



Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Report to Council on the Review of the TR071 Science Programme

2-4 December 2014

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TR071 Science Programme Review

External Reviewers' Report

January 2015

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Preamble

This report on the TR071 Science Programme was prepared at the request of the Quality Office, Trinity College Dublin. It was prompted by a 2012 review by the Irish Universities' Quality Board. That review recommended that all undergraduate degree programmes are evaluated to ensure that they meet quality standards and provide graduates with skills and experience appropriate for the needs of society.

The Review Panel convened in Dublin from 2nd – 4th December 2014 having previously been sent detailed documentation covering all aspects of the TR071 Programme. This report has been written using information obtained from a Self-Assessment Report, from interviews with academic, support and administrative staff and students associated with the Programme, with Faculty and College administrators, and from tours of teaching facilities.

The Review Panel was asked to investigate and comment on the following areas:

- Programme Structure
- Programme Administration
- Curriculum Quality - Teaching and Learning Methods
- Programme Resources
- Student Experience
- Specific Issues, other than the review process itself and the strategy for the future of TR071 are covered in these five sections.

Accordingly, following an Executive Summary, our report is arranged under these main headings.

There are a few general principles the Review Team had in mind as we made our observations and we ask that you consider these as you discuss our recommendations and considerations.

- Begin reflection by working back from the desired product: what does the College want the TR071 Science programme to achieve in terms of graduate attributes?
- Be realistic and unafraid to adapt to budgetary constraints: sometimes less is more.
- Identify and implement effective and efficient processes for decision-making and curriculum development at both the operational and strategic levels.
- Coordinate teaching activities of all years and all disciplines with empowered leadership.
- Seek genuine inter-disciplinarity and resist perpetuating options driven largely by Schools' sectional interests.

1. EXECUTIVE SUMMARY

The TR071 Science Programme is excellent in terms of its reputation, its multidisciplinary research-focused nature, the strong approval for it expressed by students, the quality of those students, and its alignment with current and future needs for graduates trained in science subjects. Likewise, the academic and support staff responsible for TR071 are excellent and committed passionately to the programme and to the students on it. It is understood that it is important to retain these qualities, and our recommendations are intended to assist with that.

The main threats to TR071 are a severe lack of resources (dwindling operating budgets and teaching facilities exacerbated by an increasing student intake with consequent risks for quality and sustainability) and serious operational inefficiencies (most notably a chaotic timetabling system, poor IT systems, over-teaching, and management structures unfit for purpose).

The Review Panel's **six main recommendations** are to:

- 1.1 **Re-structure the course management** of TR071 to increase coordination and communication by: (a) giving the Science Course Director Dean-level authority over TR071, associated Direct-Entry courses, and support units (along with significant budgetary control and representation on key Faculty and College committees); and (b) creating a compact Science Course Executive to replace the current unwieldy management committee to oversee quality, content and timetabling.
- 1.2 **Streamline teaching** across the whole programme by: (a) reducing reliance on traditional lectures to release staff and student time; (b) increasing the use of virtual learning environments; (c) rationalising content among modules; (d) promoting a wider range of final-year research projects that do not necessarily demand lab facilities; (e) involving library and learning support staff in developing innovative curriculum content; (f) allowing/encouraging more self-learning, critical thinking and development of other transferable skills among students.
- 1.3 **Change the course structure of the TR071 Programme by introducing streaming** to allow greater alignment between student intake and Moderatorship choices, better coordination between TR071 and associated Direct-Entry courses (which for marketing purposes should nevertheless retain their distinct identities), broader but fewer Moderatorships, and degree specialisations determined primarily by the final-year research project.
- 1.4 **Improve programme resource management** by: (a) instituting a robust, rolling analysis of gross income versus real costs in relation to student numbers and profile (EU vs. non-EU) for which a light-touch, College-level system of auditing staff time and a common workload model are needed to evaluate if more students on TR071 really will translate into a larger net income; (b) developing a transparent resource allocation model across Schools and support units; (c) improving student information and other online systems necessary for TR071.

- 1.5 **Improve student facilities** by providing flexible learning spaces and more common space and informal meeting areas. It is also important to at least upgrade aspects of Goldsmith Hall.
- 1.6 **Manage changes positively and transparently** by giving staff a say in the process, incentivising staff to undertake necessary changes, and placing executive responsibility in the hands of the best possible leaders.

The Review Panel recognises that these recommendations have implications that stretch beyond TR071. If implemented, they will require major, initially expensive, and perhaps unwelcome changes at College and Faculty levels, as well as in Schools that deliver TR071. Those changes could be seen to jeopardise familiar and long-standing academic structures and procedures. Nevertheless, the Panel feels strongly that the status quo is not a feasible option if TR071 is to have the healthy long-term future that it deserves.

2. COURSE STRUCTURE AND SYLLABUS

Observations:

- 2.1 Good things about the course structure are the range of student choice, final year projects, students get the opportunity to experience disciplines they would not be exposed to in high school, and cross-School Moderatorships such as Functional Biology and Neuroscience.
- 2.2 Concerns noted by the Review Panel are too many small courses in 2nd year, overlap in material taught by different Schools/ duplication and lack of integration between Schools, opportunities missed to create more cross-disciplinary Moderatorships, and misalignment between intake and Moderator choices.

Recommendations and Considerations:

Recommendation

Change the course structure of the TR071 Programme by introducing streaming to allow greater alignment between student intake and Moderatorship choices, better coordination between TR071 and associated Direct-Entry courses (which for marketing purposes should nevertheless retain their distinct identities), broader but fewer Moderatorships, and degree specialisations determined primarily by the final-year research project.

Considerations

General guidelines for all four years:

- 2.3 For maximum impact, do not over-teach. Instead, consider ways to promote self-directed learning.
- 2.4 Embed transferable skills at all levels. (Many TR071 graduates will not follow a research-focused career.)
- 2.5 Embed new material within the existing syllabus rather than add to it.
- 2.6 Whilst retaining the option of student choice, drive towards developing well-trodden pathways. This will need a radical change of attitude to timetabling, with the use of a common blocked timetable structure.

Year 4 (Senior Sophister) considerations and recommendations

- 2.7 Are 16-21 Moderatorships really necessary? Fine, if yes, but not if they exist primarily to reinforce the interests and influence of the academic School. Could some Moderatorships be combined and the final degree label depend on the project that a student pursues?
- 2.8 Whatever the number of Moderatorships, a Coordinator for each Moderatorship should be appointed whose task is to track the essential/desirable/optional modules back through the whole four-year programme (i.e., define appropriate 'pathways' through the syllabus) and, in consultation with other Coordinators and the Science

Course Director, ensuring that necessary elements are there, identifying elements that can be cut or replaced, and ensuring that information, quality and assessments are fit-for-purpose.

- 2.9 The Review Panel felt that the overall shape of the Senior Sophister year was unlikely to require change.

Year 3 (Junior Sophister) considerations and recommendations

- 2.10 Consider starting the Moderatorships in Semester 2 of the Junior Sophister year. Of course this would mean that less specialised material will be taught to the 20-30 students in each Moderatorship, but there are some pros to doing this.
- 2.11 Progressively increasing student:staff ratios are hard to manage. The solutions to this are: (a) more staff; (b) fewer students; or (c) teach in bigger groups. Options (a) and (b) are probably unlikely (although see 5.10), leaving only (c) as the practical solution.
- 2.12 Such a change would reflect the current state-of-the-art of science as an increasingly inter-disciplinary subject.
- 2.13 Only material in Semester 2 of Year 3 would be subject to formal written exams.
- 2.14 For Semester 1, the proposal is to divide the class into three streams: Physical Science; Life Science; and Earth & Environmental Science. Each stream would follow a mandatory 20-credit Current Science and Society Module, including a Literature Project, a Press Release and an Oral Presentation, and a Mandatory 10-credit Maths, Statistics, Informatics and Data Handling Module. Assessments for both Modules to be “in-course” style, so no summer exam.

Year 2 (Senior Freshman) considerations and recommendations

- 2.15 Unchanged, but fuse the ten 5-credit biology modules to create five 10-credit modules. Logical combinations would be:
- BY2201 with BY2203: Cell structure, function and metabolism.
 - BY2202 with BY2207: Vertebrate form and function and behaviour.
 - BY2204 with BY2208: Evolution and genetics.
 - BY2205 and BY2209: Microbiology, infection and immunity.
 - BY2206 with BY2210: Ecosystems, biodiversity, global change, agriculture and the environment.
- 2.16 This would reduce the amount of module administration and assessments needed and provide opportunities for reducing overlap and rationalising content across cognate subjects. It will be necessary to organise the timetable to support the pathways identified by the Moderatorship coordinators.
- 2.17 In addition, rethink the role of the five maths modules (MA22S1, MA22S2, MA22S3, MA22S4, MA22S6). The Review Panel suggests removing these modules as they stand, but embed relevant maths skills in each of the other SF modules. At least one maths

module should be mandatory for all students in the JF year, alongside a compulsory maths option in Semester 1 of the JS Year.

Year 1 (Junior Freshman) considerations and recommendations

- 2.18 Unchanged, but recommend that MA1M01 be moved to Semester 2, made mandatory for all students who are not doing MA1S11 and MA1S12, and broadened to include some basic statistics training.
- 2.19 Each of the JF non-Maths modules should be scrutinised by the relevant Moderatorship Coordinator(s) with a view to a 10-20% reduction in the overall lecture load. The notional freed-up student time could be used instead to write a 2000 word tutorial essay that would be set and assessed by appropriate members of academic staff.

3. COURSE ADMINISTRATION

Observations

- 3.1 There is too little communication within the Faculty in regard to science teaching and student recruitment onto TR071 and the associated Direct-Entry programmes.
- 3.2 The Science Course Office (SCO) deals with its regular administrative functions (including student induction, module choice, examinations, progression, etc.) with commendable efficiency, commitment and enthusiasm, but is severely hampered by poor IT systems support (see 5.4).
- 3.3 The inadequacy of online information systems by which TR071 is managed is a serious barrier to its effective administration. This is a particular concern for a multi-disciplinary and cross-School programme such as TR071. Timetabling is the worst offender. Sometimes students have full days with no breaks because Schools do their own timetabling. Students can be double-booked for classes. The system cannot handle tutorials. Lecturers sometimes do not show up for a class because they were unaware a schedule or room booking had been changed. Some suggested the need to personalize schedules so students can be timetabled more in groups (which would also reinforce a student's sense of identity with their classmates). The apparent acceptance by both staff and students of this chaos ("It's been like this for years") indicates management deficiencies that have remained unresolved for too long and that are unacceptable in any university.
- 3.4 The Science Course Director (SCD) manages the Freshman programme as effectively as possible within the constraints of limited authority and resources, and inadequate lines of communication within the Faculty.
- 3.5 The Science Course Management Committee (SCMC), chaired by the SCD and currently with 17 members, oversees the academic structure, curriculum, regulations and administrative issues associated with TR071 (Self-Assessment Report, p. 47).
- 3.6 Mechanisms for module evaluation have been introduced within the Faculty, but work remains to be done to close the feedback loop by informing students about actions and responses in a timely fashion.
- 3.7 External examiners' reports on JS and SS modules are generally very positive, but it is unclear what the mechanism is for reporting and feedback of actions and responses to comments and suggestions for change.
- 3.8 It does not appear that JF and SF modules are subject to any regular external scrutiny to ensure their quality (presumably because Freshman performance does not contribute to final degree awards).
- 3.9 Decision-making among Schools is commendably democratic, but tortuous in practice. The Review Panel was informed that decisions regarding major changes to TR071 must be reached by consensus among Schools represented on the SCMC. One School could, in principle, block constructive changes to TR071 if these were deemed not to be in the interests of that School.
- 3.10 Timetabling should be performed by a single office within the Faculty for all years of the TR071 programme and for all disciplines within it. This should be facilitated by a

central room-booking system for all teaching space within the College. Consider deploying an additional administrative staff member to the SCO to assist existing staff with timetabling.

- 3.11 Communication and coordination between School Administrative Offices and the SCO and between Heads of School and the SCD should be improved. For example, it is unacceptable that large numbers of students are enrolled onto Direct-Entry programmes without the SCD being consulted in advance. This makes resource planning extraordinarily and unnecessarily difficult and time-consuming.
- 3.12 Dedicated support should be provided to the SCO to enable effective use of information/administrative systems such as CMIS and SITS, with the College ensuring that software and hardware are fit-for-purpose.
- 3.13 Clear lines of responsibility and authority should be established within the subject disciplines, Schools and Faculty for Directors of Undergraduate Teaching & Learning, School Teaching Committees, School Executive Committees, Science Course Management Committee and Faculty Executive Committee.
- 3.14 The role of SCD should be strengthened by giving the post-holder appropriate and adequate authority to allow the very significant responsibilities shouldered by the SCD to be met. Consider redefining the SCD's role as (say) Director of Science Teaching, or Associate Dean for (Science) Learning and Teaching. Such a step would be no more than restoring to the role the Dean-level status it once had (Self-Assessment Report, p. 46).
- 3.15 Irrespective of how the post is titled, the SCD should be a full member of the Faculty Executive Committee and directly involved in decision-making in regard to quotas for entry into TR071, for progression into Moderatorships, and for enrolment onto Direct-Entry courses.
- 3.16 One necessary practical consequence of strengthening the authority of the SCD is that the post-holder should have significant control over the TR071 operating budget. Otherwise, the post of SCD will remain as powerless as it is now. This would mean Schools sacrificing some of their traditional independence for the sake of achieving a more coherent and efficient science programme.
- 3.17 A second requirement to strengthen the SCD's role would be for the SCMC to move from strictly consensus-based decision-making to a majority voting system. Again, this would mean Schools losing some of their historical influence.
- 3.18 A related change would be to replace the unwieldy 17-member SCMC with a smaller Science Course Executive comprising (say) a maximum of five members and chaired by the SCD. This would streamline decision-making processes. It would be important for the membership of such an executive to rotate and for members to represent not only the interests of specific Schools and Moderatorships, but the aims and aspirations of the TR071 programme as a whole.

Considerations and recommendations:

Recommendation

Re-structure the course management of TR071 to increase coordination and communication by: (a) giving the Science Course Director Dean-level authority over TR071, associated Direct-Entry courses, and support units (along with significant budgetary control and representation on key Faculty and College committees); and (b) creating a compact Science Course Executive to replace the current unwieldy management committee to oversee quality, content and timetabling.

See also our recommendation under Resources (Section 5).

Considerations

- 3.19 Appropriate mechanisms should be implemented to ensure that feedback cycles for student evaluations of modules and for external examiners reports are closed, with actions noted and communicated as rapidly as possible.
- 3.20 Establish mechanisms so that JF and SF modules receive the same level of scrutiny by external examiners as do JS and SS modules to ensure quality standard are met across all four years.
- 3.21 Consider creating a Faculty Learning, Teaching & Quality Committee.

4. CURRICULUM QUALITY - TEACHING AND LEARNING METHODS

Observations:

- 4.1 The TR071 curriculum and the teaching and learning methods used have a strong research-driven ethos. This should render graduates highly qualified and prepared for a research-focused career, although evidence to confirm this was not available. This approach is supported by academic staff and post-doctoral fellows.
- 4.2 The integration of an independent research project in Year 4 of the TR071 programme is invaluable to the quality of the programme as a whole.
- 4.3 The curriculum described in the Self-Assessment Report included module titles and descriptions of module contents (in Appendices 2.3, 2.4 and 2.5), although no examples of actual teaching material. The Review Panel received little information about the appropriateness of the course material in each module to evaluate the relevance and up-to-date nature of its content.
- 4.4 The TR071 curriculum, and teaching and learning methods (as reported in the Self-Assessment Report and information obtained from our interviews with staff and students), comprise:
 - In Years 1-2 (JF and SF), a traditional teaching route involving mainly large lecture theatres and repeated lab classes is used.
 - In Years 3-4 (JS and SS), students apply for entry to a specific Moderatorship. Classes are smaller and staff have greater engagement with students most of whom by then are associated with a specific School.
 - Lecture material is usually distributed as printed hand-outs or electronically via Blackboard or email. Lecture material usually includes substantial additional reading material, although students rarely have enough time to read this.
 - Substantial time dedicated to practical experience. Lab sessions are integrated with the lecture material as much as possible.
 - Choice for students to carry out an independent research project in Year 4. Such projects are almost always 'wet', involving lab work.
 - Chemistry and physics offer small group tutorials when possible.
 - In JS and SS years, students develop some transferrable skills including problem-solving, presentations/public speaking, scientific writing, computer skills, teamwork, managing a research project, writing a thesis and interview skills.
 - There are some links to industry although, as noted above (4.1) there was not enough information to judge if the curriculum prepared students to work in industry.
 - Teaching is carried out by academic staff, but heavily supported by post-doctoral research fellows and post-graduate students who act as demonstrators for lab classes and tutors for small group teaching. Student:demonstrator ratios are 15:1-25:1 depending on the subject.

- Each Moderatorship has an external examiner.
- There is an option to take Broad Curriculum modules offered by other faculties such as the Faculty of Arts, Humanities and Social Sciences.
- Some funding is available from the Dean of Engineering, Mathematics & Science to support innovation in teaching methods, although not all staff are aware of this fund.

4.5 For TR071, the curriculum, teaching and learning are managed by:

- Each School being responsible for reviewing its syllabus under the auspices of a Director for Undergraduate Teaching and Learning (DUTL) who reports to their Head of School. DUTLs are responsible for reviewing the teaching, evaluation, programme content, development and skill development for Years 1-4.
- DUTLs chair School-level Undergraduate Teaching and Learning Committees and sit on the TR071 Science Course Management Committee. It is not clear that they have decision-making authority, however.
- The Science Course Director (SCD) has the responsibility of implementing the decisions of the Schools.
- There is a College Undergraduate Studies Committee (USC), which is a committee of the University Council, chaired by the Dean of Undergraduate Studies/Senior Lecturer and of which the DUTLs and SCD are members.
- University Council approves the academic programme for TR071 based on the USC recommendations.
- Each School is reviewed externally every 7 years. Heads of School are responsible for reviewing teaching in their School.

4.6 The feedback obtained by the Review Panel and by external examiners and staff is that students' opinions about the overall quality of TR071 are typically positive. The following were noted by students as being strong points in the April 2014 student survey (which had response rates of 91% from SF and 68% from JS students), and in our interviews with students:

- The wide variety of modules offers a "good base of science" and good preparation for Sophister Moderatorships.
- Significant practical skills are obtained.
- High quality of lecturers and demonstrators: "Lecturers are enthusiastic, knowledgeable and eager to help."
- Lab work and skills experience: "Labs provided good hands-on experience essential for understanding." "Good to have labs contribute to overall exams."
- Stimulating learning material: "Interesting lecture material delivered with enthusiasm." "Interesting learning experience".
- The final-year research project was a "great experience".

- 4.7 TCD's Strategic Plan for 2014-9 and the TR071 Self-Assessment Report identify major challenges in seeking to enhance the curriculum, teaching and learning methods. Not surprisingly, both emphasised the difficulties of providing high-quality teaching under severe financial constraints (detailed in Section 5), and providing such services to a larger and more diversified student population, including more students from non-traditional backgrounds and overseas.
- 4.8 The Self-Assessment Report rightly pointed out that many aspects of the curriculum, teaching and learning methods need to be addressed to maintain and improve quality; the Review Panel agrees with this view. The Self-Assessment Report also pointed out that many aspects of the curriculum and teaching are governed by resource constraints and in particular staffing and staff:student ratios. Face-to-face contact between teachers and students is central to effective learning, but that is not to say that this should necessarily dominate thinking about teaching methods in the future.
- 4.9 Small group tutorials are also vital to student understanding but these are constrained particularly for Freshman by the current resources (both teaching space and staff; see also 5.11-5.15).

In addition to the issues raised in the Self-Assessment Report, the Review Panel found that:

- 4.10 The Science Course Management Committee is too large (see 3.18). There is a lack of communication about the best curriculum which, from our perspective, seems more focused on the needs and motives of each School rather than on the TR071 programme as a whole. The lack of a SCD with executive authority (see 3.4. 3.14), coupled with the control and power each School currently has over the curriculum risks being detrimental to teaching quality.
- 4.11 The argument for streamlining the management of TR071 to maintain (and improve) its quality is a compelling one (see Section 3).
- 4.12 The maths curriculum is not well tailored to the different science disciplines. For example, biology does not seem to be addressing the needs of the students for developing problem-solving skills and confidence in applying statistical methods.
- 4.13 The layout of JS and SS courses is for some students very unbalanced: their classes are packed into one semester leaving the other sparsely populated with classes.
- 4.14 In Years 1-2 lecturers talk about practical techniques in their lectures, but there is often no relevant follow-up in the practical sessions. There needs to be better coordination between Schools on matching practical sessions primarily to the needs of the TR071 curriculum and not, as it sometimes seems, to those of the individual Schools.
- 4.15 There was concern from some students that lab time can be used badly by lecturers in terms of the exercises they were expected to do. Some biology lab classes were not sufficiently challenging nor very 'practical'. The preparation of assessed lab reports can consume too much time in Year 3, especially for Chemistry modules.
- 4.16 Not all academic staff have embraced Blackboard as fully as they might as a virtual learning environment. Overall, the use of Blackboard for TR071 lags far behind what would be expected in comparable Schools in UK or US universities.

- 4.17 There is overlap in the content of some modules. For example, the Schools of Genetics and Microbiology may be teaching material that overlaps with the School of Biochemistry and Immunology. There appears to be no communication on the prospect of combining these modules or, at least, rationalising their contents. Students therefore risk missing out on the 'bigger picture' provided by specific modules.
- 4.18 As a result, students have little or no time to reflect on what they are learning; nor do they have enough time to make full use of the Broad Curriculum. Students have little time to develop transferable skills such as scientific writing skills in Years 1-2.
- 4.19 There are probably too many small biology modules in Year 2 (see 2.15) and too many Moderatorships (see 2.8).
- 4.20 The Review Panel heard repeated concerns from students and staff of the problems of students being unable to take their preferred Moderatorship because they did not perform sufficiently well in Freshman modules. The Panel was of the view that in principle this is not necessarily a bad thing: Freshman students have a very strong incentive to do well, and it is a universal and obvious fact that some students will do better than others. However, there is a serious concern that a Freshman student's poor performance might have more to do with stress and fatigue resulting from their sitting too many exams over too short a period than it does their knowledge of the subject. Reducing the number of SF modules would help in this respect (see 2.15), as would holding exams at the end of each semester.
- 4.21 It was the view of some students and staff that some Schools use the SF modules as a way to attract students into their Moderatorships, which may detract from delivering the best curriculum for TR071 as a whole. The SCD will need to assess how tailoring the JF and SF subjects towards the Moderatorships is and if it is biased toward molecular biology Moderatorships while neglecting other disciplines.
- 4.22 It is unclear how much time is allocated to, and what assessment methods are in place, to develop key skills for students (e.g. learning to learn, creativity, critical thinking, problem-solving, communications, collaboration, scholarly discipline, etc.). From an enterprise and service provider perspective, the inclusion of and integration of key skills into the TR071 Programme is critical. The development of key skills enables employees deal with shifting priorities, work prioritization collaborative problem-solving and building successful careers. Graduates who have had the opportunity to develop and build such skills at undergraduate level are far more likely to succeed in their chosen field and are better prepared for roles external to the academic sector.

4.23 Time must be allocated to allow for the integration of and development of these skills into the programme as well as assessments to test them. To facilitate their inclusion, existing class contact time should be reduced and these skills embedded into existing curriculum content, allowing more time for students to plan, work collaboratively, solve problems, create and communicate. Students working individually and in groups should be assigned specific areas of the curriculum to research and develop learning assets that can be shared and used as development resources for the class cohort. Sharing and communicating these resources will facilitate feedback and evaluation. Such experiences allied with reflection will help students develop a much broader range of skills that will help them make better decisions about their future. It will also provide them with the skills and experiences required for the world of work.

Recommendations and Considerations:

Recommendation

Streamline teaching across the whole programme by: (a) reducing reliance on traditional lectures to release staff and student time; (b) increasing the use of virtual learning environments; (c) rationalising content among modules; (d) promoting a wider range of final-year research projects that do not necessarily demand lab facilities; (e) involving library and learning support staff in developing innovative curriculum content; (f) allowing/encouraging more self-learning, critical thinking and other transferable skills among students.

Considerations

4.24 The introduction of an optional one-year or one-semester experiential placement should be considered. Such an option would help build links with external enterprise and service providers and would provide further opportunities for placement students to develop their key skills in an external setting. This option should be offered after the SF year and before starting the Moderatorship, for which some re-structuring of the academic programme is likely to be needed (see 2.11). For those not seeking to pursue a research path it affords an opportunity to explore alternative options. Students completing such a placement could be asked to create a learning asset based on their experience which would gradually build a repository of such assets for subsequent student cohorts. Such assets would further inform the programme about the external environment including job opportunities and growth areas in the economy. The consequent interaction and dialogue should inform future curriculum development.

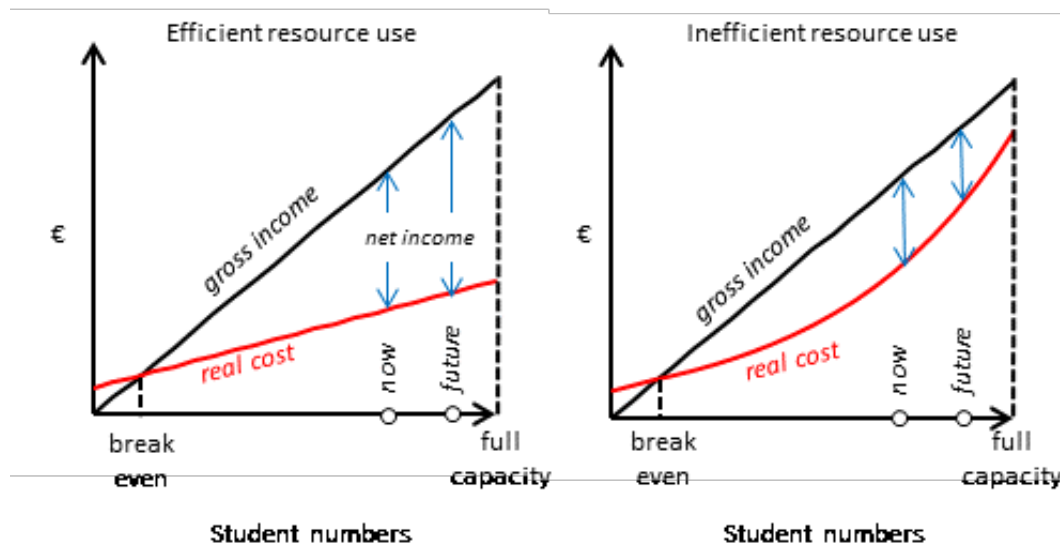
- 4.25 Consider having dedicated IT support to help teaching staff use Blackboard to encourage more innovative and up-to-date teaching methods. Given the lack of resources to create such a new position, perhaps Learning Support Services could offer this service to provide necessary training and support for teaching staff. Likewise, dedicated IT support will be needed for the SCD and SCO.
- 4.26 To ensure that quality standards are met, consider creating a Faculty-level committee to oversee learning, teaching *and* quality (see 3.21).

5. PROGRAMME RESOURCES

Observations – Financial:

- 5.1 Along with the rest of the Higher Education sector in Ireland, TCD and TR071 in particular are operating under severe budget constraints. In 2012-3 the academic Schools contributing to TR071 had a collective operating budget of €2.54M plus €30k for the Science Course Office and €165k for the Biology Teaching Centre (Self-Assessment Report, Table 5.4, p. 83). In 2014-5, these budgets were, respectively, €1.54M, €30k and €90k. Cuts so severe can only be detrimental to the provision and quality of TR071 unless steps are taken to mitigate their impact.
- 5.2 TCD's long-term mitigation strategy is a combination of (a) increasing the numbers of taught postgraduate students, (b) increasing numbers of non-EU students (from the current 4% to 18% of the College student population by 2018-9: Self-Assessment Report, p. 7), (c) philanthropy and (d) commercialisation. Of these, only (a) and (b) are realistically under the control of staff associated with TR071. In addition, the E3 initiative is planned to increase student numbers by 20-40% in subjects relevant to TR071 (specifically Natural Sciences and, to a lesser extent Chemistry) as well as Engineering (Self-Assessment Report, p. 91).
- 5.3 Increasing student enrolment on TR071 will increase gross income by € 9,578 per home/EU lab-based science student fte and approximately double that per non-EU student fte, at 2014 rates (Self-Assessment Report, Table 5.1, p. 77). However, the Review Panel was concerned that there seem to be no estimates of the real costs associated with teaching the current student intake nor of the potential costs of dealing with a larger intake in future. By real costs we mean not just known expenditures (largely academic and support staff salaries, detailed in Table 5.3 of the Self-Assessment Report, p. 81), but also the costs arising from the inefficiency with which teaching is currently done (detailed in 3.3, 5.4), from lost opportunities if more staff time is eroded by inefficiencies (for example, if research grant applications remain unwritten), and from the investment Schools are making in overseas student recruitment.
- 5.4 Inefficiencies include the significant difficulties staff face when organising timetables, booking teaching accommodation, inputting and retrieving information from student records, and obtaining reliable data on staff and student numbers. These are caused by IT systems being unfit for purpose, the lack of dedicated IT support for TR071, and by different Schools being allowed to organise timetables, room bookings and other administrative systems with a degree of autonomy that is surprising in a modern university.
- 5.5 It was clear to the Review Panel that academic and support staff must work flat-out to compensate for the constraints of poor IT infrastructure and organisation across Schools. As a startling example, one science School administrator informed the Panel that her time between May and September every year is devoted exclusively to making timetable arrangements for one part of the TR071 programme because there is no common timetable/room booking system available to streamline this vital activity. Multiplied across science Schools, such inefficiencies represent an enormous drain on resources, and likely to be exacerbated if student numbers increase further.

- 5.6 The Review Panel wishes to stress that individual members of staff are *not* inefficient, but unsuitable IT systems, poor support, and opaque administrative structures are causing unacceptable difficulties for staff and hamper the efficient use of already-scarce resources.
- 5.7 That being the case, it is essential that the real costs of teaching are evaluated accurately and used to model the cost, as well as gross income, implications of recruiting a larger student population with variable mixes of home/EU and non-EU ftes. Only then can net income be forecast reliably.
- 5.8 To illustrate the potential importance of this issue for TR071, the real costs per science student fte are likely to be about € 10,000 (figure derived from UK benchmark data for 2012-3 and obtained using Transparent Approach to Costing (TRAC) methods based on auditing academic and support staff activities in research-active institutions). This figure is very close to the € 9,578 quoted in 5.3 for gross income per home/EU lab-based fte, suggesting that margins will be extremely tight.
- 5.9 Miscalculations of cost versus income as functions of student numbers could have serious consequences: more students will not necessarily translate into a larger net income. With an efficient real cost base, net income increases proportionately with student numbers as they approach full capacity, as shown schematically in the left-hand figure below. If resources are used inefficiently, however, for which we can speculate costs rising disproportionately, more students could actually *reduce* net income, as illustrated in the right-hand figure.



5.10 To secure a positive net income stream to allow TR071 to remain financially viable, it is important that inefficiencies such as those identified in 5.4 are minimised by rationalising, updating and fully implementing key IT systems as soon as possible. Until then, consideration should be given to *not* increasing TR071 numbers, or even reducing them temporarily. A temporarily smaller student intake would also alleviate some of the pressure on teaching space (see 5.11). In the medium- to long-term, the true costs of teaching need to be evaluated accurately and used for informed resource allocation and planning, an initiative that must be implemented at College level. This can be done effectively on a “light-touch” basis alongside a common staff workload model.

Observations – Space and Facilities:

- 5.11 Large increases in TR071 student numbers cannot be accommodated within the existing facilities. Teaching labs and lecture theatres are already effectively at full capacity especially for JF and SF classes. Many lab classes must already be repeated multiple times (Self-Assessment Report, p. 89) and are at the upper limit of student:demonstrator ratios acceptable for lab safety (Self-Assessment report, p. 69). More students on TR071 will mean less lab time per student unless facilities are expanded. The Review Panel is concerned that significantly less lab time could jeopardise the quality of the scientific training provided by TR071.
- 5.12 The largest available lecture theatre, Goldsmith Hall (GH), can hold about 500, but the review panel agrees with the view expressed in the Self-Assessment report (pp. 89-90) that GH is less-than-ideal for effective teaching. The Panel recognises that replacing GH with a more suitable venue is at best a distant prospect, but such a development should be put onto TCD’s planning schedule for large capital projects. In the meantime, investment into rectifying some of GH’s fundamental deficiencies (acoustics, entry and exit points) would benefit students and lecturers in the short-term.
- 5.13 Science teaching labs are modern, well-appointed, and very well run by dedicated teaching and support staff. Biology teaching labs are fully equipped with audio-visual systems. Chemistry teaching labs would benefit from the installation of similar systems (imagers, multiple plasma screens) to display equipment and demonstrate procedures to large classes.
- 5.14 Although it was difficult for the Review Panel to be certain on this point, the availability of smaller lecture rooms across TCD as a whole does not seem to be a critical issue. But there is a problem for TR071 in accessing suitable rooms from the entire pool of those potentially available because of block-bookings, historical bookings remaining in perpetuity irrespective of current class sizes, and some rooms deliberately being kept ‘invisible’ from any booking system. This is obviously unacceptable for optimal use of teaching accommodation.

- 5.15 Few or no flexible learning spaces are available. Such facilities are increasingly being installed in universities to allow classes to be structured and run in innovative ways. Flexible learning spaces typically comprise large open rooms containing movable screens and partitions instead of walls (where possible), movable desks, workstations and chairs, wi-fi, multiple power-points/sockets, desktop PCs, data projectors, plasma screens and interactive white boards. These facilities are ideal to run hands-on sessions for training in data analysis and statistics, for example, an area identified in the Self-Assessment Report (p. 74) as a priority for TR071.
- 5.16 The Review Panel would support initiatives to increase the amount of self-directed learning expected of TR071 students (see 2.3). Students will need appropriate facilities to get the most out of new teaching approaches. In this respect, the lack of adequate social spaces for students is a concern. Such spaces provide areas primarily for relaxation but also opportunities for informal 'conversational' learning among students.
- 5.17 Falling operating budgets and increasing student:staff ratios could jeopardise final-year independent research projects, as recognised in the Self-Assessment Report (p. 88). Students, staff and the Review Panel are all strongly in favour of retaining these projects as an important and distinctive element of the TR071 programme.
- 5.18 Some resources available to TR071 are currently being under-used. One example is the minimal use of Blackboard as an online teaching and learning tool. Some teaching staff post their lecture notes on Blackboard (although others do not), and that is about the extent of its use. Opportunities are being missed to develop online quizzes, exercises, discussions, projects, provide feedback, etc. that could be used to partly replace more traditional teaching/learning activities that, if implemented well, would not jeopardise the quality of TR071 and would ease some of the pressures on classroom space. The lack of readily available IT support to help staff exploit such possibilities is an issue. Staff time that is currently consumed by timetabling, for example (see 5.5), could be redirected towards assisting with exploiting more fully online teaching initiatives.
- 5.19 A second example of an under-used resource is the library. Library staff interviewed by the Review Panel were extremely enthusiastic but clearly frustrated by never having been approached by any academic to discuss how the library might help support new learning initiatives. If, as the Review Panel believes, TR071 needs to reduce its strong reliance on traditional lectures and practical classes and increase students' self-directed learning (see 5.16), academic staff must work in partnership with library staff to facilitate such a development.
- 5.20 The Review Panel was unable to obtain a clear picture of how resources (specifically, operating budgets) are allocated by the Faculty to Schools and from there to TR071, associated Direct-Entry courses, the Science Course Office, and the Biology Teaching Centre. A resource allocation model (RAM) based largely on student ftes within Schools or Moderatorships would be the logical basis for such a RAM, but we were unable to confirm if this was the case. To allow proper planning and management, a transparent RAM should be established for operating budgets for TR071, Direct-Entry courses and support units.

Recommendations and Considerations:

Recommendation

Improve programme resource management by: (a) instituting a robust, rolling analysis of gross income versus real costs in relation to student numbers and profile (EU vs. non-EU) for which a light-touch, College-level system of auditing staff time and a common workload model are needed to evaluate if more students on TR071 really will translate into a larger net income; (b) developing a transparent resource allocation model across Schools and support units; (c) improving student information and other online systems necessary for TR071;

Considerations

5.21 One possible solution to the pressure on final-year projects is for teaching staff to promote more actively the availability of 'dry' projects that do not demand lab facilities or consumables. These include bioinformatics projects for molecular biologists and geneticists, GIS-based projects for geographers, and population/ecosystem modelling projects for ecologists. Skills gained in doing such projects are no less valuable than those obtained working at the lab bench and are highly sought-after by graduate employers especially in the age of 'Big Data'. The Review Panel believes that greater exposure of JF and SF students to such opportunities would improve the popularity of 'dry' projects among JS and SS students

6. THE STUDENT EXPERIENCE

Observations:

- 6.1 The student experience features prominently in the TCD Strategic Plans (2009-2014 and 2014-2019). The Dean of Students is responsible for planning, developing and implementing programmes and policies. Student services include (Self-Assessment Report, pp. 93-105 and information gained from the Review Panel's interviews):
- Academic Registry, which is part of Trinity Teaching and Learning within the Academic Services Division, under the Vice-Provost/Chief Academic Officer.
 - Careers services including a new programme, GradLink, that puts students in contact with graduates.
 - Disability Services and Study Skills services, some of which are online.
 - International Students' Global Room, a drop-in centre.
 - An officer for Mature Students.
 - The Student Counselling Service, free of charge.
 - Student to student (S2S) offers trained student mentors.
 - The Students' Union has representatives on all of the major College committees.
 - Each undergraduate student at Trinity is assigned a personal tutor on entry to the College. Tutors are members of academic staff who are specifically appointed and trained.
 - The Science Course Office offers undergraduate science students guidance on a day-to-day basis.
 - Trinity College Library is the biggest library in Ireland. It has subject experts who can help students. The library has a dedicated learning support service available to students.
 - SITS is a new student information system intended as the online portal for all communication with students.
 - Information System Services E-Learning. Blackboard is the College-wide virtual learning environment.
- 6.2 The feedback obtained by the Review Panel, external examiners of Moderatorships and academic staff is that the student experience is typically a very positive one. See 4.6. The following were also noted by students as strong points:
- Freshmen students appreciated the available resources and facilities. The library was singled out, in part because it has numerous places for individuals to study, some 24 hours a day.
 - Tutors are a "massive" resource, although a few are not good (a problem not confined to TCD).
- 6.3. The Review Panel agrees with these positive aspects noted by students, and found that staff also saw these as positives, with the possible exception of the library, which

was not specifically mentioned except by library staff. The library staff highlighted that their services were not being used (see 5.19) and students were not 'fully aware' of the sort of services the library offered despite some students admitting they 'remembered an email from the library'. This could be due to the lack of communication between Schools and the SCMC about the services the library can offer.

- 6.4. The College Strategic Plan and the Self-Assessment Report identified challenges to enhancing the student experience. Both identified the difficulty of providing high-quality student services in a challenging financial environment and to a larger, more diverse student population, including students from non-traditional backgrounds and from overseas. We agree. The Self-Assessment Report rightly pointed out that many aspects of the student experience are constrained by resources and staffing and that these issues can dominate the quality and range of teaching that is possible.
- 6.5. 'The student experience' risks being undermined by timetables that are unacceptably full and which allow no time for self-learning, outside reading of the primary scientific literature, or even for some relaxation on days with long stretches of back-to-back classes. Students want/need improved coordination of timetables for the reasons detailed in 3.3. Some students have a truly massive work load in Years 1 and 2. Lab reports take a huge amount of time to complete. There is no time to do recommended reading. This would be addressed by our recommendation to streamline teaching/reduction on class contact hours and greater focus on the development of transferable, self-learning and smaller group teaching and learning.
- 6.6. Exams should be held at the end of each semester for the reasons given in 4.20.
- 6.7. Students want and should receive better and more timely responses to their end-of-module feedback.
- 6.8. Large lectures in Goldsmith Hall are unpopular with students and staff. Some core biology modules are shared with first-year Pharmacy students (84), plus students from Human Health and Disease (37) and Radiation Therapy (32) – all from the Faculty of Health Sciences – and students from the following Direct-Entry Science courses: Chemistry with Molecular modelling (5), Human Genetics (18) and Medicinal Chemistry (29). These additional numbers only increase the existing pressure on GH. Students ask for additional small tutorials allowing for more student-staff and student-student interactions. Staff would like to see this as well. We agree, and this is part of our suggestion to decrease contact hours in large group settings and for fewer, bigger classes especially in the JS year (see 2.11). Doing so should release some time for small group teaching that will allow students to obtain more transferrable skills. Such approaches could also allow the integration of other student support services such as the Library Learning Support Service, which teaches students how best to find the information they need and manage their scientific writing (using Endnote etc.). The College should consider separating the Pharmacy students from the TR071 students.
- 6.9. The quality of the student experience would be improved significantly if more informal meeting areas or social spaces were available (see 5.16). Students have no place to eat their lunch if they do not purchase it from the campus food vendors. The hallways in the building housing the SCO are cold because of the open atrium and have almost no

place to sit so students were sitting on the floor. Libraries have very few small group spaces. We were told that where the problem can be alleviated by change in policy, those will be pursued but no time frame for change was provided.

- 6.10. The student appeals process is remarkably cumbersome. A system whereby students' mitigating circumstances were considered before exams rather than afterwards seems to be a simple solution that works well elsewhere. Likewise, online information input/tracking procedures to streamline the paperwork are now standard in other universities.
- 6.11. It is hard for students to do a semester abroad. They must apply in SF year but don't at that stage know what Moderatorship they will have. A fully modular system may support this in line with other European universities.
- 6.12. Students in the survey and the interviews indicated that they wanted more continuous assessment. It is not clear to the Review Panel or in the Self-Assessment Report, just what is meant by that. Is it the desire for more continuous assessment? Is it for students to take part in more tasks, have quizzes throughout modules (as would be the case in the USA)? Or is it that the current continuous assessment is felt to have too small a weighting? Continuous assessments typically comprise 25-40% of the grades in the JF and SS modules. In JS and SS years significant components of the marks are already dedicated to labs, field trips and other practical exercises (essays, presentations etc.).
- 6.13. The lack of a dedicated Freshman Teaching Director leaves students with a lack of leadership or sense of belonging in the first two years of their experience at TCD. Students feel that they are not recognized as an individual until Year 3. They can feel isolated and find it hard to meet other students outside of their lab classes. The Science Course Office provides a truly excellent if resource-limited support service to the freshman students (although a service that is vulnerable should an SCO administrator be absent). This, or something equivalent, must be retained if TR071 management is re-structured (see Section 3).

Recommendation

Improve student facilities by providing flexible learning spaces and making more common space and informal meeting areas. It is also important to at least upgrade aspects of Goldsmith Hall.

7. THE REVIEW PROCESS

- 7.1 The review process was assisted by the Quality Office and facilitated by the Academic Secretary. The Self-Assessment Report was well-written, informative and reflective – and refreshingly frank. Data analysis was included along with proposals to address resource, administrative and structural challenges.
- 7.2 The Review Panel was able to interview staff and students who were all very open and forthright with feedback and commentary. Much of the verbal feedback the review Panel received resonated with and provided greater context for information in the Self-Assessment Report.
- 7.3 Procedures, organisation and support from College, Faculty and School staff contributed to the overall high quality of the review process, which will help inform future policy, planning and resource management of the TR071 programme.
- 7.4 This was the first time a programme has been reviewed at TCD. The review took considerable time, resources, and coordination. As more programmes are reviewed it will be important to have a College-wide schedule for these reviews to avoid overlapping burdens on participants and to allow for about 12 months of preparation time.
- 7.5 We observed that the College data systems were missing data, including administrative data, and that data had to be pieced together from different sources. The Self-Assessment Report (p. 24) indicated also that no follow-up has yet been done to see how ‘non-traditional’ students are faring.
- 7.6 There were a few questions for which we did not have enough information to comment. These included detail on content of courses, whether this prepared students for jobs in industry, reasons behind student desire for more continuous assessment, and staff workloads in different Schools. A programme review by nature of the scope of a programme is expected to assess a number of fairly diverse areas. It is helpful to hone the questions asked of the review panel to those that are most important and then ensure that enough information can be provided to allow an assessment to be made.
- 7.7 It is helpful when reviews can be structured to inform each other. For example, if the external reviews of Schools had looked at all four years and asked questions about the first two years and the TR071 programme’s support of that school and Moderatorships, this information could have been very useful to our review.
- 7.8 Two very small related points are that it would be helpful if the note taker captured who was speaking and if name tags had last name and/or office in large enough print to be visible to reviewers across the table.
- 7.9 It would be good practice to inform the review panel of the ultimate fate of their report: complete acceptance, partial acceptance, or rejection? A brief email would suffice.

8. STRATEGY

- 8.1 Our general assessment of the strategic directions of the Programme is described within Sections 2 – 7 above. However, the Review Panel was also specifically asked to address the Streaming Proposal outlined in the Self-Assessment Report and Appendices, and as discussed in many of our interviews with staff.
- 8.2 As stated in Section 2, we recommend changing the course structure of the TR071 Programme by introducing streaming to allow greater alignment between student intake and Moderatorship choices, better coordination between TR071 and associated Direct-Entry courses (which for marketing purposes should nevertheless retain their distinct identities), broader but fewer Moderatorships, and degree specialisations determined primarily by the final-year research project. The Direct-Entry courses should retain their distinct identities to maintain their attractiveness, but not be managed independently of TR071.
- 8.3 We note that the streaming proposals put forward by the SCD do not appear to have been understood in the same way by all staff in all Schools contributing to TR071. We note also that further discussion of the proposals has been deferred pending this Review. We recommend that discussion is resumed as soon as possible in the appropriate College committees within the context of our other recommendations concerning the Course Structure and Administration.
- 8.4 Discussion of the streaming proposals should distinguish between implications for resources (e.g. planning for large Freshman class sizes and for Sophister research projects) and for marketing. TR071 serves as a “brand” for entry to Science courses at TCD but it seems that within the Schools there is more concern for specific Moderatorships as “brands” upon graduate exit. This leads to unhealthy conflicts of interest among the Schools that deliver TR071.
- 8.5 The marketing of Science at TCD within Ireland may be most effective by means of the common entry TR071 brand, but it ought to be possible at the same time for marketing directed at overseas student recruitment to be focused more towards specific outcomes. TR071 then becomes the portal through which students may develop their interests leading to particular Moderatorships or specialisms as defined by Senior Sophister research projects.
- 8.6 Provided that there is effective and coordinated administration, it should be possible to recruit non-EU students directly to specific specialisms even though formally they would enter Science through one of a small number of entry streams in the same manner as home students.

Response from the Science Course Director to the TR071 Reviewers' report

I would like to thank the review panel for the substantial time, attention and hard work they invested in carrying out a comprehensive, detailed study of TR071. The reviewers were extremely well prepared for the visit and were able to immediately focus on the issues regarding TR071.

I would like to welcome the reviewer's comments and the complementary view they have expressed regarding the quality of the programme, the hard work, dedication and passion of the staff and quality of the graduates.

I would agree that the main threat to the course is the severe lack of funding which risks the quality of the programme. In addition I would agree that Science lacks a clear management structure and that operational inefficiency, primarily as a result of poor IT systems, hamper the delivery of the programme.

The report makes six broad recommendations which I have addressed in turn below.

*1.1 **Re-structure the course management** of TR071 to increase coordination and communication by: (a) giving the Science Course Director Dean-level authority over TR071, associated Direct-Entry courses, and support units (along with significant budgetary control and representation on key Faculty and College committees); and (b) creating a compact Science Course Executive to replace the current unwieldy management committee to oversee quality, content and timetabling.*

I agree that there are significant management issues within TR071 due to the lack of authority and the unwieldy management committee. The suggestions of the Review committee to empower the Science Course Director with authority over all the science courses coupled with a more compact Science Course Executive would significantly strengthen the Science Course Director's role in terms of strategic and operational development. While this might not receive universal agreement amongst the schools, without such developments the science course is likely to stagnate due to an inability to make decisions.

*1.2 **Streamline teaching** across the whole programme by: (a) reducing reliance on traditional lectures to release staff and student time; (b) increasing the use of virtual learning environments; (c) rationalising content among modules; (d) promoting a wider range of final-year research projects that do not necessarily demand lab facilities; (e) involving library and learning support staff in developing innovative curriculum content; (f) allowing/encouraging more self-learning, critical thinking and development of other transferable skills among students.*

I would fully support all of the recommendations in 1.2. The use of non-traditional teaching methods (a)/ virtual learning environments (b) could potentially free up staff time, however, the development of teaching in this way often requires

significant staff time input prior to the delivery which has in part been restricted due to the severe impact of budget cuts. Mechanisms to facilitate such developments will need to be designed. The content of modules (c) are already continuously reviewed but this is normally done at a School level and hence while rationalisation is an ongoing process a programme view needs to be taken. The suggestion of encouraging non-lab projects (d) is due to the pressure on laboratory facilities due to the large number of students. Projects are already run outside of laboratories in areas where this is possible (e.g. Geography, Geology, Plant Sciences, Zoology etc) and in other areas projects abroad and in industry are encouraged (e.g. Chemistry and Physics). It may be that increased use of non-laboratory projects may be possible and should certainly be explored to make best use of the limited facilities. I would also agree that the expertise in the library should be utilised in course development (e). While I believe there are significant components of self-learning, critical thinking embedded in the course, I believe that we should explore enhancing these in line with College's Strategic Plan (f).

1.3 Change the course structure of the TR071 Programme by introducing streaming to allow greater alignment between student intake and Moderatorship choices, better coordination between TR071 and associated Direct-Entry courses (which for marketing purposes should nevertheless retain their distinct identities), broader but fewer Moderatorships, and degree specialisations determined primarily by the final-year research project.

I would agree in principle with all of the recommendations. Streaming and the folding of direct entry courses is absolutely vital to the efficient management of the programme but it is very important to retain direct marketing of the Moderatorship subjects for non-EU recruitment. Broader moderatorships in specific areas would bring the course in line with international norms and would allow more flexibility in the student allocation of moderatorship places. Both of these will require significant long-term planning.

1.4 Improve programme resource management by: (a) instituting a robust, rolling analysis of gross income versus real costs in relation to student numbers and profile (EU vs. non-EU) for which a light-touch, College-level system of auditing staff time and a common workload model are needed to evaluate if more students on TR071 really will translate into a larger net income; (b) developing a transparent resource allocation model across Schools and support units; (c) improving student information and other online systems necessary for TR071.

I fully support the recommendation that the College implement full cost accounting and common workload models to facilitate understanding the economics of programme delivery. This would need to go hand in hand with a resource allocation system and significantly improve IT infrastructure. These developments are beyond the remit of the Science Course Office and the Schools.

*1.5 **Improve student facilities** by providing flexible learning spaces and more common space and informal meeting areas. It is also important to at least upgrade aspects of Goldsmith Hall.*

The requirement for flexible learning spaces and more common space is vital. The developments of non-traditional teaching will not be possible without such facilities and the current student experience within Science is significantly compromised by the lack of such facilities. The reviewers rightly point out the need for the upgrade of Goldsmith Hall and I welcome their suggestion that the College should place the construction of a replacement large lecture theatre on the capital projects list.

*1.6 **Manage changes positively and transparently** by giving staff a say in the process, incentivising staff to undertake necessary changes, and placing executive responsibility in the hands of the best possible leaders.*

I fully agree with these points which will require resources, a common workload model and for teaching developments and administration to be appropriately rewarded.

The final comment from the review committee notes the scale of the changes recommended:

The Review Panel recognises that these recommendations have implications that stretch beyond TR071. If implemented, they will require major, initially expensive, and perhaps unwelcome changes at College and Faculty levels, as well as in Schools that deliver TR071. Those changes could be seen to jeopardise familiar and long-standing academic structures and procedures. Nevertheless, the Panel feels strongly that the status quo is not a feasible option if TR071 is to have the healthy long-term future that it deserves.

I fully agree with this and hope that the College, Faculty and Schools will fully embrace the development of the Science Programme and the changes associated with this development.

My final note is to ask that the role of the external review committee does not end here. I feel that the external reviewers were extremely knowledgeable about best practice in science teaching and management and feel that further consultation during the planning and implementation of the recommendations would be of significant benefit.

Prof Graeme Watson

School of Chemistry and Former Science Course Director (January 2011 to December 2014)

Response from the Dean of Engineering, Mathematics & Science to the TR071 Reviewers' Report.

The Review of TR071 was long overdue, as College did not have a balanced, integrated overview of this well-established, long-standing Course. The Review addresses the major concerns that I have about the sustainability of this Course in a precarious period of change and financial stringency.

The Review Panel and all the internal stakeholders put a substantial amount of time and effort into the Review which resulted in a well-prepared, comprehensive review and this should be acknowledged as this Review is very much a prototype in this College.

The Review is very complimentary to many aspects of the Course and its stakeholders, and makes recommendations for sustainability and improvements in the Course based not only on International norms but also on some unique features and constraints in an Irish setting.

Having read the previous Course Director's response, I find myself in almost total agreement with his comments and so will not repeat them, but rather endorse them.

However on one point, I would not agree, and that is that the main threat to the Course is the severe lack of funding. Although it is true that there is a severe lack of funding for the Course and without heavy subsidies from Schools in terms of academic time, use of dwindling reserves, and use of research resources both from direct and indirect research cost budgets, the Course would have suffered greatly over the last 5 years, it is also the case that more money spent without reflection is not be the solution.

Without pre-judging the take-up of these recommendations by College, I think it opportune at this stage to make some comments on possible hurdles to any implementation;

- 1) A strong governance and management structure, with perhaps an Associate Dean for Science Undergraduate Teaching, a small but influential Management Group which has budgetary responsibility and authority over the Course content and delivery requires some major changes in policy, procedures, and management and information management systems. These are not without major implementation challenges and costs, will undoubtedly have implications for other such Courses across College, and run the risk that in the short or long term, will lead to Science Schools and Disciplines no longer 'owning' their degree courses and so being unwilling to continue the time and money subsidies, which are vital at present.
- 2) Direct Entry Courses and all TR071 degree outcomes should be marketed with high visibility. TR071, although in itself having various virtues, is only the route to these degrees. The issue of the marketing of direct entry courses to non-EU students should not be a barrier to their merger with TR071 when their 3-stream entry route is considered.

- 3) The implementation of these recommendations will take considerable time. There is therefore an immediate need for an interim structure for the Course governance and management, as well as either budgetary control or a Change Fund.

This can only come from existing resources at Faculty level, currently allocated to Science Schools. The FEMS budget continues to be threatened by external factors such as decreasing Exchequer funding, and internal factors such as pressure from other Faculties for an income-based budgetary mechanism and by College's research agenda if not aligned with its education one. It is difficult to see how change can be pursued without new resources, but impossible with dwindling budgets.