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1 **Application of Bologna Cycle Programme Structures and the European**  
2 **Credit Transfer System to Irish Civil Engineering Programmes**

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21 Word count: 8175

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## 23 **Application of Bologna Cycle Programme Structures and the European** 24 **Credit Transfer System to Irish Civil Engineering Programmes**

25 The objective of this study was to assess, through a cross-institutional comparison,  
26 whether higher education institutions in the Republic of Ireland have responded to  
27 Bologna Declaration first- and second-cycle program restructuring and applied the  
28 European Credit Transfer System (ECTS) to similarly-accredited civil engineering  
29 programs in a consistent manner. Assessment strategies were also examined. The  
30 predominant programme structure was the pre-Bologna ‘4+1’ structure, demonstrating  
31 limited national impact of the principles underpinning the Bologna Declaration cycle  
32 concept. The first-cycle programmes differed widely in terms of allocated student  
33 workload per ECTS credit as well as in the way that educational outcomes were  
34 assessed, which was primarily by written examination. There was no ‘best’ (or  
35 consensus) practice for applying the two-cycle programme structure or ECTS workload  
36 norms. This lack of national consensus reveals issues that may have relevance in other  
37 countries, 20 years after the signing of the Bologna Declaration.

38

39 Keywords: Bologna process; student workload; assessment; programme structure

40

### 41 **Introduction**

42 On 19 June 1999, government ministers from Ireland and 28 other European countries signed  
43 the Bologna Declaration (European Higher Education Area, 1999). The declaration began  
44 what has become known as the Bologna Process to ‘... [ensure] comparability in the  
45 standards and quality of higher-education qualifications’ (Alma Mater Studiorum, 2019)  
46 throughout the European higher education sector [EHEA], thereby enhancing student  
47 mobility and international recognition of qualifications awarded by European universities  
48 (van der Wende, 2000). Fundamental to enhancing student mobility was adoption of a

49 uniform measurement system for assessing student workload and learning. The European  
50 Credit Transfer System (ECTS), developed in 1989 to encourage student mobility under the  
51 ERASMUS programme by *inter alia* ‘easing the process of recognising qualifications’  
52 (European Commission, 2019), eventually became the *de facto* standard for documenting the  
53 ‘normal’ level of effort required from students to achieve learning outcomes, commensurate  
54 with the minimum prescribed scheduled workload and assumed level of prior learning. One  
55 year of full-time academic study, which in most European programmes represents student  
56 workload ranging from 1,500 to 1,800 hours, is represented by 60 ECTS (European  
57 Commission, 2019). Although it is recognised that individual learners will vary in the time  
58 required to achieve learning outcomes, it has thus been stated that one ECTS credit  
59 corresponds to 25–30 hours of ‘normal’ student workload (European Commission, 2019).  
60 Twenty years after the signing of the Bologna Declaration it is timely to reflect on the  
61 implementation of its principles. This study examines the impact of the Declaration on civil  
62 engineering education in Ireland from the viewpoints of programme structures and allocated  
63 student workload. Furthermore, assessment is considered, recognising that actual workload is  
64 influenced by assessment strategy.

65 More or less concurrently with the Bologna Process, the EU encouraged and funded  
66 the development of Thematic Networks (TN) to foster university cooperation programmes on  
67 topics of common interest, such as implementing the Bologna process. The European Civil  
68 Engineering Education and Training (EUCEET) network (Cammarota and Manoliu, 2001)  
69 was one such TN. EUCEET TN evolved into the EUCEET Association (EUCEET  
70 Association, 2011a). Among the work programmes of EUCEET was ‘Implementation of the  
71 two-tier study programmes in civil engineering education across Europe, following the  
72 Bologna process’ (EUCEET Association, 2011b).

73           The use of ECTS in engineering programmes at Irish higher education institutions  
74 (HEIs) is intimately linked to regulation of the engineering profession. Engineers Ireland (EI)  
75 is the professional body that has statutory responsibility, *inter alia*, for ‘ensuring that the  
76 description “Chartered Engineer” ... is confined to a category of engineers who have satisfied  
77 the Council [of Engineers Ireland] of their professional competence and experience ...’  
78 (Office of the Attorney General, 1969). Recently, Irish HEIs were prompted to revise their  
79 programmes to comply with a change in EI’s requirements regarding the educational standard  
80 for a Chartered Engineer (Engineers Ireland, 2015). Currently (2020), persons who have  
81 achieved a level of engineering education of EQF Level 7 (European Qualifications  
82 Framework for Lifelong Learning) are recognised as meeting the required educational  
83 standard in Ireland and may later apply for professional recognition as a chartered engineer.  
84 This standard has been in place since 2012.

85           A grandfather clause for pre-2013 accredited bachelor’s degree programme graduates  
86 will expire in 2020. Thereafter, holders of a pre-2013 degree will be required to demonstrate  
87 evidence of ‘further learning’ before applying for chartered status. However, graduates post-  
88 2012 must achieve one of the following standards:

- 89       • an *ab initio* integrated National Framework of Qualification (NFQ) Level 9<sup>1</sup>  
90        accredited master’s in engineering; or
- 91       • an accredited NFQ Level 8 bachelor (honours) degree in engineering plus an  
92        accredited NFQ Level 9 master’s degree in engineering; or

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<sup>1</sup>At a national level, educational programmes in Ireland are classified in the National Framework of Qualifications administered by the government agency Quality and Qualifications Ireland. NFQ Level 8 programmes are honours bachelor’s degrees and NFQ Level 9 programmes are master’s degrees. See <http://www.nfq-qqi.com/> and <https://www.qqi.ie/>

- 93       • an accredited NFQ Level 7 bachelor (ordinary) degree in engineering plus accredited  
94       add-on NFQ Level 8 bachelor (honours) and NFQ Level 9 master’s degrees.

95       Thus, students seeking to attain the educational standard for eventual professional  
96       recognition as Chartered Engineers in Ireland now can pursue one of three routes: an  
97       integrated honours degree programme ending with a master’s degree (NFQ Level 9); a two-  
98       stage honours programme ending with a master’s degree (NFQ Level 8 + NFQ Level 9); or a  
99       three-stage programme starting with an ordinary engineering degree (NFQ Level 7) and  
100       progressing to an honours bachelor’s degree (NFQ Level 8) and master’s degree (NFQ Level  
101       9). Ireland’s NFQ Level 7 and 8 programmes are referenced to the EQF Level 6 ‘first cycle’,  
102       while NFQ Level 9 programmes are referenced to the EQF Level 7 ‘second cycle’, according  
103       to the Framework of Qualifications for European Higher Education Area<sup>2</sup>.

104       Prior to entering third level education, students in Ireland complete a minimum of 13  
105       years of classroom studies from age 5. An additional one year can be pursued in a practical  
106       “transition year” programme outside the classroom. Entry of most students into third level  
107       education is based on achievement in a competitive examination system (the ‘leaving  
108       certificate’ examination). (Other non-competitive routes are available to facilitate students  
109       with certain disabilities, those from socially disadvantaged backgrounds and mature  
110       students.) The required scores are dictated largely by the availability of student spaces  
111       relative to demand, and vary among HEIs, academic disciplines (and sometimes among  
112       programmes within disciplines) and from year to year. Prior to the Bologna Process, honours-

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<sup>2</sup>The full, approved version is contained in the following report (Report from the Conference of European HE Ministers, Bergen, 2005, Pages 27-28):

[http://www.ehea.info/media.ehea.info/file/2005\\_Bergen/37/9/2005\\_Bergen\\_BFUG\\_Report\\_577379.pdf](http://www.ehea.info/media.ehea.info/file/2005_Bergen/37/9/2005_Bergen_BFUG_Report_577379.pdf) (Accessed March 2019).

113 level civil engineering programmes in Ireland were almost exclusively 4-year bachelor's  
114 degree programmes, and prior to 2013 graduates from these programmes were eligible to  
115 seek professional registration. Following the bachelor's degree, graduates seeking further  
116 engineering education could pursue a one- or two-year master's programme (the former being  
117 a taught masters and the latter being a research masters) or (exceptional students) could enrol  
118 directly in a PhD programme.

119 EI currently accredits seven active civil engineering programmes at NFQ Level 9 (i.e.,  
120 second cycle, master's level programmes) and 15 active civil engineering programmes at  
121 NFQ Level 8 (i.e., *ab initio* and add-on programmes). However, no comparison has been  
122 made of the numerous accredited Irish civil engineering programmes that facilitate learners  
123 on the three routes to the educational standard for Chartership. The objective of this study  
124 was to assess whether HEIs in the Republic of Ireland had fully embraced the Bologna  
125 Process principles of 'first cycle' and 'second cycle' education during the updating of EI-  
126 accredited engineering programme structures, and the extent of consistency, if any, in the  
127 application of the ECTS to allocated student workload in the updated civil engineering  
128 programmes. Assessment strategies also were examined, recognising their impact on actual  
129 student workload. The study was part of a larger examination of all European civil  
130 engineering programmes being conducted by the EUCEET Association (correspondence to  
131 members, 6 June 2018 from I. Manoliu). This study is timely considering that the 20<sup>th</sup>  
132 anniversary of the Bologna Declaration occurred in 2019, a landmark that governments and  
133 academia in Europe should use to review evidence of any disconnect between the Bologna  
134 principles and the uncoordinated roll-out of those principles across European universities and  
135 HEIs.

## 136 **Methodology**

137 To maximise the relevance of the study internationally, only similar programme groups  
138 accredited by EI were examined. Furthermore, because this study was part of a larger pan-EU  
139 project, data collection followed a template developed by the EUCET Association covering  
140 course structure, workload distribution and assessment strategy. Content, teaching methods,  
141 and other metrics were not included in the EUCET Association project and were not  
142 included in the study reported here. (In-depth comparisons of some Irish and many EU civil  
143 engineering programmes are available elsewhere, e.g. EUCET Association (2011c)). The  
144 required data included the names of modules<sup>3</sup> in a programme, and for each module the  
145 number of ECTS credits, the assessment method, the semester and year/stage of the module;  
146 and the weekly number of lecture hours, seminar hours, project hours, laboratory hours, and  
147 individual study (interpreted as self-study) hours. Twenty-two active civil engineering  
148 programmes were included in the study, seven of which were graduate programmes and 15  
149 were undergraduate programmes (Table 1).

150 The required data were extracted from publicly available internet sources (i.e.,  
151 websites maintained by each HEI offering an accredited civil engineering programme) during  
152 June–October 2018. The sources included up-to-date descriptions of the 22 programmes and  
153 descriptions for each module (ca. 850). The sources were the same ones that students would  
154 use to guide them in their studies, not only in the selection of modules (when choice was  
155 possible), but also to understand the normal student workload distribution embodied in each  
156 module. Likewise, a prospective student (e.g., an ERASMUS student) would utilize these  
157 same sources to assemble a programme of study (e.g., a learning agreement). To assure

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<sup>3</sup>Academic terminology varies internationally. In Ireland, ‘module’ refers to a distinct collection of material on a specific topic or topics and is synonymous with the term ‘course’ in some countries. Modules are assembled to form a ‘programme’, which is synonymous with the term ‘major’ in some countries and with ‘course’ in other countries.

158 comparability among the Irish datasets, data were extracted from the module descriptors (or  
159 from elsewhere in the HEI websites) without interpretation. This approach avoided  
160 assumptions about the data supplied by each HEI. Nevertheless, once compiled, each dataset  
161 was sent to the appropriate authority in each HEI to review, correct as necessary, and verify.

162 Total student workload per module and its distribution (lectures, tutorials, laboratory,  
163 project work and independent self-study) were recorded directly from the published module  
164 descriptors. For the analysis reported here, the categories were condensed to total hours,  
165 contact hours (through lectures, tutorials, laboratory and seminars, i.e., ‘face time’), and  
166 independent self-study. Data for each category were accumulated to give a total value across  
167 a semester. For reporting purposes this was expressed as an average value per week,  
168 assuming 12 teaching weeks per semester. This use of normal student workload as a  
169 comparator, though imperfect due to permitted variability in hours-per-ECTS credit (please  
170 see the subsequent ‘Results and discussion’ section), was **an appropriate** metric given that  
171 each HEI subscribed to the Bologna Process, had the same guidance provided by the  
172 European Commission for its application, and was accredited by the same engineering  
173 professional body. Thus, one would have assumed some consistency among programmes  
174 within a given academic discipline (i.e., civil engineering) regarding not only their  
175 educational outcomes, but also in the way that they were structured in terms of normal  
176 student workload, etc.

177 Data on mode of assessment in each module were quantified as a percentage allocated  
178 between formal written examination and continuous assessment (i.e., non-examination). A  
179 simple arithmetic average was determined for student workload per week from the total hours  
180 per semester. Contact hours per week were determined assuming a 12-week teaching period  
181 per semester. To conform with the EUCEET template (and simplicity in reporting),  
182 ‘equivalent’ average independent study hours were determined by averaging over the same

183 12-week teaching time-frame, although independent study of course would actually occur on  
184 a variable basis across the full 15 weeks of the semester. A weighted average was calculated  
185 for the annualised assessment metrics, taking account of the ECTS value of each contributing  
186 module, which was sometimes higher than a norm of 5 ECTS.

## 187 **Results and discussion**

188 An analysis was conducted of programme structure; total student workload; workload  
189 composition; and student assessment. Trends in the data of the 1<sup>st</sup> cycle were especially  
190 reviewed and reported here.

### 191 *Structures*

192 The data in Table 1 indicate that the predominant, but not universal, structure of civil  
193 engineering curricula in Ireland continues to be the same traditional Anglo-Irish format that  
194 was used before the Bologna Process, i.e., four years of undergraduate education (240 ECTS)  
195 followed by one year of master's level graduate education (60 ECTS) as a '4+1' programme.  
196 Thus, the Bologna principle of differentiating 1<sup>st</sup> and 2<sup>nd</sup> cycle education has not been  
197 translated into practice. Although Trinity College Dublin (TCD) offers a 5-year integrated  
198 programme leading to a master's degree in civil engineering (programme 10, Table 1), it is  
199 effectively constructed around a '4+1' offering. Furthermore, the TCD master's programme  
200 shares at least 205 ECTS credits (85%) in common with the bachelor's programme in the first  
201 4 years. Commonality of modules rises to 225 (94%) ECTS credits for master's students who  
202 do not opt for an internship. Only University College Dublin (UCD) offers integrated civil  
203 engineering degrees to master's level in the '3+2' format (programmes 5 + 6; programmes 7  
204 + 8, Table 1), and has done so since the early 2000s (Gibney, 2003).

205 The most recent pan-European survey of civil engineering programmes was  
206 completed in 2009 as an element of EUCEET-III (2006–2009). The survey was sent to all 75

207 members of the network (Manoliu, 2010) and the responses indicated that although 2 years  
208 (120 ECTS) was by far the dominant duration for 2<sup>nd</sup> cycle programmes, the 1<sup>st</sup> cycle  
209 programmes were approximately evenly split between 3-year and 4-year (180–240 ECTS)  
210 programmes. However, among programmes that were then transitioning from an integrated 5-  
211 year duration, the ‘3+2’ structure was dominant (Manoliu, 2010, p. 34). The ‘3+2’ structure is  
212 now the predominant format for 1<sup>st</sup> and 2<sup>nd</sup> cycle programmes across the EHEA, with 180  
213 ECTS characterising the 1<sup>st</sup> cycle workload of most programmes in more than half of the  
214 member countries (European Commission/EACEA/Eurydice, 2018). This indicates a  
215 collective connection with the concept of the first three years of university education being 1<sup>st</sup>  
216 cycle and differentiated from 2<sup>nd</sup> cycle. Less evident however, at least in Ireland, is  
217 differentiating the 1<sup>st</sup> cycle between vocationally based and theoretically based content.

218         The relative lack of structural difference among most pre- and post-Bologna Irish civil  
219 engineering programmes may suggest that many of the programmes have been ‘simply’  
220 repackaged to conform to the requirements of the ECTS. Previously, in evaluating the effect  
221 of the Bologna Process on a variety of EU third level programmes, Alderman (2009) reached  
222 such a conclusion. Among the engineering community in Ireland, as in the UK, influential  
223 engineers within and outside of academia were vocal in questioning the need to shorten the  
224 duration of 1<sup>st</sup> cycle programmes below 4 years (e.g., Kelly, 2001; McGrath, ca. 2001). Case  
225 (2017) documented that diverse and competing interests, not necessarily academic concerns,  
226 often shape the structures of engineering programmes. Yet, the preponderance of the ‘4+1’  
227 structure for the 1<sup>st</sup> and 2<sup>nd</sup> cycles in Irish civil engineering programmes also may be an  
228 unintended result of Irish higher education policy.

229         Since 1997, Irish students (also other qualifying EU residents, EEA and Swiss  
230 nationals) who enrol in recognised full-time undergraduate programmes in Ireland *for the*  
231 *first time* are eligible to have all tuition fees (but not all costs) paid by the Irish Exchequer

232 (Higher Education Authority, 2003; Department of Education and Science, 2009). The “free  
233 fees” initiative was welcomed by families, even though it was not a “free education”  
234 initiative. A student ‘contribution’ (registration fee, amounting to €3,000 per annum in  
235 2019/2020) is not included in the tuition waiver scheme (Higher Education Authority,  
236 2019a), but some students receive government financial assistance that reduces the fee.  
237 Importantly, the free tuition scheme supports each year of only the *first* undergraduate  
238 degree; subsequent degrees, including graduate (i.e., 2<sup>nd</sup> cycle) degrees, are *not* included.

239         Thus, now that a Level 9 (2<sup>nd</sup> cycle) degree is required to achieve Chartered Engineer  
240 status in Ireland (Engineers Ireland, 2015), students enrolled in a ‘3+2’ programme  
241 experience twice the personal costs for this degree as those enrolled in ‘4+1’ programmes  
242 because the 2<sup>nd</sup> cycle programme is twice as long. This extra cost has been perceived as a  
243 deterrent to students enrolling in ‘3+2’ programmes (and therefore a reason for not  
244 developing them). However, the supposition has not been tested and some contrary evidence  
245 exists in that UCD’s first ‘3+2’ engineering programme (Structural Engineering with  
246 Architecture) was over-subscribed from inception until the 2008 economic downturn  
247 impacted heavily on construction-related programmes. Despite the lack of evidence that the  
248 Irish ‘free fees policy’ achieved its intended purpose to promote wider access to university  
249 education (Organisation for Economic Co-Operation and Development, OECD, 2006), the  
250 policy is popular politically and has remained in place despite several years of extremely  
251 difficult economic conditions. So, too, has the ‘4+1’ structure in Irish civil engineering  
252 programmes.

### 253 ***Total Student Workload***

254 In Europe, the definition of an acceptable time period for third level education has been  
255 provided by the Bologna Process, in which ‘... 60 ECTS credits are allocated to the learning

256 outcomes and associated workload of a full-time academic year or its equivalent' (European  
257 Union, 2015). 'Workload' is defined as '... the time [an] individual typically needs to  
258 complete all learning activities such as lectures, seminars, projects, practical work, work  
259 placements and individual study required to achieve the defined learning outcomes in formal  
260 learning environments ...'; although workload varies among countries, '... in most cases,  
261 workload ranges from 1,500 to 1,800 hours for an academic year, which means that one  
262 [ECTS] credit corresponds to 25 to 30 hours of work' (European Union, 2015). The figure is  
263 lower in the United Kingdom (UK), with 120 UK credits per annum being the norm, where  
264 10 notional hours of learning equate to each UK credit (Quality Assurance Agency, 2018);  
265 thus 1 ECTS = 2 UK credits (Universities UK, 2012). Because they were 'Bologna-  
266 compliant', the programmes examined in this study were expected to encompass a total  
267 student workload of 1,500–1,800 hours per annum according to most European country  
268 norms or 1,200 hours per annum according to UK norms.

269         The programmes in this study mostly utilized 15-week semesters comprising 12  
270 'teaching weeks', 1 week for 'reading/study' and 1–2 weeks for formal examinations in each  
271 semester (Table 1) and all programmes were comprised of 60 ECTS per academic year. One  
272 HEI (TCD, programmes 9 and 10, Table 1) utilized 11 teaching weeks and 2 weeks for  
273 reading/study per semester. Two HEIs (CIT and WIT, programmes 1315, 21 and 22) utilized  
274 13 teaching weeks and 1 week for reading/study per semester. One programme was not  
275 offered on a semester basis (IT Carlow, programme 19, Table 1) and hours for it were  
276 calculated as the average per week in each 30-week annual stage. Thus, all programmes in  
277 this study consisted of 30 weeks per academic year in which students were required to  
278 complete the required workload embodied in the modules.

279         Figure 1 illustrates the variation in total hours per week for student workload during  
280 the initial and final year of study in each of the programmes listed in Table 1. No universal

281 relationship existed between the relative workloads in these two years; in other words, the  
282 workload in final year was neither universally higher nor lower than that in first year. The  
283 same could be said for relative workload in intermediate years (data not shown).

284         Perhaps the lack of inter-year differences is unremarkable given the fundamental basis  
285 of the ECTS. Other than the assumption that one academic year's workload is expected to  
286 vary between 1,500 and 1,800 hours (i.e.,  $\pm 10\%$  around a mean of 1,650 hours) under the  
287 ECTS (European Union, 2015), there is no suggestion within the ECTS framework that more  
288 work should be scheduled in the final year of the programme than in the initial year (or, for  
289 that matter, between 1<sup>st</sup> cycle and 2<sup>nd</sup> cycle programmes). Anecdotally, from conversations  
290 with students over a combined half-century of university teaching, the authors question the  
291 validity of the assumption that typical learners in final year require no more hours of  
292 combined contact and independent study than those taking first year modules. That a greater  
293 level of effort may be required as a learner progresses through a programme *is* acknowledged  
294 within the ECTS framework, but this difference is not reflected in ECTS credits; instead  
295 HEIs are encouraged to utilise 'progression rules' in combination with ECTS (European  
296 Union, 2015, p. 21). Figure 1 shows that the Irish civil engineering programmes adhere to the  
297 premise that all years require approximately the same amount of combined total hours of  
298 workload.

299         However, fairly large differences are apparent in the average student workload *among*  
300 Irish civil engineering programmes. Figure 2 shows the total student workload per week. The  
301 global mean is 52 hr wk<sup>-1</sup> (i.e., average workload of all programmes across all years). The  
302 least total average workload (CIT, 42.3 hrs wk<sup>-1</sup>) is approximately 18.5% less than the global  
303 mean and almost 38% less than the greatest total average workload (WIT-1, 67.9 hrs wk<sup>-1</sup>).  
304 However the scheduled contact hours are 10% higher in the CIT programme (22.1 hrs wk<sup>-1</sup>)  
305 than in the WIT-1 programme (19.9 hrs wk<sup>-1</sup>), demonstrating significant inconsistencies in

306 the hours allocated to independent study per ECTS (0.67 hrs/ECTS in CIT, 1.59 hrs/ECTS in  
307 WIT-1). These values differ by a factor of 2.4 but may be apparent rather than real, given that  
308 actual independent study hours are not monitored and vary from student to student in  
309 accordance with their individual learning needs. Notably, the highest total average annual  
310 workload (WIT-1; 1,622 hrs yr<sup>-1</sup>) fits into the 1,500–1,800 hours of time commitment  
311 anticipated in the ECTS framework (European Union, 2015), whereas the mean annual  
312 workload of all Irish civil engineering programmes (1,248 hours) is close to the UK norm  
313 (Quality Assurance Agency, 2018).

314 As recognized in the Bologna Process, reciprocal recognition of student learning is  
315 fundamental to facilitating student movement among HEIs. Within the EHEA, the ECTS is  
316 accepted as the tool by which to document student learning. However, for the tool to be truly  
317 effective, it must be implemented consistently within all HEIs. As part of the Bologna  
318 Process, the EU has provided guidance (e.g., European Union, 2015) for implementing the  
319 ECTS uniformly among HEIs, and in Ireland this guidance has been ‘translated’ into  
320 guidance for Irish HEIs (National Qualifications Authority of Ireland, 2006). Similarly, Irish  
321 HEIs have guided their academic staff in applying ECTS to modules (e.g., Trinity College  
322 Dublin, 2006). Thus, individual academic staff members with responsibility for delivering  
323 modules have been the ones to decide how much time and effort (i.e., workload) they think  
324 the *typical* student will have to expend to achieve the designated learning outcomes. Even  
325 with the benefit of guidance (and subsequent oversight from academic administrators), it  
326 seems logical that variations in the application of ECTS could occur. Indeed, it is unknown  
327 whether these academics subscribed to the fundamental assumption on which ECTS is based  
328 that a typical student should expend 1,650 hours per academic year to master one year of  
329 academic work.

330 ***Workload Composition***

331 The average contact hours (or ‘face time’) with students over the duration of each programme  
332 was 15.1–24.8 hrs wk<sup>-1</sup> (data not shown). The global mean of contact hours for all  
333 programmes was 21.5 hrs wk<sup>-1</sup>, which was about 41% of the global average total student  
334 workload (52 hr wk<sup>-1</sup>). Thus, (by difference) the global average amount of autonomous study  
335 time would be expected to be 30.5 hr wk<sup>-1</sup>, comprising approximately 59% of total time. In  
336 comparison, Harmon and Erskine (2017) published results of a national survey (in which  
337 respondents were self-selected and data were self-reported) that showed full-time Irish  
338 university students generally expected to spend at total of 37.5 hr wk<sup>-1</sup> on their studies, while  
339 students enrolled in science, mathematics, computing and engineering programmes expected  
340 to spend slightly more (39.8 hr wk<sup>-1</sup>). Regarding first-year students transitioning to a  
341 university learning environment, Gibney et al. (2011) found that first-year students expected  
342 to spend approximately 24 hr wk<sup>-1</sup> in total attending classes *and* completing academic work.  
343 Both of these studies highlight a significant gap between the average workload that civil  
344 engineering programme co-ordinators in Ireland, guided by ECTS norms, prescribe their  
345 students to undertake, and what students themselves expect to undertake. Indeed, the ECTS  
346 approach is understandably a ‘one-size-fits-all’ approach that assumes the workload of a  
347 *typical* student. The actual gap between expectations of students and academic staff members  
348 may be much larger than is reflected by self-reported data; in a study of mathematical  
349 sciences students from all four university years at one Irish HEI, Kelly (2012) found that  
350 measured attendance was less than student-reported lecture attendance. These data  
351 corroborate findings by others that university students spend considerably less time studying  
352 than is prescribed through module descriptors (Kolari et al., 2006).

353 In contrast to the relative lack of inter-year variation in total workload (Figure 2),  
354 there were fewer contact hours in the final year of all programmes than in the first year of  
355 each programme (Figure 3). In some programmes, these differences were relatively small

356 (1.5 hrs wk<sup>-1</sup>, UCD-2 and UCD-3) but in other programmes were as much as 14.5 hrs wk<sup>-1</sup>  
357 (IT-Carlow). Relative to the number of Year 1 contact hours, the final year contact hours in  
358 specific programmes were 6–56% fewer.

359         The relatively higher number of contact hours in the initial year of programmes may  
360 help students transition from secondary level education in which almost all learning takes  
361 place within a formal classroom setting. Furthermore, the relatively fewer average number of  
362 contact hours in final year may reflect the inclusion of a greater number of project-based  
363 assignments and independent research studies that are completed outside of the classroom.  
364 Another explanation for the reduced contact hours is that the final year of programmes can be  
365 based on the assumption that, relative to their first year counterparts, the more mature final  
366 year students can be expected to take more responsibility for their own learning and achieve  
367 the learning outcomes envisaged through full use of the hours scheduled as independent  
368 study. Indeed, Kelly (2012) found that student attendance was highest in final year modules  
369 and suspected that the better attendance was at least in part because these modules were more  
370 directly related to a student's particular area of study.

371         Interestingly, the data for the number of lecture hours (Figure 4) in the first and final  
372 years of programmes contradict the conclusions suggested by the differences in contact hours  
373 (Figure 3). While some programmes (e.g., UL) devote obviously fewer lecture hours in the  
374 final year than in the first year, the converse is also true (DIT-1). It was beyond the scope of  
375 this study to examine how content was being taught in the various programmes other than  
376 through prescribed workload distribution across contact and independent study hours.  
377 Nevertheless, all programmes included some form of final year comprehensive project that  
378 was largely (if not entirely) self-directed by students outside of the classroom. Thus, it was  
379 somewhat surprising that several programmes included significantly more lecture hours in  
380 final year than in first year. In the nationwide survey of Irish university students reported by

381 Harmon and Erskine (2017), the self-selected respondents that were 4<sup>th</sup> year students reported  
382 that they spent more time on their studies (42.6 hrs wk<sup>-1</sup>) than did the 1<sup>st</sup> year students (35.7  
383 hrs wk<sup>-1</sup>); however, within these total time commitments, the proportion of total study time  
384 reportedly devoted to self-study was approximately the same (57.7% and 56%, respectively).  
385 Across the EU, students self-report that on average they devote 34 hrs wk<sup>-1</sup> on academic  
386 activities and this time is evenly split between self-study and in-class activity (lectures,  
387 laboratories, seminars, etc.) (Hauschildt et al., 2018).

### 388 *Student assessment*

389 As shown in Figure 5, on average across all years of the civil engineering programmes, most  
390 (55%) of a student's final grade was determined by written examination rather than  
391 continuous assessment. However, in some programmes (e.g., UCC, DIT-2, IT-Carlow) the  
392 reliance on written examinations for assessment was even greater ( $\approx 60\text{--}70\%$ ). The study did  
393 not evaluate the teaching techniques used in each programme, but the data in Figure 5 suggest  
394 that relatively less emphasis is placed on assessing student performance by means other than  
395 end-of-semester written examinations (e.g., continuous assessment, project performance,  
396 etc.).

397 The variations in assessment techniques across years (Figure 6) amplify the  
398 differences among programmes but exhibit no consistent trends. Given the importance of  
399 project work (individual and group design and research projects, etc.) and independent study  
400 in final year, a logical assumption would be that continuous assessment would play a greater  
401 role in final year than in the initial year of programmes, but such an assumption is not  
402 justified by the data portrayed in Figure 6.

403 These results are similar to those in a recent study of assessment strategies in use  
404 across the Irish higher education system (National Forum, 2016). In that study, investigators

405 concluded that written examinations were ‘the most common assessment method, although  
406 [their] popularity and weighting differ[ed] between fields, programmes and stages of  
407 programme.’ The same study evaluated the assessment strategies used in a random selection  
408 of modules in ‘engineering, manufacturing and construction’ and determined that the ‘relative  
409 weighting of examinations changed across programme stages from 44% in first year to 53%  
410 in mid-programme to 43% in final year.’

### 411 *Implications*

412 The comparisons made in this study were based on fundamental concepts embodied in  
413 the Bologna Process, i.e., workload and ECTS. In the context of student mobility,  
414 descriptions of modules (and the programmes they comprise) in terms of ECTS are  
415 vitally important because together with module content, the ECTS affect a prospective  
416 international student’s choices of what modules to include in a learning agreement.  
417 Arguably, the descriptions of programmes in terms of ECTS and workload could also  
418 affect a student’s choice of HEI.

419 Whether ECTS have been assigned uniformly among Irish HEIs offering  
420 accredited civil engineering programmes is still open to question; however, the study  
421 results show that inconsistencies exist. For example, there were considerable  
422 differences in the reported student workload among several programmes even though  
423 all met the same accreditation criteria of Ireland’s professional engineering body (and  
424 therefore the Washington Accord). Although the outcomes-based accreditation criteria  
425 are non-prescriptive in terms of programme content, a reasonable assumption would be  
426 that all accredited programmes within a given discipline should be similar.

427           Whether the differences in workloads are authentic is unclear because the actual  
428 number of hours expended by each student in achieving learning outcomes is a  
429 variable, irrespective of norms published in module descriptors. Nevertheless, one  
430 would have expected less variation in the average hours across the programmes  
431 reported given that their structures were built around 60 ECTS per full-time academic  
432 year and the relationship that has been established within the EU regarding annual  
433 workload. During the development of the ECTS, consensus within the EHEA was  
434 reached both on the average number of hours that EU students spent in HEIs to obtain a  
435 degree and on the average number of ECTS credits an academic year should contain;  
436 then the value of each ECTS credit was determined by simple division of the two. As  
437 deduced by Tsigelny (2011), the ECTS workload assumptions correspond to 5 hours of  
438 combined contact and self-study time per day for 5–6 days per week. However,  
439 Tsigelny (2011) also quoted a study that theorised that one ECTS credit equated to 28  
440 hours of student workload per week based on the assumption that a typical EU  
441 academic year consisted of 42, 5-day weeks.

442           On the basis of a 42-week academic year, 1,680 hours of combined contact and  
443 self-study time for 60 ECTS would require a time commitment of 8 hours day<sup>-1</sup> (i.e., 8  
444 hours day<sup>-1</sup> × 5 days week<sup>-1</sup> × 42 weeks year<sup>-1</sup> = 1,680 hours year<sup>-1</sup>). The assumed  
445 average workload in the ECTS framework is 1,650 hours year<sup>-1</sup> (European Union,  
446 2015). Notably, the academic year of programmes in this study was comprised of 30  
447 weeks. Consequently, to achieve the ECTS average workload of 1,650 hours per  
448 academic year, students would need to devote 11 hours day<sup>-1</sup> to classroom and self-  
449 study activity (i.e., 11 hours day<sup>-1</sup> × 5 days week<sup>-1</sup> × 30 weeks year<sup>-1</sup> = 1,650 hours  
450 year<sup>-1</sup>). Anecdotally, this level of time commitment seems unrealistically high.

451 As acknowledged by the European Union (2015, p. 18), ‘The use of ECTS in  
452 HEIs requires both an institutional credit framework based on institutional regulations  
453 and a *profound understanding of the system by each member of the academic staff*  
454 (emphasis added). It is unknown how individual academic staff members decided to  
455 allocate a notional value for total student workload among various categories of  
456 learning activities (lectures, etc.). The level of care devoted to writing module  
457 descriptors (which were the primary source of data for this study) by academic staff is  
458 also unknown. What is clear is that, as described by the documentation endorsed by  
459 each HEI, the amount of work embodied in ECTS is significantly higher than that  
460 which students themselves intend to expend in meeting the learning outcomes for the  
461 programmes reviewed in this study. Indeed, the mean workload of 52 hr wk<sup>-1</sup> for the  
462 civil engineering programmes compared in this study seems unrealistic in comparison  
463 to the average workload (39.3 hr wk<sup>-1</sup>) of full time workers in Ireland (Eurostat, 2019)  
464 and the amount of time (34 hrs wk<sup>-1</sup>) students across the EU report that they expend  
465 (Hauschildt et al., 2018).

466 As noted in the Methodology section, a working assumption during the study  
467 was that there would be significant similarities among programmes because they were  
468 in a single academic discipline. Differences in ECTS/student workload are recognised  
469 among programmes (European Union, 2015), but several of the differences identified in  
470 this study seem extraordinary. The differences are somewhat worrying given that all  
471 programmes reviewed were accredited by EI under the same general criteria. EI is a  
472 signatory to the Washington, Dublin and Sydney Accords and applies “outcomes  
473 based” accreditation criteria that are recognised internationally and lead to the  
474 reciprocal recognition of qualifications awarded to students who successfully complete  
475 the programmes. The EI accreditation criteria also reflect the ‘... accreditation

476 processes undertaken by the European Network of Accreditation for Engineering  
477 Education, which licenses Engineers Ireland to award the EUR ACE label' (Engineers  
478 Ireland, 2014). While outcomes-based accreditation criteria are not prescriptive, the  
479 large (apparent) differences in student workload among programmes in this study  
480 suggest that programmes having low workload demands enjoy the same accreditation  
481 recognition benefits as programmes having high workload demands.

482

### 483 **Conclusions**

484 This study demonstrated that the ECTS system established as part of the Bologna Process is  
485 fully implemented in all accredited civil engineering programmes in Ireland; however,  
486 inconsistencies in the application of ECTS among programmes are apparent. A possible  
487 reason for the differences is that individual academic staff members may interpret and apply  
488 EU guidance about ECTS differently.

489 No single structure in terms of the durations of 1<sup>st</sup> and 2<sup>nd</sup> cycles exists in these  
490 programmes. Some examples of the popular European '3+2' structure exist, but the so-called  
491 '4+1' structure that was in use prior to the Bologna Process still dominates. This suggests that  
492 most 'pre-Bologna' Irish civil engineering programmes have been repackaged to conform to  
493 the ECTS system but have not been reformed structurally.

494 All but one institution has adopted the UK workload norm of 20–25 hrs per ECTS  
495 credit, rather than 25–30 hrs norm embodied in the ECTS framework. Even so, the mean  
496 specified student workload arising from ECTS allocation for the civil engineering  
497 programmes compared in this study seems unrealistically high in comparison to the average  
498 workload of full-time workers in Ireland. Indeed, there is lack of clarity in the ECTS

499 framework about the basis for assuming that 25–30 hrs of student work are required per  
500 ECTS credit. This lack of clarity may be a reason for the apparent inconsistent application of  
501 the ECTS in the programmes examined in this study.

502         While there is relatively little variation in student workload from year to year within  
503 programmes, there is substantial variation in workload among institutions, despite the fact  
504 that all programmes are accredited under the same international scheme (i.e., Washington  
505 Accord). Programmes that have a relatively low student workload requirement enjoy the  
506 same accreditation privileges as those that have a relatively higher workload requirement. In  
507 contrast to total workload, significant differences exist in the number of student contact hours  
508 in the first and final years of programmes. This difference might be attributable to the greater  
509 proportion of project-based assignments in the final year of study. Written end-of-semester  
510 examination dominates other forms of assessment as the assessment technique used to  
511 determine student performance in all programmes.

512         Variations in the balance between written examinations and other assessment exist  
513 across years in many programmes but do not exhibit consistent trends. Nevertheless, the  
514 reliance on written examinations as assessment of student learning in these programmes is  
515 higher than that used in other Irish engineering, manufacturing and construction programmes.

516         In summary, the application of the ECTS system to accredited Irish civil engineering  
517 programmes appears to be inconsistent and may mislead students and academic staff who try  
518 to use ECTS as the basis for mobility decisions (learning agreements, etc.) and other study  
519 choices (selection of modules, etc.). The accreditation of programmes with widely different  
520 workload requirements warrants closer examination.

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664 Table 1. Irish civil engineering programmes

	Institution (common name)	Abbreviation	Semester Schedule (2 per academic year, 15 weeks each)	Programme	Level	Duration, years
1	National University of Ireland - Galway	NUIG	12 weeks teaching 1–2 weeks reading/revision 1–2 weeks examinations	BE (Hons) <sup>a</sup> , Civil Engineering	8	4
2				ME <sup>b</sup> , Civil Engineering	9	1
3	University College Cork	UCC	12 weeks teaching 1–2 weeks reading/revision 1–2 weeks examinations	BE (Hons), Civil and Environmental Eng.	8	4
4	University College Dublin	UCD	12 weeks teaching 1–2 weeks reading/revision 1–2 weeks examinations	BE (Hons), Civil Engineering	8	4
5				BSc, Engineering Science <sup>c</sup>	8	3
6				ME, Civil, Structural and Environmental Eng.	9	2
7				BSc, Structural Engineering with Architecture	8	3
8				ME, Structural Engineering with Architecture	9	2
9	Trinity College Dublin	TCD	11 weeks teaching 2 weeks reading/revision	BAI <sup>d</sup> , Civil, Structural and Environmental Eng.	8	4

10			2 weeks examinations	MAI <sup>e</sup> Civil, Structural and Environmental Eng.	9	5
11	University of Limerick	UL	12 weeks teaching 1–2 weeks reading/revision 1–2 weeks examinations	BE (Hons), Civil Engineering	8	4
12	Athlone Institute of Technology	AIT	12 weeks teaching 1–2 weeks reading/revision 1–2 weeks examinations	BEng (Hons) Civil Engineering	8	5
13	Cork Institute of Technology	CIT	13 weeks teaching 0–1 weeks reading/revision 1–2 weeks examinations	BEng (Hons), Structural Engineering	8	4
14				MEng, Civil Eng. (Environment and Energy)	9	1
15				MEng, Structural Engineering	9	1
16	Dublin Institute of Technology <sup>f</sup>	DIT	12 weeks teaching 1–2 weeks reading/revision 1–2 weeks examinations	BE (Hons), Civil Engineering	8	4
17				BE (Hons), Structural Engineering	8	4
18				ME, Sustainable Engineering	9	1
19	Institute of Technology, Carlow	IT-Carlow	Not semesterized; 30 weeks of instruction per academic year	BEng (Hons), Civil Engineering	8	4
20	Institute of Technology - Sligo	IT-Sligo	12 weeks teaching 1–2 weeks reading/revision 1–2 weeks examinations	BEng (Hons), Civil Engineering	8	4

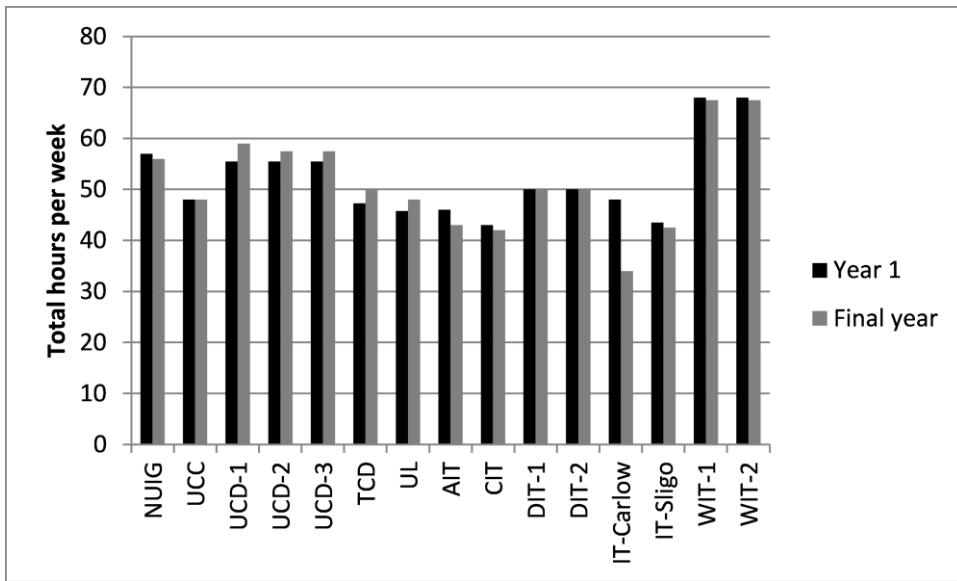
21	Waterford Institute of Technology	WIT	13 weeks teaching 1 week reading 1–2 weeks examinations	BEng (Hons), Sustainable Civil Engineering, 3 years Level 7 + 2 years Level 8 'add on'	8	3+2
22				BEng (Hons) Sustainable Civil Engineering Level 8 <i>ab initio</i>	8	4

665 <sup>a</sup>Bachelor (Honours level) of Engineering; <sup>b</sup>Master of Engineering; <sup>c</sup>Bachelor of Science in Engineering Science; <sup>d</sup>Bachelor in the Art of Engineering; <sup>e</sup>Master  
666 in the Art of Engineering; <sup>f</sup>DIT became a constituent of Technological University Dublin as of 1 January 2019.



668 Figure 1

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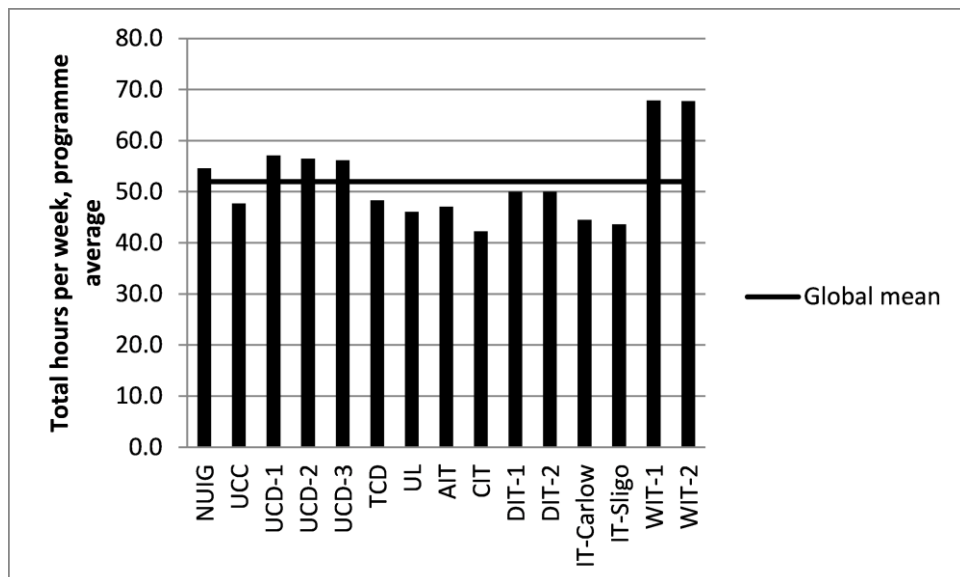
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672 Figure 2

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677 Figure 3

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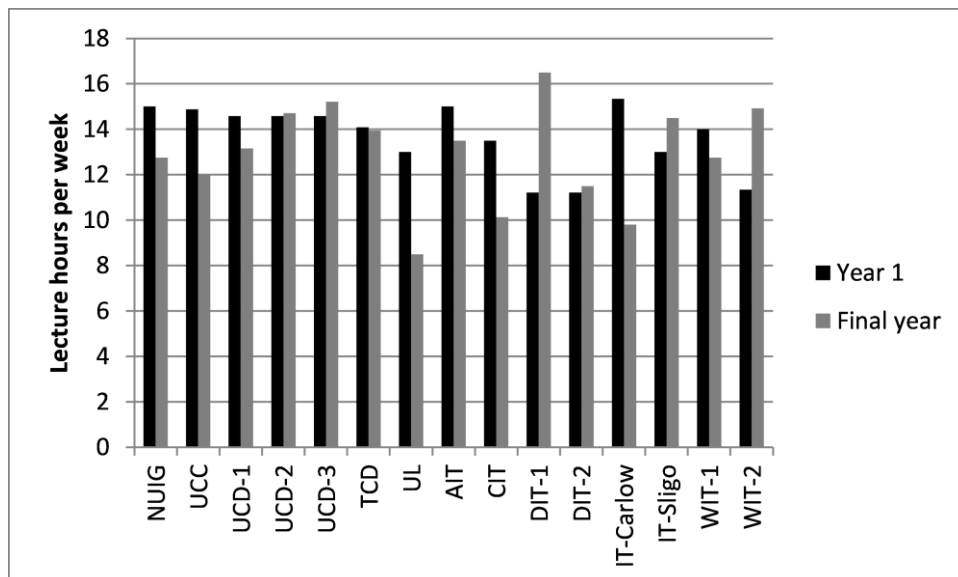
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681 Figure 4

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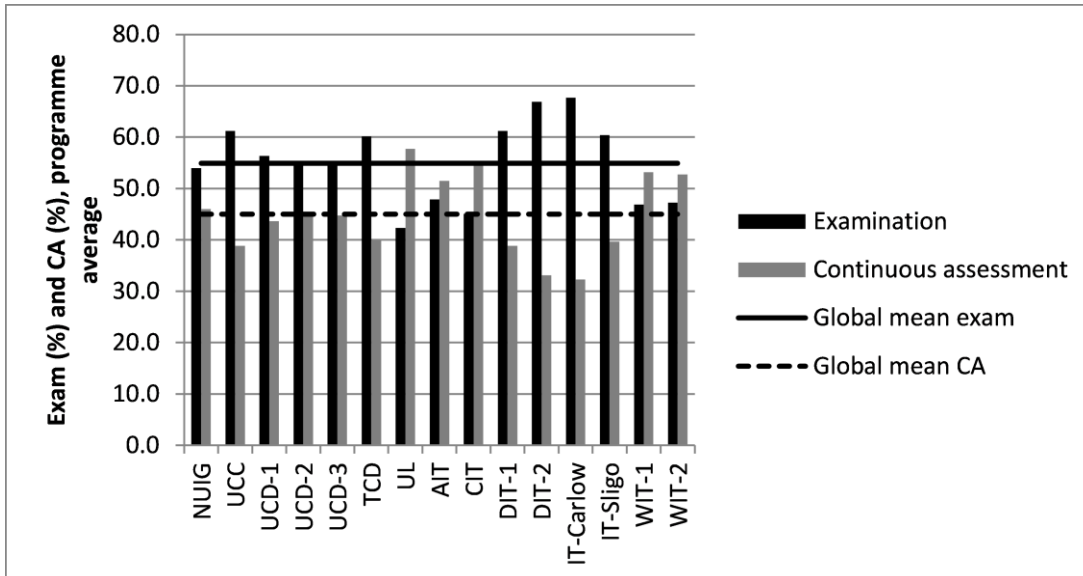
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686 Figure 5

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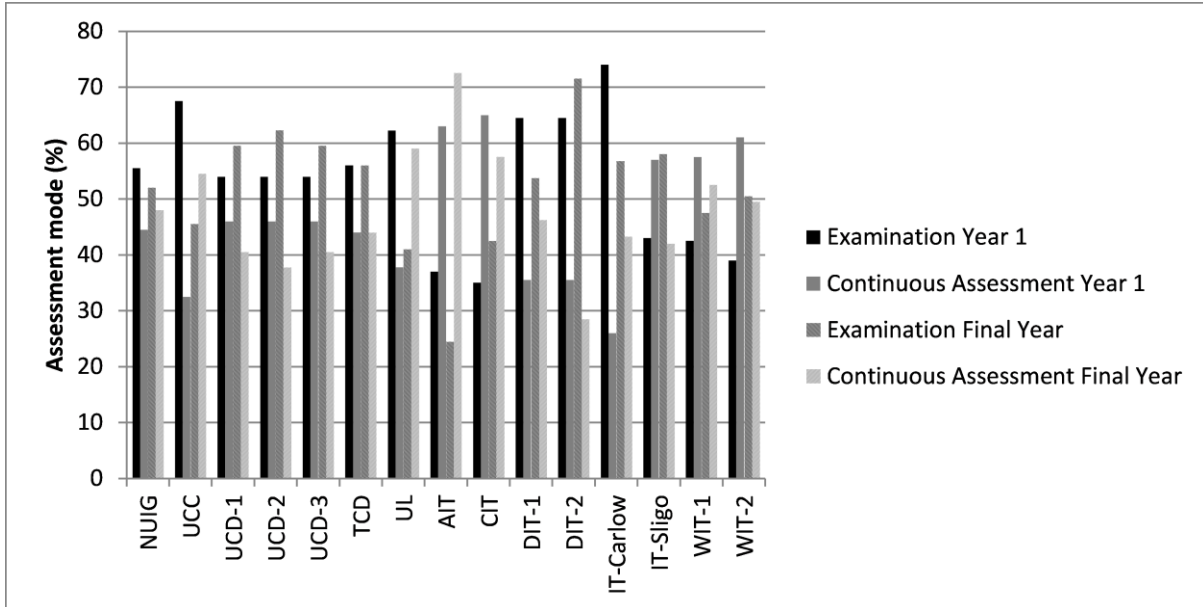
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691 Figure 6

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696 **Figure 1.** Comparison of student workload (total hours per week) in the initial and final years  
697 of all Level 8 accredited Irish civil engineering programmes. Data are averages for modules  
698 comprising each of the two years. Students graduate with a '1<sup>st</sup> cycle' engineering degree at  
699 the end of four years *except* UCD-2 (BSc in Engineering Science, 3 yrs), UCD-3 (BSc  
700 Structural Engineering with Architecture, 3 yrs), AIT (BEng in 5 yrs, i.e., 3 yrs Level 7 and 2  
701 yrs Level 8 ), WIT-1 (BEng in 5 yrs, i.e., 3 yrs Level 7 and 2 yrs Level 8).

702 **Figure 2.** Total student workload (hours per week) in all Level 8 accredited Irish civil  
703 engineering programmes. Data are averages for the entire duration of each programme (3–5  
704 years). The global mean is the average for all programmes. Students graduate with a '1<sup>st</sup>  
705 cycle' engineering degree at the end of four years *except* UCD-2 (BSc in Engineering  
706 Science, 3 yrs), UCD-3 (BSc Structural Engineering with Architecture, 3 yrs), AIT (BEng in  
707 5 yrs, i.e., 3 yrs Level 7 and 2 yrs Level 8 ), WIT-1 (BEng in 5 yrs, i.e., 3 yrs Level 7 and 2  
708 yrs Level 8).

709 **Figure 3.** Comparison of student engagement (contact hours per week) in the initial and final  
710 years of all Level 8 accredited Irish civil engineering programmes. Data are averages for  
711 modules comprising each of the two years. Students graduate with a '1<sup>st</sup> cycle' engineering  
712 degree at the end of four years *except* UCD-2 (BSc in Engineering Science, 3 yrs), UCD-3  
713 (BSc Structural Engineering with Architecture, 3 yrs), AIT (BEng in 5 yrs, i.e., 3 yrs Level 7  
714 and 2 yrs Level 8 ), WIT-1 (BEng in 5 yrs, i.e., 3 yrs Level 7 and 2 yrs Level 8).

715 **Figure 4.** Comparison of student engagement (lecture hours per week) in the initial and final  
716 years of all Level 8 accredited Irish civil engineering programmes. Data are averages for  
717 modules comprising each of the two years. Students graduate with a '1<sup>st</sup> cycle' engineering  
718 degree at the end of four years *except* UCD-2 (BSc in Engineering Science, 3 yrs), UCD-3  
719 (BSc Structural Engineering with Architecture, 3 yrs), AIT (BEng in 5 yrs, i.e., 3 yrs Level 7  
720 and 2 yrs Level 8 ), WIT-1 (BEng in 5 yrs, i.e., 3 yrs Level 7 and 2 yrs Level 8).

721 **Figure 5.** Percentages of total programme marks awarded through written examination  
722 (Exam) and continuous assessment (CA) in all Level 8 accredited Irish civil engineering  
723 programmes. Data are averages for the entire duration of each programme (3–5 years).  
724 Global means are averages for all programmes. Students graduate with a '1<sup>st</sup> cycle'  
725 engineering degree at the end of four years *except* UCD-2 (BSc in Engineering Science, 3

726 yrs), UCD-3 (BSc Structural Engineering with Architecture, 3 yrs), AIT (BEng in 5 yrs, i.e.,  
727 3 yrs Level 7 and 2 yrs Level 8 ), WIT-1 (BEng in 5 yrs, i.e., 3 yrs Level 7 and 2 yrs Level 8).

728 **Figure 6.** Comparison of student assessment mode (by examination and continuous  
729 assessment) in the initial and final years of all Level 8 accredited Irish civil engineering  
730 programmes. Data are averages for each of the two years. Students graduate with a ‘1<sup>st</sup> cycle’  
731 engineering degree at the end of four years *except* UCD-2 (BSc in Engineering Science, 3  
732 yrs), UCD-3 (BSc Structural Engineering with Architecture, 3 yrs), AIT (BEng in 5 yrs, i.e.,  
733 3 yrs Level 7 and 2 yrs Level 8 ), WIT-1 (BEng in 5 yrs, i.e., 3 yrs Level 7 and 2 yrs Level 8).