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Mapping Research across the Undergraduate Curriculum in UCC

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Executive summary

UCC identifies itself as a research-led University and has stated the ambition to strengthen the integration of research, teaching and learning by maximising opportunities for students to participate in research programmes throughout their undergraduate studies. The number of undergraduate programmes with student-involved research from first year onwards is an important measure of this ambition. A curriculum analytics project was enacted by CIRTl staff and Academic Systems Administration to gather evidence of research-oriented and research-based teaching in undergraduate programmes offered to students via the CAO system in 2015/2016. The review showed that 55% of undergraduate programmes make explicit mention of research and inquiry in their programme learning outcomes. Analysis of module learning outcomes further showed that 45% of the reviewed programmes provide students with exposure to research-based or research-oriented teaching across the duration of their programme. The project provides an important baseline of existing research in the undergraduate curriculum, it uncovers exemplar activities across a range of subject areas and disciplines, and extends the vocabulary around research and inquiry to include discipline-specific approaches and understandings. Future work will include gathering feedback from staff and qualitative research with students to correct any inaccuracies in the data with a view to refining the search query and running a regular, more automated analysis.

Introduction

Research-based learning is evident where students are engaged in activities based on authentic inquiry processes. In this approach, students are given the opportunity to practice expert thinking and, often, have their work assessed and receive feedback in a manner true to their area of study (Wieman and Gilbert 2015a). This mode of learning is the essence of student centeredness, and the benefits to students include increased engagement, fostering of critical thinking and greater independence, lower failure rates and greater learning gain amongst other benefits (Wieman and Gilbert, 2015b, Blessinger and Carfora, 2014, Wood, 2010, Brown and McCartney, 1998).

Learning approaches centred on research and inquiry can help invigorate and inform curricula (Breen *et al*, 2003; Healey and Jenkins, 2009; Jenkins and Healey, 2005; Jenkins, 2009; and Kreber, 2006), but the converse is also true, and teaching has been showed to enhance research skills (Feldon *et al*, 2011). Staff can experience increased motivation towards their own research and increased job satisfaction (Harland, 2016, Osborn and Karuksis, 2009). For universities and policy makers this mode of learning and teaching has the potential to meet wider societal needs, through its emphasis on equipping graduates with the attributes needed to address complex global challenges (Tassone *et al*, submitted).

There is a strong policy context for this approach to learning. The European Association for Quality Assurance in Higher Education recommends that institutions ensure *“programmes are delivered in a way that encourages students to take an active role in creating the learning process, and that the assessment of students reflects this approach”* (ENQA, 2015, Standard 1.3). In the Irish context, the Strategy for Higher Education to 2030 stresses that *“all students in Irish higher education – both undergraduate and postgraduate – should learn in an environment where research and teaching are closely linked”* (DES, 2011, p. 54).

Rationale for study

UCC identifies itself as a research-led University and has stated the ambition to strengthen the integration of research, teaching and learning in UCC through the greater engagement of researchers in teaching activities and by maximising opportunities for students to participate in research programmes throughout their undergraduate studies. Five strands for the integration of research, teaching and learning have been named:

- researchers teaching about their research (known as research-led teaching)

- undergraduate modules on research skills (known as research-oriented teaching)
- undergraduate students carrying out research (known as research-based teaching)
- postgraduate teaching assistants;
- Scholarship of Teaching and Learning.

These strands are being implemented, but not all are quantified. The number of undergraduate programmes with student-involved research from first year onwards has been identified as a key performance indicator. This project seeks to gather evidence of research-oriented and research-based teaching in undergraduate programmes.

Objectives of study

This project has three objectives

1. Uncover whether research-oriented and research-based teaching is evident in UG programmes (level 7/8) based on a key word search of module and programme Learning Outcomes.
2. Identify the extent to which research-oriented and research-based teaching is evident across programmes by year.
3. Develop a glossary of key words relating to research-oriented and research-based teaching in UG programmes¹.

Methodology

The project involves two research approaches which occurred in parallel and were used to inform each other.

Desk-based review

The desk-based review involved the manual review of Programme Learning Outcomes (PLOs) to ascertain whether research-oriented and research-based teaching is mentioned explicitly. The sample is comprised of the programmes offered to students via the CAO system in 2015/2016. It was decided not to include the PLO's of exit pathways, focussing entirely on the major award originally aspired to at point of access. A subset of module Learning Outcomes from twelve programmes and 608 modules were reviewed manually to test the methodology and to develop and refine the search query.

The criteria for the identification of research-oriented or research-based teaching was underpinned by the following definitions:

Research-based teaching and learning

"The curriculum contains many activities in which students actually conduct research e.g. inquiry based projects. These activities are based on authentic processes of inquiry and are connected to the research of the institute."

Research-oriented teaching and learning

"The curriculum emphasises the processes by which knowledge is produced in the field as much as on learning the content of a subject. Teaching focuses on inquiry skills and on acquiring a 'research ethos'."

¹ The resulting key words can be included in the meta-data of the Departmental Module Information System as an attribute thus allowing future reviews of occurrences of student-involved research and research-based teaching in undergraduate programmes.

Development of the Search Query

The search query developed in the desk review was generated using terms associated with research and inquiry and using verbs referring to higher order thinking, and resulted in a list of 93 words. These were used to interrogate the Book of Modules by Academic Systems Administration to check the accuracy and validity of the returning sample and to ensure the robustness of the approach. The initial search returned too large a dataset, and a methodology based on keyword frequency was developed to identify the most relevant keywords across a broad range of disciplines. The original subset of twelve programmes was reviewed again, and the keywords present in learning outcomes referring to research and inquiry were identified. This refinement exercise resulted in the following shortened list of eighteen keywords (see Figure 1):



Figure 1: Word cloud of keywords used in Book of Modules search.

Refinement of dataset

The curriculum dataset for 2015/2016 includes more than 89,000 records. Use of the revised search query still returned a high number of positive returns, i.e. ~9000 records. A further filtering step was taken to remove all modules with less than three occurrences of the keywords in the learning outcomes, while retaining modules whose titles refer to research and inquiry (see Appendix A for full list). This threshold value was identified as being optimal from the earlier desk based review. The final dataset of was reviewed manually by reading through the module learning outcomes listed in the online Book of Modules. Module Learning Outcomes which did not indicate research-based or research-oriented teaching were not counted (see Figure 2 for overview of dataset refinement approach).

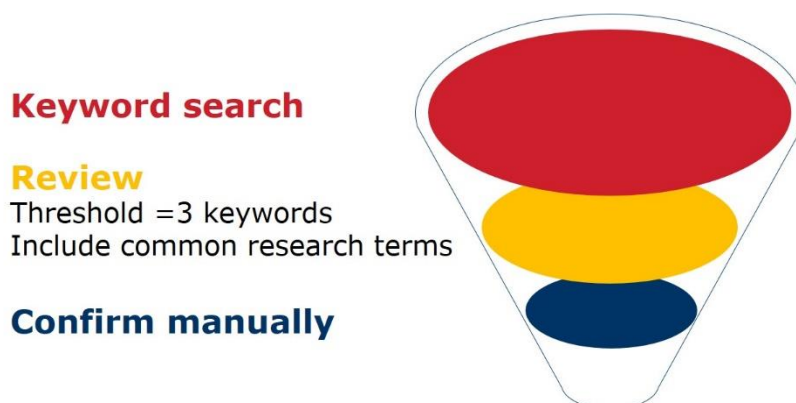


Figure 2: Overview of approach taken to refine dataset for module learning outcomes review.

Results

1: Review of Programme Learning Outcomes

55% of programmes reviewed make explicit mention of research in their programme Learning Outcomes (see Table 1 and figure 3).

Table 1: Extent to which research is explicitly mentioned in Programme Learning Outcomes for 62 courses offered by UCC in 2015/16.

College	School	No of Programmes		No of programmes without LOs	No of programmes with LOs with research-based/ oriented teaching		% of programmes with LOs with research-based/ oriented teaching		% of programmes with LOs with research-based/ oriented teaching, by college
College of Arts, Celtic Studies and Social Sciences	Schools within College of Arts, Celtic Studies and Social Sciences (CACSSS)	17		8	7		41%		41%
College of Business and Law	School of Business	11 ²		0	0		0%		31%
	School of Law	5 ³		0	5		100%		
College of Medicine and Health	Cork University Dental School and Hospital	1 ⁴		0	0		0%		50%
	School of Medicine	3		0	3		100%		
	School of Nursing and Midwifery	5		0	0		0%		
	School of Pharmacy	1		0	1		100%		
	School of Clinical Therapies	2		0	2		100%		
College of Science, Engineering and Food Science	Science	8 ⁵	29 ⁶	0	8	26	100%	90%	94%
	Engineering and Architecture	5 ⁷		1 ⁸	4		80% ⁹		
	Food Science	4		0	4		100%		
Total		62		9	34		55%		

² This school offers two programme (CK506 and CK501) jointly which are accounted for within the College of Science, Engineering and Food Science.

³ The Evening BCL (Hons) Degree is not included.

⁴ Does not include BDC (Hons) Degree (Non-EU Graduate Entry).

⁵ Includes CR320 which is offered jointly with CIT.

⁶ Some qualifications were duplicated across programmes but are accounted for here only once.

⁷ CK600PCE is offered jointly with Food Science but is accounted for here.

⁸ CK600NPF does not have learning outcomes as students transfer into one of four other Engineering courses on completing first year.

⁹ CK600NPF was not included for the purposes of this calculation (see point 7).

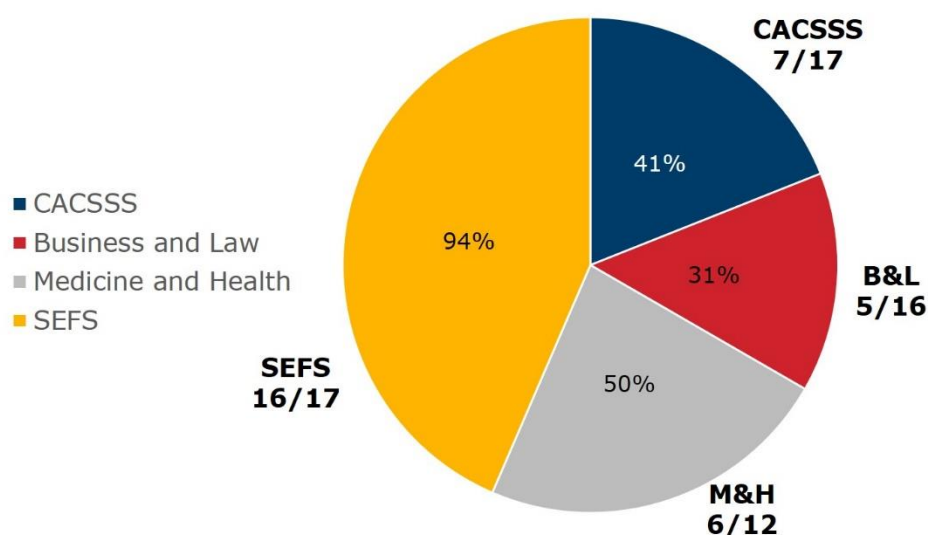


Figure 3: Percentage of programmes with Learning Outcomes referring to research-based or research-oriented teaching by College.

Some programmes do not list Learning Outcomes. For example, CACSSS offers seventeen programmes at UG level, eight of which do not list PLOs. This left nine programmes for review in CACSSS. Of these, seven refer to research and two do not.

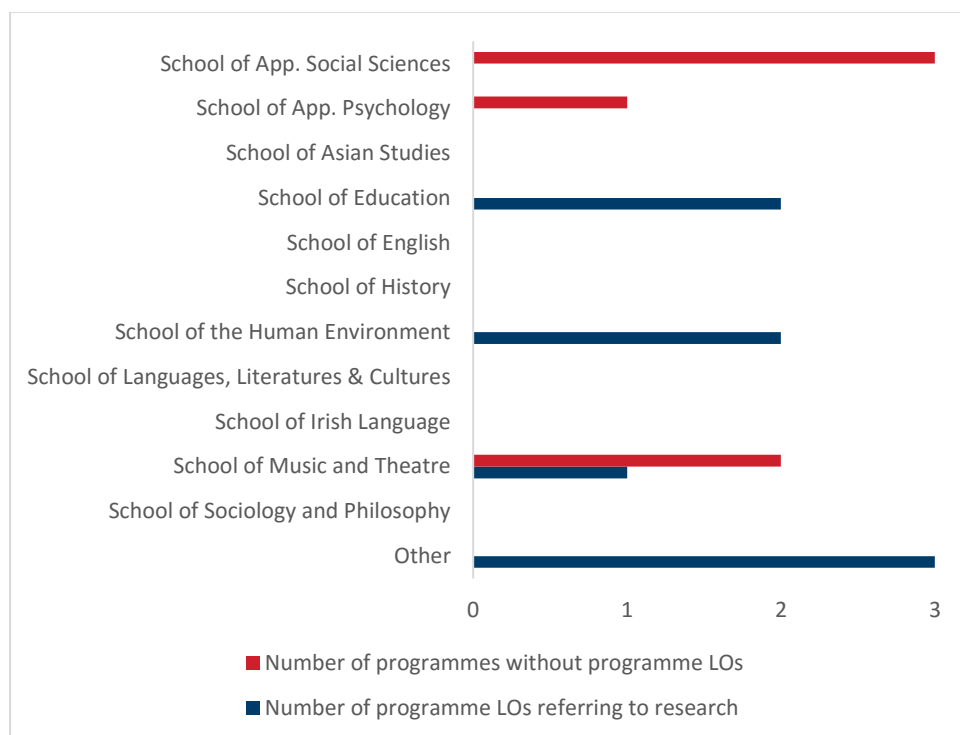


Figure 4: Number of programmes with LOS referring to research in CACSSS per School¹⁰.

¹⁰ The category "Other" is comprised of Digital Humanities, Economics and Criminology. Film and Screen Media, in the School of Music and Theatre lists its programme learning outcomes. Other degree programmes such as CK101 include modules from the School of Music and Theatre, but do not list programme Learning Outcomes.

2: Review of Module Learning Outcomes

Almost all programmes provide the opportunity for students to engage in research-based or research-oriented learning depending on their module selection. 28 (45%, n=62) of the reviewed programmes expose the student to research-based or research-oriented teaching across the duration of the programme.

Table 2: Number of modules per programme in sample with evidence of research-oriented and research-based teaching (n=62).

College	Programme	Prog. Code	No of modules with LOs per year				
			1 st year	2 nd year	3 rd year	4 th year	5 th year
CACSSS	BA	CK101	5	31 ¹¹	48	-	-
CACSSS	Social Science	CK102	0	2	4	-	-
CACSSS	BA (Arts Music)	CK104	3	18	24	-	-
CACSSS	BA (Film and Screen Media)	CK105	2	12	13	-	-
CACSSS	BA (Applied Psychology)	CK106	4	3	4	-	-
CACSSS	BA (Geography and Archaeology)	CK107	0	2	5	-	-
CACSSS	BA (International)	CK108	5	31	50	-	-
CACSSS	BA (English)	CK109	3	1	0	-	-
CACSSS	BA (World Languages)	CK110	2	7	5	-	-
CACSSS	BA (Early Years and Childhood Studies)	CK111	1	1	2	-	-
CACSSS	BA (Drama and Theatre Studies)	CK112	2	14	21	-	-
CACSSS	BA (Criminology)	CK113	3	1	1	-	-
CACSSS	BSocSc (Youth and Community Work)	CK114	0	1	2	-	-
CACSSS	Social Work	CK115	0	1	1	1	-
CACSSS	BEd Sports Studies & Physical Education	CK116	2	4	7	1	-
CACSSS	BA (Economics)	CK117	5	5	4	-	-
CACSSS	BA (Digital Humanities & Info Tech)	CK118	4	7	- ¹²	-	-
B&L	BComm	CK201	1	1	7	8	-
B&L	BSc (Accounting)	CK202	0	1	2	1	-
B&L	BSc (Business Information Systems)	CK203	0	2	0	3	-
B&L	BSc (Finance)	CK204	2	0	1	0	-
B&L	BComm (International) with French	CK205	1	1	-	10	-
B&L	BComm (International) with German	CK206	2	0	-	10	-
B&L	BComm (International) with Italian	CK207	2	1	-	11	-
B&L	BComm (International) with Hispanic Studies	CK208	1	1	-	11	-
B&L	BComm (International) and Irish	CK209	0	0	-	9	-
B&L	BSc Government	CK210	1	2	3	3	-
B&L	BComm (International) with Chinese Studies	CK211	2	0	-	8	-
B&L	BCL (Law)	CK301	1	1	1	-	-
B&L	BCL (Law and French)	CK302	1	2	-	2	-
B&L	BCL (Law and Irish)	CK304	0	1	-	1	-
B&L	BCL (Clinical)	CK305	1	2	-	1	-
B&L	BCL (International)	CK306	1	1	-	1	-
SEFS	BSc (Computer Science)	CK401	0	4	6	4	-
SEFS	BSc (Biological and Chemical Sciences)	CK402	1	2	11	14	-
SEFS	BSc (Biological, Earth & Environmental Sciences) ¹³	CK404	1	20	31	46	-
SEFS	BSc (Genetics)	CK405	0	0	1	1	-

¹¹ This is the average for the BA joint honours, single honours and major honours degree. See Table 3 for breakdown.

¹² This project focussed on the curriculum analytics data present for 2015/16 academic year. Thus, third year results were not available for the CK118 programme which was launched in 2014/2015.

¹³ General entry courses such as CK404 were further reviewed at the active programme level as the keyword search linked to the CAO listing contains the multiple root through each programme. See Table 3 for breakdown.

SEFS	BSc (Chemical Sciences)	CK406	0	1	1	2	-
SEFS	BSc (Mathematical Sciences)	CK407	0	1	2	11	-
SEFS	BSc (Physics and Astrophysics)	CK408	0	5	5	7	-
SEFS	BSc (Biomedical Sciences) Joint UCC/CIT	CR320	0	0	1	1	-
SEFS	BSc (Food Marketing & Entrepreneurship)	CK502	0	0	2	1	-
SEFS	BSc (Nutritional Sciences)	CK504	0	0	2	1	-
SEFS	BSc (Food Science)	CK505	0	0	0	4	-
SEFS	BSc (International Development & Food Policy)	CK506	2	2	2	0	-
SEFS	BE (Process and Chemical Engineering)	CK601	2	3	1	2	-
SEFS	BE (Civil Engineering)	CK602	2	1	3	7	-
SEFS	BE (Energy Engineering)	CK603	2	1	2	4	-
SEFS	BE (Electrical & Electronic Engineering)	CK605	2	0	1	2	-
SEFS	BSc (Architecture)	CK606	1	1	3	4	-
M&H	Medicine	CK701	2	4	3	2	1
M&H	Medicine (Graduate Entry)	CK791	0	3	1	1	-
M&H	BSc (Public Health)	CK706	0	2	0	2	-
M&H	BDS Dentistry	CK702	0	1	0	0	0
M&H	Pharmacy	CK703	0	1	0	2	-
M&H	BSc (Occupational Therapy)	CK704	2	5	1	2	-
M&H	BSc (Speech & Language Therapy)	CK705	0	4	4	5	-
M&H	BSc Nursing (General)	CK710	0	1	1	1	-
M&H	BSc Nursing (Children's & General)	CK712	0	1	1	1	-
M&H	BSc Nursing (Psychiatric)	CK720	0	1	1	1	-
M&H	BSc Nursing (Intellectual Disability)	CK730	0	1	1	1	-
M&H	BSc (Midwifery)	CK740	0	1	1	1	-

2.1: Review of Module Learning Outcomes - SEFS Pathways

The general entry courses such as Biological and Chemical Sciences (CK402) are more difficult to interpret as the returned data either exaggerates or under-reports the number of modules showing evidence of research-oriented or research-based teaching. For this reason, a review based on active programmes was completed for the multiple exit pathways in the College of Science, Engineering and Food Science (see Table 3).

Table 3: Number of modules per year with evidence of research-oriented and research-based teaching per pathway qualification in SEFS.

Programme	Qual code	No of modules with LOs per year				
		1 st year	2 nd year	3 rd year	4 th year	5 th year
BSc (Computer Science)	CK401	0	4	6	4	
Science Education - Direct entry	BSCSDD	-	-	0	0	-
Science Education	BSCSED	-	1	2	0	-
Computer Science - Single Honours	BSCS	0	1	1	0	-
Computer Science - Single Honours - Software Entrepreneurship	BSCSE	-	2	2	3	-
Computer Science - Single Honours - Web Systems Engineering	BSCSW	-	1	1	1	-
BSc (Biological and Chemical Sciences)	CK402	1	2	11	14	
Biological & Chemical Sciences ¹⁴	BSCBF	1	-	-	-	-
Biological Systems	BSCB	-	1	-	-	-
Chemistry with Forensic Science	BSCCF5	-	0	1	1	-

¹⁴ The dash symbol in the table cell indicates that no result was returned for that module. In some cases, this can be understood to be the exit pathway for a particular programme. For example, students undertaking CK402 with an exit qualification of Chemistry with Forensic Science engage in research and inquiry in three years out of their four-year programme.

Chemistry	BSCCH	-	1	1	1	-
Neuroscience	BSCAN	-	-	2	3	-
Biochemistry	BSCBC	-	-	3	2	-
Chemistry of Pharmaceutical Compounds	BSCCPC	-	0	1	4	-
Microbiology	BSCMB	-	-	1	2	-
Physiology	BSCPL	-	-	2	1	-
BSc (Biological, Earth & Environmental Sciences)	CK404	1	20	31	46	
Biological, Earth and Environmental Sciences	BSCR	1	-	-	-	-
Environmental Plant Biotechnology ¹⁵	BSCRPB	-	-	4	5	-
Applied Plant Biology	BSCRBL	-	2	-	-	-
Ecology ¹⁶	BSCREY	-	-	4	6	-
Ecology and Environmental Biology	BSCREB	-	2	-	-	-
Earth Sciences	BSCRER	-	4	5	7	-
Environmental Sciences	BSCRES	-	4	6	5	-
Geography	BSCRGG	-	3	5	7	-
Geology	BSCRGL	-	2	3	6	-
International Field Geosciences ¹⁷	BSCRGS	-	1	-	5	-
Zoology	BSCZY	-	2	4	5	-
BSc (Chemical Sciences)	CK406	0	1	1	2	
Chemical Sciences	BSCCM	0	-	-	-	-
Chemical Physics	BSCCPY	-	1	1	2	-
BSc (Mathematical Sciences)	CK407	0	1	2	11	
Mathematical Sciences	BSCMS	0	-	-	-	-
Financial Maths and Actuarial	BSCMFM	-	0	0	5	-
Mathematical Sciences - Joint Honours	BSCMJH	-	1	1	3	-
Mathematical Sciences - Single Honours	BSCMSH	-	0	1	3	-
BSc (Physics and Astrophysics)	CK408	0	5	5	7	
Physics and Astrophysics	BSCPY	0	-	-	-	-
Physics – Single H	BSCP	-	2	2	2	-
Physics and Mathematical Sciences - Joint Honours	BSCPJ	-	1	1	3	-
Astrophysics	BSCPYA	-	2	2	2	-

2.2 Review of Module Learning Outcomes - Arts pathways

Similarly, general entry courses in Arts and Humanities required further investigation to differentiate between different subject choices and credit balance. A review was completed for the multiple exit pathways in the College of Arts, Celtic Studies and Social Sciences in BA Honours degree (CK101) (see Table 4), and the BA International (CK108) (see Appendix B).

Table 4: Number of modules per year with evidence of research-oriented and research-based teaching per subject area for Bachelor of Arts degree (CK101).

	BA Joint Honours			BA Major Honours			BA Single Honours		
	1 st yr.	2 nd yr.	3 rd yr.	1 st yr.	2 nd yr.	3 rd yr.	1 st yr.	2 nd yr.	3 rd yr.
Applied Mathematics			1						
Archaeology		3	1		3	1		3	1
Béaloideas		2	2						
Celtic Civilisation			1			1			1
Chinese Studies						1			
Economics		2	5		2	5		2	10

¹⁵ The title of this degree award has changed from Environmental Plant Biotechnology to Applied Plant Biology

¹⁶ The title of this degree award has changed from Ecology to Ecology and Environmental Biology for students entering Second Science from 2015/16 onwards. Ecology has one module in year 1 (Biological, Earth and Environmental Sciences) that supports UG research, two modules in year 2, four modules in year 3 and six modules in year 4.

¹⁷ Third year is spent pursuing approved programmes of study at the University of Montana. The fourth year of this programme draws on biology, geology or earth science modules. The dash symbol in the table cell indicates that no result was returned for that year.

English ¹⁸			3			3			1
Folklore		2	3		2	1		2	1
French		1	2		1	2		1	2
Geography	1	3	4	1	3	4	1	3	
German	2			2			2		
Greek and Roman Civilisation		1	1		1	1		1	
History	1	4	8	1	5	9	1	5	9
History of Art	1	3	3	1	3	3	1	5	3
Italian			1		1	2		1	2
Mathematical Studies		1	1		1	1			
Philosophy		1	4		1	4		1	4
Politics		3	5		3	5		3	5
Sociology		3	2		3	2		3	2
Spanish			1		1	1		1	2
Studies in Psychology					2	3		2	3
<i>The following subjects had no modules returned following the keyword search and review</i>	Asian Studies, Computer science ¹⁹ , Digital Arts and Humanities ²⁰ , European Studies ²¹ , Gaelige/Irish, Greek, Latin, Mathematics, Portuguese, Religions and Global Diversity								

Discussion

A learning outcome is a statement of what a learner should know, understand and be able to demonstrate after completion of a learning process (ECTS Users' guide, 2015, p.10). The articulation of learning outcomes within curricula, a programme or a module, can support the design of assessment strategies, and the identification of teaching and learning methods. It also marks the shift from a teacher-centred to student-centred approach to teaching and learning. Ireland is a signatory to the Bologna process which requires that learning outcomes are written for all modules and programmes, and that these be aligned with the National Framework of Qualifications.

The review of programme learning outcomes demonstrated that 55% of programmes have learning outcomes that refer to research and inquiry. Of the 62 programmes reviewed, eight in the CACSSS do not list programme learning outcomes. Identifying specific programme learning outcomes for programmes such as the Bachelor of Arts is somewhat complicated as students can navigate many different routes through programmes depending on their subject choice and credit load. Arguably a similar challenge arises in the pathway courses in SEFS, and programme learning outcomes here have been articulated per exit pathway or qualification

The review of general entry programmes in SEFS shows that three quarters of the exit qualifications provide research exposure for students in the final three years of the degree (n=26). One programme in particular, i.e. Biological, Earth & Environmental Sciences, offers modules that refer explicitly to UG research over all four years of the programme for all exit pathways.

Students can choose from several different subjects in their Bachelor of Arts degree, and these are grouped to make subject choice and class timetabling easier. Twenty-one out of thirty-one subject areas have modules that refer to research-based or research-oriented learning. At least one subject per grouping of subjects has a research element depending on whether students take the subject modules as part of a minor, major or joint honours degree. Two subjects, History and History of Art

¹⁸ The Special Studies Seminars in English were under the threshold for number of keywords but were showed a positive result in the broader search.

¹⁹ Computer Science, Latin and Greek are available in First arts only and thereafter as a 10-credit subject within the single subject degree

²⁰ Digital Humanities is available only in 2nd and 3rd Arts as a 10-credit subject (CK101 and CK108). DH3001 came under threshold for keywords and was not included in results despite research being evident in the module. DH3002 was not returned by curriculum search despite referencing Methodologies in title.

²¹ European Studies is available in First Arts and thereafter only as part of the BA International degree. When analysed it showed evidence of research-based or research-oriented modules in years 2 and 3 of the joint honours programme (see Appendix A).

showed positive results across all three years in both programmes and all credit loads. Geography showed positive results for its joint honours and major honours degrees.

When comparing the results of the review of the programme learning outcomes and the module learning outcomes, it is clear that learning based on research and inquiry is not made explicit. For example, the review of Nursing programme learning outcomes uncovered no programme learning outcomes relating to research, but the module review shows that there is one module referring to research in three of the four years of the course.

Limitations of study

There are a few limitations to this research approach. Clearly, there are disciplinary ways of conducting research, e.g. solving problems, mapping etc., and the keywords used in the search may not capture these. As the keyword search was confirmed by a manual review it is possible for errors to occur as it requires the researcher to interpret whether research-based and research-oriented teaching is explicit in the Learning Outcomes. Both issues may be resolved by checking the findings with the various programme teams. It is expected that the list in Appendix A will be expanded to include the breadth of disciplinary approaches to research thus developing a shared terminology and common language around research and inquiry.

The keywords used in the search could also be strategically used in writing and revising module LO's in the future to indicate modules that have a research element. This would simplify and streamline future reviews to uncover this data. There is a danger that such an approach would lead to inaccurate representations of the learning from the module or programme and parallel qualitative studies with students and staff will provide more specific insights to complement this quantitative study. The researcher conducted a focus group with eight students across the four colleges of the University as a supplement to the curriculum analytics work (see Appendix C).

This research approach does not fully capture the research-based and research-oriented teaching in evidence in the general entry programmes or it can over-exaggerate it in some cases. A review of the active programmes was carried out to mitigate against this inaccuracy. The researcher will also look at steps for automating the refining of the initial data return to remove the possibility for error.

The choice of module and programme learning outcomes as the site for inquiry makes an assumption about the quality and accuracy of the learning outcomes. The qualitative work with staff and students to uncover the actual teaching strategies employed in the module or programme and the students' experiences of same will help mitigate against any inaccuracies or misrepresentations here.

Conclusions and recommendations

It is evident from this project that research-oriented and research-based teaching is happening across the University, and that there are many interesting and innovative approaches being taken by staff to engage students in this approach to learning. A key issue is for module and programme learning outcomes to be more explicit in describing the research and inquiry present in the various courses, but also for the research team to develop and expand the keywords denoting research and to review the findings with programme teams in order to correct any inaccuracies in the data and to refine the search query for future use. Similarly, a qualitative study with students will be carried out more extensively to complement this work.

The recommendations from this study are summarised below:

- 1: *Define*: Develop shared language for research that reflects different disciplinary approaches
- 2: *Discuss*: Share results, correct any inaccuracies in the data and refine the search query.
- 3: *Showcase*: Develop and share case studies of inspiring practices.
- 4: *Embed*: Highlight at institutional level, celebrate best practice and recognize staff activity through awards, promotions etc.

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Appendix A

The following is a list of research terms that were used to refine the dataset returned from the original examination of the module learning outcomes. The module titles were reviewed to check whether they contained the following terms. Those that contained these terms were retained even if the modules were under the threshold for number of keywords in their learning outcomes. In the final manual review, the module learning outcomes were read in their entirety to check whether there was evidence of an inquiry cycle (research-based learning), or if the full module was focussed on the development of a research skill (research-oriented learning).

Analysis	Field course	Literature Review	Quantitative
Data	Field training	Methods	Research
Dissertation	Fieldwork	Practical	Seminar
Experimental design	Inquiry	Project	Study
Extended essay	Interview	Qualitative	

Figure 5: List of research terms used to refine the dataset relating to the review of Module Learning Outcomes

Appendix B

Table 5: Number of modules per year with evidence of research-oriented and research-based teaching per subject area for Bachelor of Arts International degree (CK108).

	BA Joint Honours			BA Major Honours			BA Single Honours		
	1 st yr.	2 nd yr.	3 rd yr.	1 st yr.	2 nd yr.	3 rd yr.	1 st yr.	2 nd yr.	3 rd yr.
Applied Mathematics			1						
Archaeology		3	1		3	1		3	1
Béaloideas		2	2						
Celtic Civilisation			1			1			1
Chinese Studies			1			1			
Economics		2	5		2	5		2	10
English			3			3			1
European Studies		1	5						
Folklore		2	3		2	1		2	1
French		1	2		1	2		1	2
Geography	1	3	4	1	3	4	1		
German	2			2			2		
Greek and Roman Civilisation		1	1		1	1		1	
History	1	4	8	1	5	9	1	5	9
History of Art	1	3	3	1	3	3	1	5	3
Italian			1		1	2		1	2
Mathematical Studies		1	1		1	1			
Philosophy		1	4		1	4		1	4
Politics		3	5		3	5		3	5
Sociology		3	2		3	2		3	2
Spanish			1		1	1		1	2
Studies in Psychology					2	3		2	3
<i>The following subjects had no modules returned following the keyword search and review</i>	Asian Studies, Computer Science, Digital Arts and Humanities, Gaeilge/Irish, Greek, Latin, Mathematics, Portuguese, Religions and Global Diversity								

Appendix C

The researcher carried out a focus group with eight students from across the four colleges in UCC in April 2017, to gather student feedback on their academic experience of the integration of research and teaching in UCC. The participants were asked to reflect on their experiences of the integration of research and teaching in their particular area of study, and the findings are grouped thematically and summarised below:

Graduate attributes

One of the topics discussed was the benefits associated with learning through research. The students outlined a number of graduate attributes that could be acquired as a result of learning through research. The dominant graduate attribute identified was adaptability. The participants emphasised that the skills and methods gained through research were not useful in academia alone, but were essential in their future careers and even in everyday life. They felt that research gives students transferable skills which are crucial in the modern world. The second graduate attribute that was discussed was resilience. Participants described the research process as key to developing this trait. The process of searching for answers and new approaches to problems might not always yield immediate results, but it was felt that continued searching and methods used builds resilience.

Finally the group discussed how learning through research allows students to have greater understanding of material or problems. As a result of research they can then interpret the material they are researching and apply solutions to a particular problem or issue. This is in stark contrast to memory based learning which doesn't teach students to dissect a problem from first principles, but instead encourages a system of rote-learning and the ability to recollect and describe material.

Placing the student at the centre

The second topic discussed by the focus group was how best to place the student at the centre of the research process. A number of exemplar approaches were shared by the group. One of the students described how he was engaged in locating secondary metabolites in the soil. This project sought to address a real-world issue, antibiotic resistance, and the students had to explore issues and find solutions. The group found bacteria in the soil, a new development, and they went on to present their research at an international conference. In this 3rd year module they gained real insight into how to do research in their area.

Another participant reflected on his experience of collaborating with their supervisor in their research as part of his final year project in Engineering. The student was invited to work towards the co-creation of a paper with his supervisor and the work was subsequently published, a very unusual occurrence for an undergrad student. This partnership approach allowed the student to become actively involved in creating the learning process.

At the end of the focus group the participants outlined a number of challenges to learning through research.

Challenge 1

The first of these was that students felt that research needed to supplement the learning of theory not replace it entirely. The participants felt that there needed to be a sufficient base of theory and understanding before progressing to the research stage. They encouraged a step-wise approach to engaging students in research.

Challenge 2

Research overload is another issue for students. If there is an excessive emphasis on research and too many continuous assessment projects running concurrently students may experience over-assessment. This can result in a lack of space for thought, contemplation and reflection about the work they are completing. *The issue of excessive workload could be overcome by diversifying assessment and learning activities to cater for different student need according to the principles of 'Universal Design for Learning'.*

Challenge 3

Constructive feedback from lecturers to students is also important to ensure that students can complete effective research and understand how to improve their methodologies. Insufficient feedback is contrary to the idea of a student-centred approach to research integration. Furthermore, supports need to be made available to staff to provide sufficient guidance to students on how to undertake and complete effective research. Feedback issues could be resolved by implementing an effective feedback policy.

Challenge 4

The students also reflected on the importance of the Research Supervisor and the provision of support for the student. They asserted that staff need to be shown how to be an effective supervisor. Staff in UCC can take accredited courses in Teaching and Learning. More recently staff can gain a national digital badge in Postgraduate Research Supervision and a similar one could be developed for all levels of supervision.

Challenge 5

Students in the group felt that spaces that facilitated research based learning were extremely important. The provision of sufficient laboratories but also spaces that facilitated inter-disciplinary cooperation was heavily emphasised. UCC has some initiatives on track to promote this style of learning. An example of this is the new Student Hub, which is currently undergoing construction. The teaching & learning spaces in the Hub will be innovative in nature and allow for inter-disciplinary cooperation. Similarly, in October 2016 UCC launched a funding call allowing staff to develop Next Generation Learning Spaces across the campus. This would seek to transform static, traditional teaching & learning spaces to innovative new next generation spaces. This too would create an environment where research, particularly inter-disciplinary research can flourish.

Conclusions

There are key elements that will support a student-centred approach to integrating research, teaching and learning, but these need to be nurtured to ensure the outcomes we have identified as possible. This is what we have uncovered from local discussions with students.