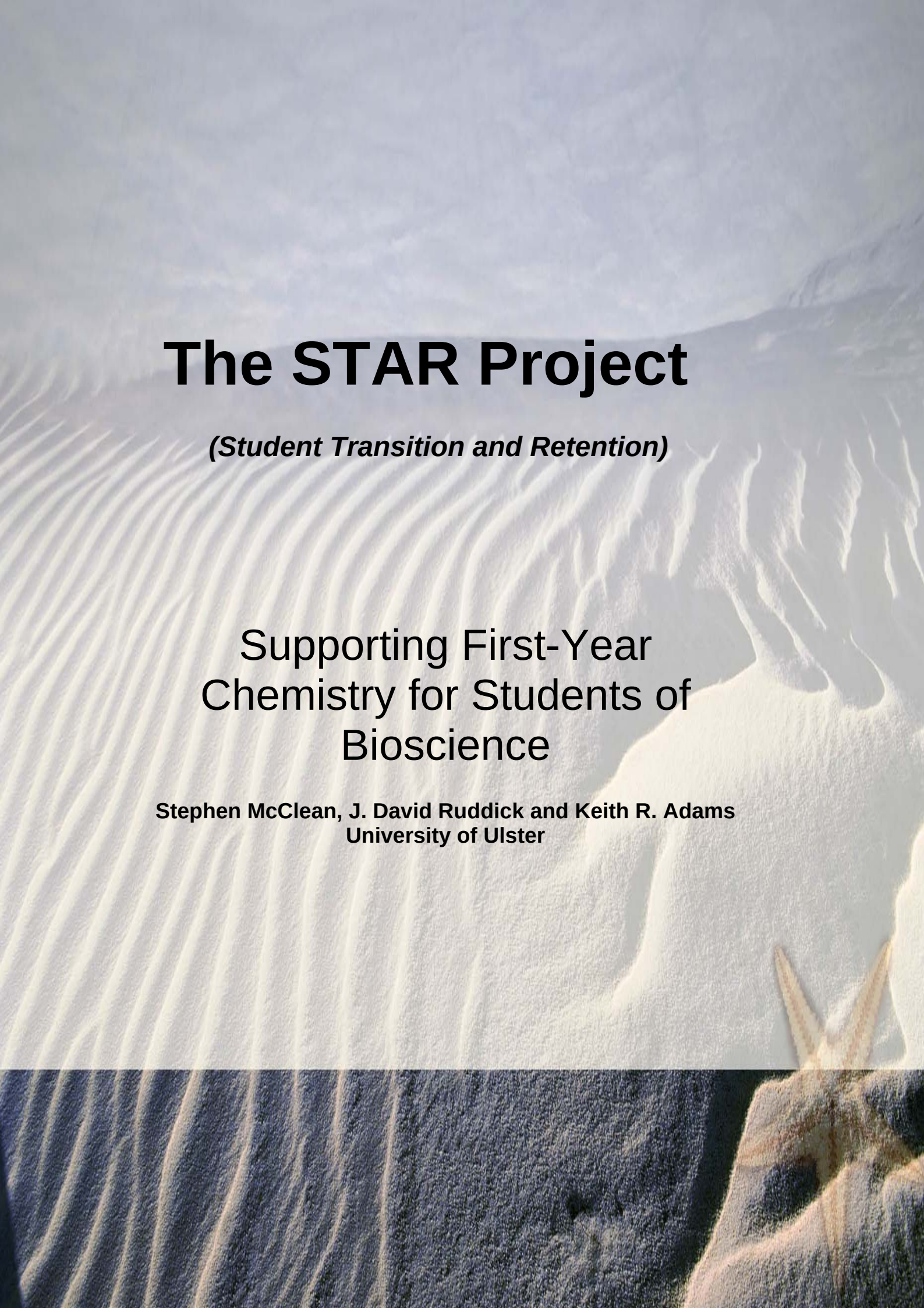

The STAR Project

(Student Transition and Retention)

Supporting First-Year Chemistry for Students of Bioscience

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SUMMARY

Bioscience students require a broad background in chemistry in order to underpin much of modern-day biology; however, differential performance in Chemistry A-level or its equivalent or even students entering bioscience without a Chemistry A-level qualification make the teaching of chemistry to such mixed-ability groups extremely difficult. A first year, first semester chemistry module taken by a very wide group of students (biology, biomedical sciences, dietetics, food and nutrition, human nutrition, molecular biosciences, optometry and pharmacology) has put into place a variety of mechanisms to support these students in a module where the students have traditionally struggled. These have included: printed handouts; regular, computer-driven summative tests (supported by practice questions); weekly assessment of practical work using standardised proformas; tutorial support with topics chosen by the students; and a web-based message board and text-messaging to improve communication. The students have welcomed these and course directors have also noted that there has been a marked increase in the general satisfaction with chemistry teaching. However, further enhancements are planned to continue to improve this element of service teaching.

Keywords chemistry, service teaching,

INTRODUCTION

Students entering university bioscience degree programmes are normally required to take one or two modules of chemistry to provide them with the necessary foundation in theory and practical skills that underpin biochemical or advanced chemistry modules. As more and more students are now entering university from a diverse range of educational backgrounds the level of chemistry that some have attained prior to enrolling may be negligible while others who have done well at A level chemistry, for example, may be much better equipped.

Many first year undergraduates find the transition from school to university difficult. Their difficulties include an inability to make adequate notes from

lectures and an inability to manage their study time effectively – in particular, they tend not to make a serious attempt to understand the material they are being taught until immediately before the examinations at the end of the semester. These difficulties are exacerbated when the class contains a wide range of students with different levels of background knowledge in the subject, since those students with little knowledge feel overwhelmed and those with much greater knowledge become bored with the earlier work and under-perform.

A solution to these problems was developed for the first year biological chemistry classes for undergraduates studying Clinical Physiology and Podiatry at the University of Ulster (Adams, Ginn and Ruddick 1998). The associated computer-based tests have subsequently been further developed into Question Banks (Adams *et al*. 2002, Adams 2003, Adams *et al*. 2004).

The techniques thus developed have now been applied to a large first year undergraduate class in Introductory Chemistry numbering around 160 students enrolled on a number of courses including biology, biomedical sciences, dietetics, food and nutrition, human nutrition, molecular biosciences, optometry and pharmacology. The module handout for 2005-06 is given in Appendix 1.

Since the 2003/04 academic year, an ever-expanding student support system has been evolving within the module which we perceive has led to greater engagement by the students in the module, a greater level of satisfaction with the support offered and an increase, if small, in the overall pass rates.

RELEVANCE TO THE STAR GUIDELINES

At its outset the STAR project researched, produced and published a set of guidelines (Cook *et al*., 2005) based on the causes of student attrition and which pointed the way towards possible good practice. The STAR guidelines relevant to this case study are:

3.2 The course and its delivery should assist students' transition from their previous educational experience to studying at tertiary level as well as addressing the different needs arising from the subject backgrounds of the student cohort.

3.3 Students should receive regular, formative evaluations of their work early in their course or course component.

3.4 Attendance at all teaching sessions is a key requirement for success.

4.2 Staff should recognise that expertise in ensuring appropriate support and guidance of students is as important as expertise in their subject.

4.3 Staff should seek to monitor their own performance in managing student transition through a process of focussed investigation, personal reflection and development and seek to communicate the outcomes to others.

THE PRACTICE

Teaching Support

The twelve-week semester was divided into three equal sections; the syllabus of each section was defined by a comprehensive handout that the students purchased at (printing) cost price. The handouts were illustrated with numerous diagrams and chemical equations, and had space in the margins for the students to make additional notes. Sample problems were included where appropriate.

The students were informed that there would be a computer-based test after four and eight weeks, to ensure that they had studied the first two sections. There was a paper-based test at the end of the third section.

To allow the students to familiarise themselves with the computer-based testing system (QuestionMark 'Perception'), practice questions were available at any time (over the Web) for the students to try out. These were of similar style to the summative tests (multiple choice, multiple selection, fill in blanks) and gave feedback for each question, but did not contribute to the overall coursework mark. We initially allowed the students to login anonymously to do these; we felt that it would encourage participation if there were no danger of silly errors being identified with particular students.

There were three 50-minute lecture periods per week, plus a weekly three-hour practical class that (as far as possible) covered material that was related to that week's theory. The practical results were recorded on a proforma before leaving the laboratory; these were returned with comments the following week. The lectures were used to give an overview of the main points in the printed handout, but the lecturer discussed the more difficult aspects (e.g. chemical equations and any mathematics) in detail. Since problem solving (including numeracy) is considered an essential skill, the lecturer went through most of the example types in the handout, giving the students opportunities to ask questions. There was an additional weekly one-hour tutorial class for a small number of students identified as needing extra tuition.

The summative tests contributed (with the practical work) to the coursework mark. For logistical reasons the class was divided into three groups who took the test in consecutive 50-minute supervised sessions. To prevent students logging in elsewhere (and getting unauthorised assistance) a password was only available from the supervisor in the computer laboratory and the test was restricted to a particular time slot for each student.

The results were available to the staff immediately, and could be released to the students the next day. Staff were able to analyse the performance of each

question and could make amendments to the scoring with immediate effect or amend the wording for subsequent use.

The module has a summative examination following the Christmas break. Since some students find the strange environment intimidating, the test at the end of the third section was a paper-based one held in the examination hall, but supervised by their lecturer. This, as far as possible, mimicked examination conditions right down to the style of answer booklet used by the students. The tests were then marked by the lecturing staff and returned a few dates later at a feedback session.

Student performance in the first year in which this module was run in the way outlined was better than in previous years (taught by traditional methods). However, it was felt that improvements could be made if the students were under more pressure to attend the lecture slots and if they felt that staff would know how much effort they had put into doing the practice questions. Accordingly, a lecture attendance register was kept (numbers in the lecture theatre visibly increased) and the students had to login to the practise tests using their identification number. A more regular pattern of study was also imposed by substituting four shorter scoring tests at 2-weekly intervals (the practise tests were subdivided to correspond with these). The test results and examination performance have again improved.

A downside of the reliance on computer testing is that virus attacks on the university's servers have sometimes delayed the processing of the tests, and in one case caused a test to be postponed for a week.

In addition, compulsory tutorials were introduced on a weekly basis for all students and based upon cohort group. As far as was possible, tutorials were student-led. An A4 page was circulated at every tutorial where students could anonymously list the parts of the course that were causing concern. These areas then became the focus for the tutorial the following week.

Common practice within the tutorial group was to consider one examination question per week that was relevant to the part of the course being studied at that time. Students, in small groups, were asked to prepare an overhead transparency with an outline of their answer to the question and the academic member of staff then fed this back to the group. Such an exercise provides useful examination preparation.

Early in the semester, students had been asked to complete a short survey on the module website regarding their previous experience of chemistry before coming to university. Those who had not studied chemistry previously or those who expressed concerns about the module were placed on an email distribution list and contacted periodically throughout the semester by the module co-ordinator as to their progress. This provided a useful communication tool for those 'at risk' students who may normally disengage with the module should they find difficulty with it.

RESOURCE REQUIREMENTS

Currently (the third year the test-driven module has run) there are 3 1 hour lectures per week during the semester shared between two members of academic staff who also share the three weekly 3-hour practical sessions. Two other members of academic/academic-related staff assist with organic chemistry practicals during the last three weeks of semester and there is also input from the Faculty Health and Safety Officer on Control of Substances Hazardous to Health (COSHH) and Risk Assessment. To support the practical classes a total of six postgraduate demonstrators are available during the sessions and they also mark the practical books to a prescribed marking scheme.

The academic member of staff responsible for the lectures also delivers the accompanying three compulsory 'small group' tutorial sessions each week throughout the semester. For these, as with the practicals, students are kept in their cohort groups as much as possible with each class having 70, 55 and 40 students corresponding to human nutrition, dietetics and food and nutrition courses; biomedical sciences, pharmacology and molecular biosciences courses; and biology courses respectively. Academic members of staff also administer the class tests (either written or computer-based); support in the administration of the module is supplied by other academic members of staff on a separate campus.

EVALUATION

Towards the end of the semester, module evaluation information was garnered from students. Module evaluation for that year (the second year the module had run in this format) revealed that students greatly appreciated the provision of written notes, online support material and tutorial support. There was also a general consensus that even more tutorial support would be appreciated. Casual student feedback to staff in terms of satisfaction with the module indicated that this had again improved upon previous years. A student focus group acknowledged that although there were support mechanisms in place some students still struggled and there was still work to be done in supporting students in chemistry teaching:

> "*It was tough to understand the material*"
>
> "*In school when we did something, we spent time on it, did work on it but here they just mention it and move on. We have to go and look at it and learn it ourselves*"

Nevertheless, some things do seem to be working. About the tutorials:

> "*When you're in a big lecture group it is very hard to put up your hand to say if you have a problem*"

> "*Yes, mine* [the tutor] *told us to write any problems we had on the back of the attendance sheet and that was good because you didn't have to say in front of everyone that you had a problem*"

and, the computer tests:

> "*It was a good idea, it got it over quickly*"

> "*For me it broke the material up into smaller sections. I found the module tough but it would have been even tougher if I had all the material to learn at once*"

and the practise questions:

> "*It was good being able to see the structure of the questions and get used to the way they looked on screen and what buttons you had to press and stuff.*"

and, on text messaging:

> "*We were texted reminders of when assignments were due and when exams were and if the lecturer couldn't make it*"

> "*It's always good to be reminded if assignments are due or if we have a test, just in case you forget*"

In addition staff within the School, particularly course directors, have noted that there has been a marked increase in the general satisfaction with chemistry teaching. A paper correlating the use of online practice questions with overall examination performance is in preparation.

These enhancements to the module have continued into the present academic year. In addition, the module website has been redesigned to provide further support to students in the form of a message board and an online coursework mark look-up facility. Communication with students has also been enhanced by using text messaging which is a fast and efficient method of reminding students of class tests, changes to the timetable, etc.

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THE CONTEXT

University of Ulster	• 4 campuses • 24,389 students • Undergraduate: 19,796 • Postgraduate 5593 • Full time: 16,821(15,397 UG, 1424 PG) • Part time: 7,568 (4399 UG, 3169 PG) • >3500 staff

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