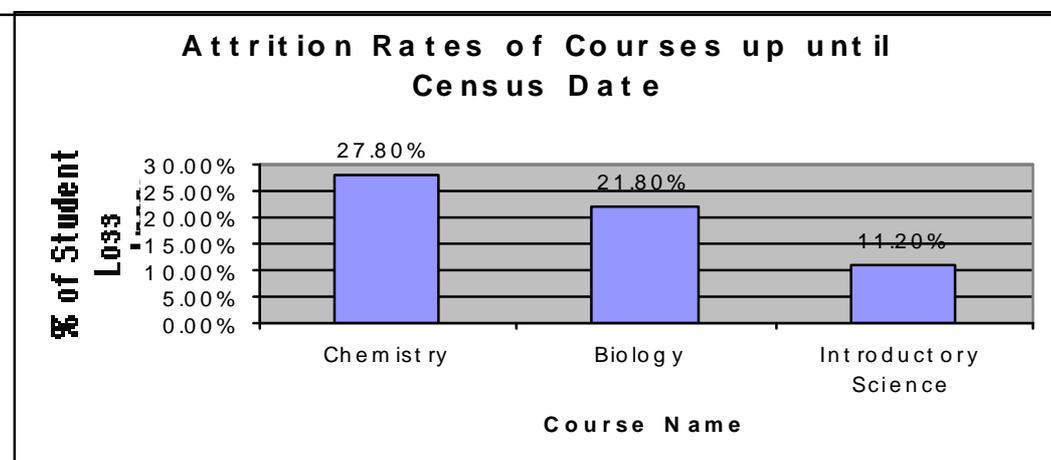


Figure 2: Total attrition

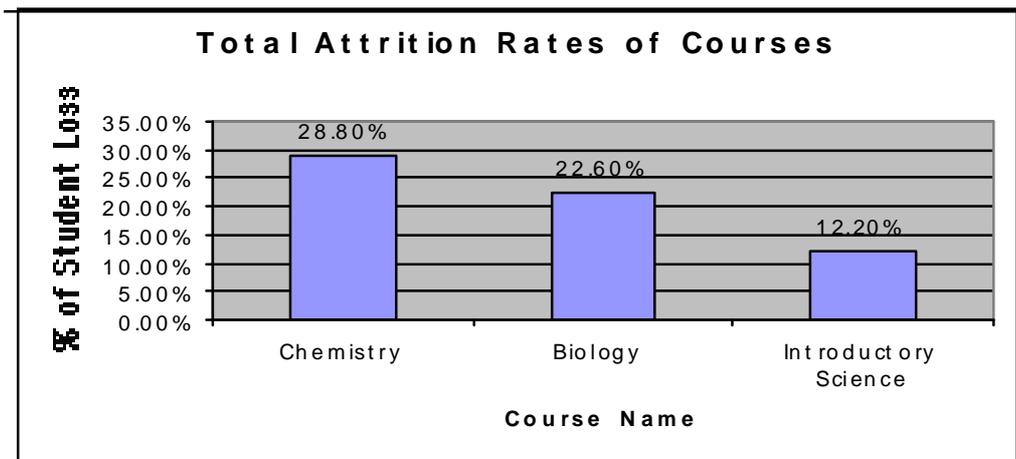
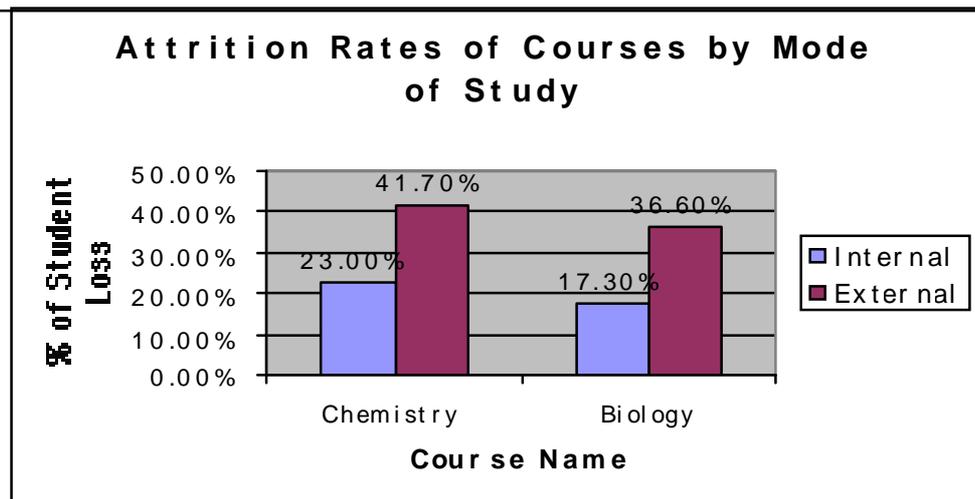


Figure 3: Attrition rates of course by mode of study



## Summary of findings

The literature review of this paper stated that it would discuss attrition within the context of financial issues and improved institutional strategies. It is felt that the data gathered around student attrition have demonstrated that there is a definite need to address issues of attrition and retention from those perspectives. The presentation of the student statistics above highlights the need for the university to address immediately attrition and retention as a strategic issue and a consequence for the long-term success of the institution, as identified by McLaughlin, Brozovsky and McLaughlin (1998).

### Student issues in this case study

#### Age and gender

One issue that has relevance in terms of attrition rate is the demographic data of students studying at the institution. It was found that the average student age did

not support the notion that there was a dominance of school leavers, suggesting that the university should be more inclusive of student issues from a mature aged student perspective regarding information on pre-requisite knowledge and recruitment. It was also found that there were more women than men enrolled in the courses. These data concur with those of Wallace (1999), who discovered that nearly one quarter of females attending university had dependents, and of these nearly half were the sole caregiver. This finding has enormous significance for helping to explain university attrition rates, as it implies an influencing factor in many students' decisions to withdraw from university.

### **Mode of study**

The mode of study that a student chooses is often undertaken without prior knowledge of the implications (Carr, 2000; Morgan & Tam, 1999). This is particularly relevant to those students who choose to study by distance education. It was found that student motivation in the distance education mode was required to be higher than in a traditional face to face context (Morgan & Tam, 1999). Therefore the issues explored by Yorke (1998, 2004) – such as the workload of the program and the courses within it, issues of new knowledge and little pre-requisite knowledge, issues of assumed independent learning when previous educational experiences did not promote this and not knowing student peers for support in program – are critical identifiers in the discussion of attrition and failure rates.

### **Pre-requisite prior knowledge**

The OP positioning of students indicated that there was a limited number of students who were school leavers or else who had applied for an OP. This meant that for those students using alternative entry criteria to gain access to university pre-requisite prior knowledge may have been assumed and not enforced for these science courses. The implications of such a statement mean that students may not have been prepared for the level of content information that is taught in these foundation courses. This is an additional stressor for students and was one of the attrition factors identified by Yorke (1998).

### ***Institutional and teaching issues in this case study***

The high incidence of attrition in these courses also suggests that there must be institutional factors that significantly influence these losses. Therefore one must dissect and identify the institutional factors that can influence students to leave. It would seem from the information gained from this research that the problem areas identified include:

### **Financial implications of attrition**

Clearly, the attrition data illustrate a major financial loss not only for these courses but also for the programs, faculty and university. The Chemistry course lost nearly one third of its students, the Biology course over one fifth and the Introductory Science course lost over one tenth of its students. The attrition rates for courses with internal and external students were also alarming. The data illustrate that student attrition before census date results in a financial loss to the university. If it is assumed that these students all have used the HECS option, this attrition rate equates to a loss of approximately \$100,000, and this is only over three individual courses in one academic term in one particular year. Extrapolate this notion to other courses and programs and the picture becomes clear from a financial perspective.

## Assessment

One would need justification from a pedagogical perspective for the considerable number of assessment items that exist in these science courses. While it could be argued that the laboratory reports are skill-based reports performed in groups, there seems to be a lack of cross-disciplinary communication about timing and volume of assessment pieces.

## Timetabling

From an adult learning perspective, the research identified difficulties in reading and understanding the timetable initially, yet there is the issue of attendance, particularly when there is limited public transport after hours. From the mature aged students' perspective as many have dependents, after school care and childcare become an issue. This situation becomes untenable when students are asked to make choices that involve night classes, especially for those single parents who have transport problems or have had to re-locate away from family and support networks.

## Teaching methods

One could make assumptions about the teaching methodologies when examining assessment pieces as much as gaining an understanding of the true reasons for failures, withdrawals and attrition. Not all attrition can be institutional or academic issues, yet there would seem to be some suggestion that Tinto's (2005) work on fostering a support network within the classroom needs to be examined. Further to this, academics need to shift perceptions and increase awareness of student issues by becoming more consumer-focused in their attitude towards the types of students enrolled rather than continuing practices designed for the types of students whom they want to be enrolled. It would seem that communication at all levels of the institution is important. From the data gathered students are unaware of their study commitments because of the complexity of the environment. It is not transparent or clear enough for the student without experience of higher education institutions to understand readily. It is also important to note that even staff within the university are not aware of the types of support services that are available to students nor do some see it as their responsibility to lead students to these services. While the issues need to be identified, it is equally important to provide recommendations.

## Recommendations

As mentioned previously in this paper, it is often assumed that to address issues of retention and attrition a unified approach is most suitable. However, it is felt that this need not be the case. There must be an approach where everyone takes responsibility for the problem of decreasing attrition rates. There are many improvements and interventions which can occur at a micro level which are just as important as those at the macro level. With this in mind, as well as recognising the fact that there will always be attrition rates within universities, the following recommendations have been made:

### *Student issues*

It is integral that every university knows its student cohort (in terms of age and gender, geography and other socio economic statistics). In fact, universities must go one step further than this and gear their recruitment, support and awareness strategies towards the diverse nature of these groups. If lecturers know the background of the students whom they have in their classes, they will be well

placed to approach the learning–teaching process more appropriately. In addition, if the university were able to predict accurately the types of students likely to be enrolled in particular courses, they could arrange the class timetables around these issues. For example, if a course has a high percentage of mature age students, and it is known that 25% are women who are likely to have dependents and 50% of those are the sole carers (as identified by Wallace, 1999), it would make sense to schedule the classes at a suitable time for those students or provide additional support if they are undertaking their studies externally. This would greatly lessen the life stress of the students by enabling them both to take care of their families and to complete their studies.

The types of communication between the institution and the individual student can become quite complex. It is suggested that this needs to be simplified, especially in terms of recruitment, pre-enrolment, enrolment, the induction process and the post-induction process. Students need to be able to understand what is expected of them, what they can expect and how they can obtain assistance or advice in language that they are able to understand. This means that the university should attempt to simplify the language in its written materials such as the handbook, the program and course information outlines. It also means that they should encourage all staff to have a consumer/client service attitude, encourage a responsive and easy access support service and help faculties to identify and assist ‘at risk’ students (once identified). The use of mentors is one excellent way to provide support in the learning journey from enrolment to post-induction. It is felt that a positive customer-focused institutional atmosphere will greatly improve student retention figures.

### ***Institutional teaching and learning issues***

The university must address attrition rates through a thorough review of assessment pieces and practices for all courses and each program. The assessment timetable for one program for one term (as described in Table 2) clearly indicates that there is a high demand on students in their first year of university. Yet it is felt that the assessment timetable was formulated without any cross-disciplinary communication and with minimal regard for the other stressful issues that students face in their first year of tertiary education. One could question the educational value of the volume of assessment described. Tinto (2005) asserts that the first year university academic experience occurs within the broader social spectrum of the university; this must be recognised when planning assessments for first year students. It should be said that this recommendation is not about reducing or simplifying to the point of valueless content; it is simply that staff need to examine what are the key attributes with which a student should exit from a course or more broadly from a program. Wallace (1999) suggests that “first year provides the main or only opportunities to invest students with the skills and literacy needed to succeed at tertiary level...that it cannot be presumed that these are already possessed” (p. 2). Therefore the university must encourage academics to prepare their coursework on the basis that students have differing levels of prior knowledge yet have the skills to build their knowledge rapidly.

It is well known that students need to have institutional support services available to them to help them persist with their studies. It is felt that, by encouraging a community type atmosphere in the classrooms and connecting with students by technology in the external mode, lecturers could facilitate a number of different support networks for their students through alternative approaches to teaching and assessment. Involvement with academics inevitably helps students to persist; as well, involvement with their peers enables students to experience both academic

discourse and social interactions with the same people. Personal contact, whether face-to-face, via telephone or electronically, should be encouraged.

The data also identified some disturbing trends in relation to the high percentages of attrition of students studying externally. This identifies the need for improved distance education support strategies, such as implementing a system of distance education mentors, and encouraging further utilisation of technology such as e-mail and the Internet. It also identifies the need for lecturers to take into account teaching and learning processes and methodologies that mirror sound distance educational practices.

One issue worth discussing is the development of staff awareness of support services. Obviously, when contact is made with these students, the caller should be able to offer some suggestions and advice about how to continue with study. As illustrated earlier in the paper, students were contacted and this contact was found to be of value to both student and faculty staff. This view is supported by Muldoon (1999), who notes "...that learning support and academic skills enhancement is accepted Australia-wide as a necessary adjunct to university teaching and learning...and is recognized as important not only in terms of student welfare but also in terms of institutional wellbeing" (p. 7).

## Limitations of the Research

The principal limitation of this case study revolved around the fact that the data presented are raw. In fact, the data must be considered unclean and unstable because of the system from which they were retrieved. This does not detract from the importance of the findings; it merely highlights the fact that one could not expect to reproduce these results accurately.

Furthermore, the research examined only three courses, and therefore cannot provide conclusive results related to university-wide trends. It also analysed courses in the science disciplines, which again could not be indicative of trends in all other disciplines, and it could negatively influence perceptions of science courses. Finally, the data provided are only a 'snapshot' of one academic term in one year. Obviously, all research conducted has limitations of some kind. It is felt that, whilst this case study had a number of inhibiting factors, once it is placed within the context in which it was designed, the data can be viewed as illustrative of the problem. The study identifies that more research must be done in this area and must result in recommendations that address problems that have become quite obvious.

## Conclusion

From this case study, it would seem that institutions need to reach a 'student-focused' perspective. The systems that can elicit information about student demographics should be made available to academic and administrative staff members (in easy-to-use formats) soon after enrolment for awareness and enhancement of learning and teaching practices. The university should make a concerted effort to simplify its communication to students and to develop in its staff improvements in pedagogical practices and increased awareness of support services. At the same time, students have responsibilities to be informed about the environment and program in which they are enrolled as well as the procedural aspects of the educational process. The data presented above suggest that for students there are many negotiations and practices that they have to undertake

successfully early in their learning journey if they are to survive the first year. The goal of any university is to retain students whilst providing a quality educational experience that has value for the student, the institution and more widely the employment marketplace.

## Acknowledgement

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