



Applicability of non-modular assessment in construction management and allied undergraduate programmes: perspective of the academics involved

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ABSTRACT

Undergraduate programmes on construction management and other closely related built environment disciplines are currently taught and assessed on a modular basis. This is the case in the UK and in many other countries globally. However, it can be argued that professionally oriented programmes like these are better assessed on a non-modular basis, in order to produce graduates who can apply knowledge on different subject contents in cohesion to solve complex practical scenarios in their work environments. The examples of medical programmes where students are assessed on a non-modular basis can be cited as areas where this is already being done. A preliminary study was undertaken to explore the applicability of non-modular assessment within construction management undergraduate education. A selected sample of university academics was interviewed to gather their perspectives on the applicability of non-modular assessment. General acceptance was observed among the academics involved that integrating non-modular assessment is applicable and will be beneficial. All academics stated that at least some form of non-modular assessment was being currently used in their programmes. Examples where cross-modular knowledge is assessed included comprehensive/multidisciplinary project modules and creating larger modules to amalgamate a number of related subject areas. As opposed to a complete shift from modular to non-modular, an approach where non-modular assessment is integrated and its use further expanded within the current system is therefore suggested. This is due to the potential benefits associated with this form of assessment for professionally aligned built environment programmes.

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1. Background

In the UK, most of the undergraduate programmes are delivered and assessed in a completely modular form. A modular assessment is one in which the content is divided into a number of units or modules, each of which is assessed separately (Rodeiro and Nadas 2010). However, in some fields of study students are assessed on a non-modular basis, at least up to a certain extent. At the undergraduate (UG) level, these seem to be core professional programmes such as medical and pharmaceutical studies. The UK universities seem to still employ non-modular assessment within postgraduate study programmes to a higher extent than in UG programmes. Leask (2014) identified over-assessment and heavy workload

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within modular assessment as key issues that favour non-modular assessment. It was also noted that non-modular programmes could lead to better student–staff relationships (ibid).

UG programmes in construction management (CM) – and other related programmes such as quantity surveying, building surveying, facilities management – are also currently being delivered and assessed on a modular basis. However, it may be argued that introducing non-modular assessment, at least partially, may benefit a professionally aligned study programme such as construction management (CM), where the knowledge of students can be assessed across different modules. Similar to other fields of study, factors such as over-assessment provide the basis for the debate as to whether the method can be re-introduced to the construction management curriculum. Opportunity provided by non-modular assessment to assess the ability of students to apply subject matter delivered in separate modules to solve real-life scenarios where cross-modular knowledge is required provides an even stronger basis for the argument. The method is adopted currently in higher degrees such as professional doctorates in the built environment. However, its use in UG programmes has been limited, since the universities have shifted towards modular delivery and assessment in recent decades. This research was developed to explore the applicability of non-modular assessment in construction management UG programmes. There is limited discourse in the literature and research contextualising application of non-modular assessment within UG built environment programmes.

To a certain extent, universities now attempt to assess students undertaking construction management and allied programmes on their cross-module knowledge and understanding through a separate module. This is being achieved through a module in which students have to design and plan a project for a given (real or hypothetical) scenario. However, this is done in addition to regular module assessments. Further, its primary objective is to provide students with an understanding of roles and responsibilities of different professions involved in designing a construction project and to develop their ability to work together as a team. The study investigates the possibility of adopting non-modular assessment to an even greater extent within construction management and allied programmes. It seeks to explore this issue by reviewing literature and qualitatively assessing the views of academics involved in delivering UG construction management programmes.

2. Aim and objectives of the study

The aim of the study was to explore whether non-modular assessment can be adopted as an effective assessment technique in UG construction management programmes. The objectives of the study were to:

- Assess the pros and cons of adopting non-modular assessment in construction management and allied undergraduate programmes.
- Investigate the applicability of non-modular assessment within current construction management curricula.
- Identify issues that may arise and will have to be addressed if the technique is to be adopted.
- Determine and recommend whether to, and if so how to, adopt non-modular assessment in UG construction management programmes.

The study seeks to explore the above from the perspective of academics involved in designing and delivering construction management programmes. Whilst a comprehensive study will benefit from gathering the perspectives of diverse stakeholders such as the industry, professional institutes, universities, and students, this phase of the study is limited to exploring the perspectives of academics involved.

3. Modular and non-modular assessments

Modular assessment describes a system whereby the content is divided into a number of units or modules, each of which is assessed separately (Rodeiro and N adas 2010). This is facilitated by modular programme delivery, which is a common and widespread practice across higher education institutes

in the UK and worldwide. Developed in the 1970s, the modular curriculum is considered an important innovative development in education (Carr 2003). It has since become increasingly popular and adapted worldwide, as it is thought that modular programme delivery offers flexibility and choice for students, reduces the cost of delivery, enables student numbers to be expanded and facilitates centrally administered structures of regulation (Booth et al. 2000). When these modules are assessed separately, modular assessment occurs. Rodeiro and Nadas (2010), through a detailed review of the literature, identified issues such as the ability to spread assessments over the term/year; the ability to re-take a module rather than the entire assessment, making it easy for students to prepare for assessment and manage their time effectively; and ease of revision as some of the advantages associated with modular assessment.

However, modular programme delivery and assessment is not without criticism. For instance, in the same study mentioned above, Rodeiro and Nadas also identified a range of disadvantages of modular assessment. They identified issues such as danger of fragmentation of learning and lack of coherence in learning programmes; poorly developed overview of subjects; inability to connect discrete areas of knowledge, adversely affecting the coherence of a programme; possibility of assessment rather than learning taking centre stage; and over-assessment as some of the key drawbacks of modular assessment. Similar views have been shared by other researchers. For example, Cox and King (2006) found disadvantages such as students not forming coherent groups as they progress through the course together; difficulty tracking students' progress, as each student can have their own individual programmes of study; and various module combinations confusing employers regarding what subjects have been studied. Leask (2014) identified over-assessment as one of the key issues associated with modular assessment in UG programmes. 'Bunching' of assessments, where assessments are concentrated around the mid and later stages of a term/year, was also identified as a key issue (ibid).

Due to these issues, approaches in which modular assessment is complemented by non-modular assessment within a programme or where courses are being offered on a completely non-modular basis have been introduced by higher education institutes. Non-modular professional doctorate programmes (Frame 2013) and non-modular postgraduate taught and research programmes are some examples. At the UG level, non-modular programmes offered by the Faculty of Medicine, Dentistry and Health at the University of Sheffield, by the School of Social and Community Medicine at the University of Bristol, and by the School of Medicine at Cardiff University can be cited as some examples of UG programmes delivered completely on a non-modular basis. Additionally, there are many examples of non-modular and modular assessments being used in a complementary fashion at the UG level by UK universities.

The salient feature of non-modular programmes offered at the UG level seems to be that they are often courses related to medicine and allied professions, where complete and coherent knowledge and expertise in the subject content is required to be a skilled practitioner. This would require them to be able to link subject content learned progressively and apply it coherently rather than in isolation; whereas the lives of patients could be at risk if this was not the case. Hence, such professional disciplines seem to favour non-modular assessment. Whilst it may be argued that a similar level of professional expertise is not required by construction management graduates, perhaps a similar level of professional expertise should be expected of them graduates as clients, employers and society in general rely on their professional judgement and practice.

4. Non-modular assessment in undergraduate construction programmes

4.1. Nature of construction higher education

Higher education institutes that produce CM graduates cater for an important sector in any economy. In the UK, for example, the industry contributes to over 7% of gross domestic product, and accounts for over £110 billion of economic activity (Cabinet Office 2011). Accordingly, the government recognises that a successful construction industry is vital for sustainable growth, as the industry is responsible for the delivery and maintenance of residential and commercial properties, and economic and social infrastructure that support the whole economy of the country (HM Treasury 2011). CM graduates are

expected to play a key role in this significantly important industry sector. Being professionally oriented programmes, UG construction management courses are therefore required to cater for the requirements of the industry. For instance, as the industry is characterised by its fragmented and adversarial nature, it is continuously being encouraged to develop collaborative working (Cabinet Office 2011; Egan 1998; Latham 1994). Therefore, HE institutes are being required to develop graduates with the ability to work collaboratively with the stakeholders involved. This requirement – the need to develop graduates with the ability to engage in effective cross-disciplinary teamwork with other industry professionals – was highlighted by Nicol and Pilling (2005). However, universities have long been criticised for not covering the subject matter that the industry requires (Oglesby 1983). Specifically, the HE sector has been found slow to respond to emerging trends, for example to address issues related to flood adaptation and disaster risk reduction within their UG programmes (Wedawatta, Ingirige, and Proverbs 2012). Although such criticisms exist, it is clear that industry requirements play a prominent role in determining the direction of UG programmes in CM.

Further, as Durning and Jenkins (2005) noted, links with professional bodies significantly shape the relationships of students and staff in CM higher education. Most programmes are accredited by professional institutes such as the Royal Institution of Chartered Surveyors (RICS) and the Chartered Institute of Building (CIOB). For instance, Aston's undergraduate programme in Construction Project Management is accredited by both these professional institutes. Therefore, the curriculum is determined by the accreditation frameworks of these professional institutes to some extent. The CIOB Education Framework, for example, must be followed when applying for CIOB accreditation/re-accreditation and to inform programme design or review in CM education (CIOB 2013).

Chynoweth (2009) discussed the built environment as an applied, but theoretically coherent, inter-discipline. Further, according to Gajendran et al. (2014), the construction manager's role in project-based organisations is dominated by complexity, uncertainty and interconnectivity. The inherent nature of the construction industry, and its operation within uncertain and dynamic socio-cultural-political environments, poses considerable difficulties for those working on and trying to understand construction projects. Therefore, it was concluded that such a turbulent operating environment demands CM graduates who have the knowledge, skills and attitudes needed to operate in it (Gajendran et al. 2014).

Summating these features, the subject benchmark statement for UG construction programmes (Quality Assurance Agency for Higher Education 2008) identified a range of issues related to the nature of such courses. It was noted that students are required to acquire the subject-specific skills that will enable them to work effectively within their field and develop generic, cognitive skills which they will be able to apply within their academic and work contexts upon graduation (ibid). The students on UG construction programmes also highly value practice-relevant, hands-on learning whereby references are made to tangible and real situations (Frank 2005). It is therefore essential that these skills and competencies are instilled among CM graduates through learning and assessment.

4.2. Assessment in undergraduate construction programmes

Given that construction is a discipline that links theoretical, practical and professional competencies, the pedagogy adopted is encouraged to embrace practical application of theory and include a variety of assessment methods (Quality Assurance Agency for Higher Education 2008). There also seems to be a great deal of emphasis on including both formative and summative assessment within the undergraduate CM programmes (CIOB 2013; Construction Industry Council 2005; Perera and Pearson 2013; Quality Assurance Agency for Higher Education 2008). In general, UG programmes in construction seem to follow a modular structure in delivery of learning content and its assessment. Within this overall structure, however, HE institutes seem to employ a variety of assessment methods as encouraged by the Quality Assurance Agency for Higher Education.

One of the key issues associated with modular learning and assessment in UG construction programmes seems to be the lack of coherence; that is, assessing students' ability to connect specific subject content learned within different modules in order to solve complex problems. For example,

Chynoweth (2009) found that law-related modules are rarely integrated with other subjects and law subjects were delivered and assessed exclusively within their module. It was noted that a wider interdisciplinary curriculum integrating all necessary subject domains (technology, management, law and so on) is required. Although the subject benchmark statement for construction programmes (Quality Assurance Agency for Higher Education 2008) recognises the multidisciplinary and applied nature of CM education and the need for producing graduates with cognitive skills and the ability to apply their learning in practical settings, it falls short of specifically calling for the assessment of students' overall knowledge and understanding rather than in isolation within specific modules.

Further, CM programmes are often attributed with over-assessment. During his time at three UK universities, this researcher has observed that undergraduate CM programmes offered by HE institutes often tend to over-assess students, a situation reported by other academics too (Higgins, Grant, and Thompson 2010; Scott and Fortune 2013). Further, although it was found comparable to levels reported in previous research using non-construction student samples, Lingard et al. (2007) did observe burn-out among undergraduate CM students. Whilst assessment load was not a variable studied therein, over-assessment could well be associated with this phenomenon.

4.3. Applicability of non-modular assessment in undergraduate construction programmes

The rationale for inclusion of some sort of non-modular assessment in undergraduate CM programmes is based on the issues discussed above. As detailed in Section 3, modular assessment is associated with drawbacks such as danger of fragmentation of learning and lack of coherence in learning programmes, poorly developed overview of subjects, inability to connect discrete areas of knowledge, and an adverse effect on the coherence of a programme (Rodeiro and Nádas 2010). Such drawbacks could be particularly damaging for professionally aligned UG programmes similar to CM.

Similarly, the RICS (2014) also requires graduates to have the ability to apply theory in practice. What this highlights is that both the industry and the professional bodies require graduates to be able to apply what they learn in practice. Further, as noted by Lee et al. (2011), the changing nature of social, economic and environmental issues related to CM drives CM programmes to produce more prepared personnel. Furthermore, CM professionals are expected to be competent problem-solvers in construction projects and organisations. This requires them to apply different subjects learned separately at the university in coherence to solve problems and make decisions. Such cognitive skills need to be instilled among undergraduate CM students during their studies. It can be argued that at least a certain degree of non-modular assessment is required within undergraduate CM programmes to achieve these objectives.

Considering the need for problem-solving skills by integrating content learned in different modules, universities have attempted to introduce assessment that assesses the knowledge and understanding of students across different modules and subject content learned progressively. One such development is the use of a separate integrated project module in which students from different subject backgrounds come together or play the role of different professional members in a project team to develop a comprehensive solution to a real or hypothetical scenario. As noted by Wood (1999), such assessments act as a method of fostering collaboration, enable students to experience working together and encourage them to appreciate the abilities and roles of others, as well as putting their own specialism into context. Therefore, it is inevitable that students will benefit from more assessment of their knowledge across modules, either via non-modular assessment or through separate modules for this purpose (which in this study is identified as a form of non-modular assessment due to the fundamental arguments behind their introduction being similar to those of introducing non-modular assessment discussed here).

Further, Scott and Fortune (2013) noted that students find it difficult to benefit from feedback as comments relate only to specific modules. This suggests that students would benefit from an approach where feedback is provided by making connections to other modules, that is, cutting across modules. In practice, this would be possible if non-modular assessment were included within UG programmes.

Frame (2013) demonstrated the ability to design and operate a non-modular programme at the doctoral level to meet the needs of professionals working in construction. Although this programme related

to a doctoral programme, it does suggest the applicability and suitability of non-modular learning and assessment in built environment/construction management courses in higher education.

A further justification would be how this type of delivery and assessment is being used in medical and allied UG programmes, as mentioned in Section 3. It can be argued that, as professionally aligned programmes seek to deliver competent professionals to the construction industry, a similar standard of expertise should be expected from CM graduates. The decisions and actions of the CM graduates have significant and far-reaching effects on many fronts, including for the organisations that employ them (financial, reputational, legal), people working for and with them (health and safety, personal wellbeing), government and local authorities (rules and regulations, government strategy) and society in general (sustainability, climate change, health and safety).

5. Research method

5.1. Research design

Whilst it is not intended to discuss the philosophical stance of the study in detail, it is necessary to describe it briefly in order to clarify the methods adopted. The philosophical position of this research was that of an interpretivist. Interpretivism is an epistemology that advocates the necessity of the researcher understanding the differences between humans in their role as social actors and to emphasise those differences when conducting research among people rather than objects (Saunders, Lewis, and Thornhill 2009). The nature of research questions involved in the study favoured this philosophical stance.

The extent to which a researcher is clear about the theory at the beginning of a project raises important questions about research design and which research approach will be employed (ibid). Two approaches that can be undertaken therein are deduction (testing theory) and induction (building theory). The deductive approach involves the researcher developing a theory and hypothesis and designing a research strategy to test that hypothesis. The inductive approach involves the researcher collecting data and developing a theory based on analysis of that data. According to Collis and Hussey (2009, 8), inductive study is 'a study in which theory is developed from the observation of empirical reality; thus, general inferences are induced from particular instances'. Given that the study sought to investigate the views of academics involved in undergraduate CM programmes and to seek answers to the research questions, it was thought that the inductive approach was most suitable.

Philosophical positioning and the research approach favoured the adoption of a qualitative research design. Qualitative research, according to Creswell (2003, 18), is 'one in which the researcher often makes knowledge claims based primarily on constructivist [which is closely aligned with interpretivism] perspectives, or advocacy/participatory perspectives or both'. Under the qualitative approach the researcher, according to Creswell, collects open-ended, emerging data and develops themes from them. Given that this research was undertaken as an exploratory study, the qualitative research approach was selected as best suited to achieve the expected aim and objectives. Within this, semi-structured interviews were conducted to collect information from the research participants.

5.2. Data collection method

Bryman (2008) and Cassell (2009) identified interviews as probably the most widely utilised method in qualitative research. Interviewing is a method for collecting data in which selected participants are questioned in order to find out what they do, think or feel (Collis and Hussey 2009). Semi-structured interviews allow collection of specific information from participants whilst maintaining a consistent line of inquiry. Short telephone interviews were conducted with the selected participants to gather their views and opinions. A similar research design was used by Wood (1999) to explore attitudes among CM academics to the introduction of interdisciplinary working within built environment education, suggesting the suitability of this method for this research. Ethical approval was obtained from Aston University prior to execution of the data collection process and informed consent was obtained from the participants.

5.3. Sample

Informants involved in the study were academics – lecturers, senior lecturers and programme directors – involved in the design and delivery of UG construction management and allied programmes (e.g. quantity surveying) in UK universities. Access was possible as a result of the researcher's personal connections with such academic staff.

A purposive sampling technique was adopted for selecting and recruiting universities and academics for the study. According to Saunders, Lewis, and Thornhill (2009), purposive sampling enables a researcher to use his/her own judgement in selecting cases in a way that best enables the researcher to answer the research questions and accomplish the research objectives. Yin (2011) commented that purposive sampling was likely to be used in qualitative research where samples are selected in a deliberate manner. He highlighted that the reasoning behind the use of purposive sampling was to select the cases that could provide the most relevant and rich data. The sample of academics selected for the study sought to achieve a balance of participants in terms of their role in programme design and delivery, assessment design and delivery, level of experience and standing of their university. Accordingly, short telephone interviews were conducted with the selected sample.

Table 1 presents the sample of participants involved in the study. Accordingly, academics from nine UK universities that offer CM and allied programmes were interviewed for the study – out of an original sample of ten. The sample consisted of academics with significant teaching experience in an HE setting to early-career academics who have been involved with teaching and assessment for a few years. Whilst some universities (e.g. U5 and U6) only offered a single undergraduate CM programme, others offered a number of related programmes.

5.4. Data analysis

Data collected from the interviews were analysed using content analysis. According to Easterby-Smith, Thorpe, and Jackson (2008), content analysis is a technique in which the researcher interrogates data for constructs and ideas that have been decided in advance. Krippendorff (2004) identified that content analysis can take the form of word count or be thematic and conceptual. In this study, conceptual content analysis was used to analyse interview data. In conceptual content analysis the text is scrutinised to check the existence of a concept, considering terms related to the concept both implicitly and explicitly (ibid). Conceptual content analysis was adopted in this study. Therefore, as opposed to numerical count or frequency, importance was placed on the views expressed by the interviewees irrespective of the number of times the issue was mentioned. Considering the sample size, this method allowed for the capture of a wide spectrum of issues raised by the participants.

Table 1. Details of the interview sample.

University	Academic	Position	Programmes delivered at the university
U1	U1A	Lecturer	Construction Management, Quantity Surveying, Building Surveying
U2	U2A	Senior lecturer/programme director	Construction Management, Construction Project Management, Quantity Surveying
U2	U2B	Senior lecturer	Construction Management, Construction Project Management, Quantity Surveying
U3	U3A	Lecturer	Construction Project Management, Quantity Surveying
U4	U4A	Senior lecturer	Construction Management, Construction Project Management, Quantity Surveying, Facilities Management
U5	U5A	Lecturer	Construction Management
U6	U6A	Lecturer	Construction Project Management
U7	U7A	Senior lecturer/programme director	Construction Management, Construction Project Management, Quantity Surveying
U8	U8A	Lecturer	Quantity Surveying, Building Surveying
U9	U9A	Lecturer	Construction Engineering Management, Commercial Management and Quantity Surveying

6. Findings and analysis

The interviews with the academics involved in designing and delivering undergraduate CM programmes in UK universities addressed the following issues: applicability of non-modular assessment in UG programmes in CM, whether and how it is being currently applied in their institutes, opportunities to further expand its application, potential benefits of and barriers to implementation of such assessment and how to overcome such barriers. The following sections present and discuss findings from the interviews.

6.1. *Applicability of non-modular assessment in undergraduate CM programmes*

In general, the academics interviewed were in agreement that non-modular assessment is applicable in undergraduate CM programmes. The main reason cited for its applicability was its ability to provide cross-disciplinary knowledge to students thus enabling them to obtain better overall understanding. This is consistent with the rationale behind this study, as discussed previously. The following observations were made:

I'm supportive of using non-modular assessment for progressive knowledge development that will help students. (U2A)

Non-modular assessment is a quite essential and beneficial form of assessment within undergraduate construction programmes given that construction is a multi-professional effort; and application of knowledge during construction requires cross-disciplinary understanding and understanding across modules. (U3A)

In a way non-modular assessments provide a greater opportunity for students to articulate everything in a single bit, which of course helps them to foresee the big picture of their programme. (U4A)

Non-modular assessment methods are vital in order to ensure that students meet all module learning outcomes. (U5A)

However, it was also noted that caution has to be exercised when introducing/using non-modular assessment within the current HE and institutional settings. One academic noted that the method will only be effective in some areas, whereas modular assessment will be beneficial in other cases. There was agreement that switching to a complete non-modular assessment framework would not be applicable or practicable. It was recognised that opting for a combination of modular and non-modular assessment is a better way of achieving learning outcomes and producing industry-oriented graduates, as these comments demonstrate:

It would be dangerous to use only non-modular assessment as construction programmes should cover theory and practices in different domains. However, it would be good to mix modular and non-modular assessment so that students have a chance to be assessed in a balanced manner. (U6A)

A combination of modular and non-modular would be good. It would allow the essential element of integration to be achieved within the programmes. (U8A)

6.2. *Benefits of non-modular assessment to CM programmes*

The views of the academics were gathered on the potential benefits of using non-modular assessment within undergraduate CM programmes. The views expressed are summarised in Table 2, based on those of students, academics and the industry.

Analysis of the potential benefits identified by the academics demonstrates that many of the benefits will accrue to students and the industry. These benefits are mainly associated with students being able to receive a practically-relevant coherent learning experience which will enable them to collaborate effectively within the project team. The industry, on the other hand, will benefit from graduates with problem-solving skills and multidisciplinary knowledge and understanding who will be able to quickly adapt to working conditions and contribute effectively to the construction team. Therefore, there seems good justification to integrate non-modular assessment within undergraduate CM programmes, as clear benefits can be expected.

Table 2. Benefits of integrating non-modular assessment in undergraduate CM programmes.

Students	Academics/universities	Industry	Other
<ul style="list-style-type: none"> • Reduced assessment load • Less pressure on them • Improved quality of assessments • Progressive knowledge development • Opportunities for collaborative working • Opportunity to learn key principles of team working • Opportunity to become familiar with the roles and responsibilities of other construction professionals • earn and understand where and how their knowledge, skills and expertise could form part of the entire collaborative effort • improve practical application skills • reater confidence • Chance to avoid fragmentation in learning 	<ul style="list-style-type: none"> • Ability to assess student knowledge on the whole component rather than in parts • Ability to provide a more coherent picture • Less marking load • Increased graduate employment rates • Increased value of UG programmes in the industry • Better National Student Survey (NSS) score 	<ul style="list-style-type: none"> • Opportunities to get more involved with UG programmes • Help the industry to establish strong links with academia • Identify deficiencies in student skills and knowledge in real-life scenarios • Receive innovative, creative thinkers as graduates • Graduates who will require less time to adapt to working conditions • Graduates with multidisciplinary, problem-solving skills • Less risk in hiring fresh graduates • Resolve industry fragmentation in terms of disciplines, knowledge, people 	<ul style="list-style-type: none"> • Opportunity to re-visit Assessment of Professional Competence (APC) criteria

6.3. Current use of non-modular assessment in CM programmes

All academics stated that at least some form of non-modular assessment was currently used in their UG programmes. Examples where non-modular assessment is included or where students are assessed across modules included individual/group case studies, group presentations, virtual models, scenario-based assignments and role-play. Academics specifically recognised that the objective of providing cross-disciplinary understanding is currently being achieved though the inclusion of separate modules. The examples noted were:

- Integrated project module/multidisciplinary project module
- Professional practice module/integrated professional practice module
- Final-year dissertation module

No examples of modules being assessed together (e.g. construction technology and measurement delivered separately, but assessed together) were noted. However, instances where modules have been combined and allocated a higher credit load (double or triple, based on how many modules are brought together) to create super modules were noted. This actually suggests that non-modular assessment has been integrated within the existing modular system in undergraduate CM programmes in some of the universities included in the study.

The academics recognised the relevance of and need for assessing students' cross-disciplinary knowledge and understanding. Whilst no programmes involved in the study are currently being delivered on a completely non-modular basis, it was also recognised that a complete shift from the current system would not be ideal. Rather, a system in which traditional modules are combined to create super modules, separate modules are brought together across different subject domains and assessment of students' cross-disciplinary knowledge via different formative assessment methods seems to be the current approach undertaken.

6.4. Potential for further application

Academics were questioned on whether there is potential to further apply non-modular assessment within undergraduate CM programmes, and many responded in the affirmative; for example:

'Yes, some modules need knowledge and understanding from previous or concurrent modules, which can be easily grouped together during summative assessments' (U1A)

In particular, it was mentioned that new developments related to construction, such as building information modelling (BIM), will present more opportunities for this. This is due to the fact that BIM makes it possible to bring different subject domains together, for example drawing and CAD, measurement, scheduling, cost estimating and so on:

With the introduction of building information modelling there will be more opportunities to use non-modular assessment within the UG programmes. (U4A)

[BIM will allow for] more simulated professional practice and research-driven teaching. (U8A)

Further, it was also noted that expanding the use of non-modular assessment should be carefully assessed to ensure that learning outcomes are properly achieved:

It is more about achieving a balance between modular knowledge-driven sections and practice-based cross-modular, inter-disciplinary requirements. (U7A)

The need for achieving a balance between the two types was again highlighted. One academic opined that a complete revamp of course structure would be required if more non-modular assessment were to be included. In general, it was accepted that a complete revamp would not be desirable; rather, the integration of non-modular assessment within the current modular structure would be appropriate.

6.5. Challenges for further application and way forward

For ease of analysis, academics' views on barriers to the inclusion or further expansion of non-modular assessment are categorised in four groups: student-related, staff-related, programme/institute-related and external. Table 3 summarises the views expressed by the academics under these four categories. Given that it was difficult to attribute resistance to change and the challenge of convincing all stakeholders involved to a particular group(s), these were included in the table as factors related to all groups in general.

Some of the issues expressed can, in fact, be identified as drawbacks to the inclusion of non-modular assessment; for example, difficulties in planning and managing modules, additional work for academics and lack of flexibility for students. There were concerns that additional non-modular assessment and the resultant combined workload difficulty associated with spreading out assessments may not be preferred by students. There was also recognition that the approach would increase the workload of academics. It was noted that setting appropriate assessments, marking and providing detailed feedback would be difficult. There was also recognition that more non-modular assessment would require additional resources, create operational and planning difficulties and require changes to current programme and assessment structures. It was also noted that cross-modular assessment via integrated projects would require greater industry involvement. Lack of industry involvement was therefore identified as a

Table 3. Challenges for integrating/urther expanding the application of non-modular assessment.

Student-related	Staff-related	Programme/nstitute-related	External
<ul style="list-style-type: none"> • Student expectations • Difficulties in managing student workload • Student demand for structured and spread-out assessment points • May not always allow students to pick and choose subjects; low flexibility 	<ul style="list-style-type: none"> • Difficulties in marking and providing feedback • Academics' lack of industry practice/experience • Issues related to setting an appropriate assessment • Additional workload for academics • Difficulties in managing the pace of students' work and learning 	<ul style="list-style-type: none"> • Difficulty in planning and managing modules • Operational issues including staff timing, appropriate facilities, timetabling • High resource requirement • Current programme and assessment structures • Difficult to cover all the necessary knowledge and skills • Relevance and inter-connection between some subjects, concepts and principles • Could act as a barrier to sharing modules across programmes 	<ul style="list-style-type: none"> • Lack of industry involvement
<ul style="list-style-type: none"> • Resistance to change • Convincing the stakeholders involved 			

Table 4. Suggestions of means by which to overcome challenges.

Student-related	Staff-related	Programme/institute-related	External
<ul style="list-style-type: none"> • Clear communication of assessment criteria and the purpose/benefits of non-modular assessment 	<ul style="list-style-type: none"> • Improving practical knowledge of academics • Improving the involvement of academics in non-modular assessment • Integrating past knowledge/aspects taught in previous modules within the current assignments/reports, etc. • Cooperation with other colleagues would be necessary as one lecturer would not be able to cover all different disciplines 	<ul style="list-style-type: none"> • Re-assessing and careful designing of curriculum, well-structured specification • Making it a requirement for the relevant department • Careful planning to achieve all learning outcomes through non-modular assessments • Additional staff to enable adoption of the approach • Considering the needs of non-modular assessment when selecting and allocating modules among teaching staff • Develop specialised multidisciplinary lecturers 	<ul style="list-style-type: none"> • Better collaboration with the industry

barrier to expanding such cross-modular assessment. Accordingly, if non-modular and cross-disciplinary assessment is to be enhanced, these barriers will have to be addressed.

Academics' suggestions for overcoming the difficulties posed by non-modular assessment are also grouped under the classifications described above and are shown in Table 4. Accordingly, it can be seen that many of the improvements are related to curriculum design and the capacity of academics. It was highlighted that academics will have to venture beyond their specialist subject domains and expand their knowledge base and practical understanding if non-modular assessment were to be increased. It was also recognised that cooperation among academic staff would be required to make the approach a success, as it was accepted that many academics would be unwilling or hesitant to deliver super modules spanning different subject domains on their own. To address this competency requirement, it was suggested that universities develop more multidisciplinary lecturers. These comments suggest the need for capacity building of academics in terms of their knowledge, understanding and teamworking ability if non-modular assessment is to be increased. The other major suggestions for improvements included issues around curriculum design and development. The importance of obtaining comments and feedback from internal and external stakeholders, including the industry and professional institutions, were cited as important if barriers to non-modular assessment were to be overcome.

The analysis of potential benefits described in Section 6.2 demonstrated that many of the potential benefits will accrue to students and the industry. However, difficulties and suggestions to address those difficulties demonstrate that many of those are related to either academics or universities/programmes. Therefore, it can be seen that a lot of work needs to be undertaken by the academics and universities in terms of implementing/introducing/expanding non-modular assessment practices, although these will in the main benefit students and the industry.

7. Conclusion and recommendations

It was generally accepted among academics that integrating non-modular assessment is applicable and would be beneficial on undergraduate CM programmes (and other closely-related built environment disciplines). Whilst a complete shift from modular assessment to non-modular assessment will require extensive re-designing of assessment practice, regulations and so on, this does not appear to be the preferred option on undergraduate CM programmes within the current academic context. What is required on these programmes is an approach in which non-modular assessment complements modular assessment in order to derive the benefits of both methods and give professionals problem-solving ability, applying what they have learned in individual modules coherently rather than in isolation. There was a strong justification for and agreement with the inclusion and further development of cross-disciplinary,

cross-modular assessment due to the benefits it will create. This is fundamentally due to CM being a profession that cuts across many knowledge domains and disciplines, requiring CM graduates to possess a multidisciplinary understanding of construction. Given that cross-modular assessment was considered a form of non-modular assessment in this research, differentiation between these concepts was not attempted. However, if strict differentiation is applied, there seems to be stronger support for enhancing the application of cross-disciplinary, cross-modular assessment than for a dominantly non-modular system, given current programme structures.

The study identified that such practices can benefit both students and the construction industry significantly. For students, the main advantages identified in the study included the ability to obtain a multidisciplinary perspective, working collaboratively and reduced assessment load. It was identified that the industry would benefit by receiving graduates with an overall perspective and problem-solving and team-working skills, who will be able to quickly adapt to working conditions. Whilst it was identified that there was potential to further apply non-modular assessment within undergraduate CM programmes, it was noted that this has to be done with caution and proper planning. It was also noted that technological innovations like BIM have enabled further application of non-modular assessment. Challenges that will need to be managed in doing so included student expectations and flexible study options, difficulties in marking and providing feedback, lack of industry experience among academics, difficulties in planning and scheduling assessments and increased resource requirements. Suggestions for improvements included furthering the practical knowledge of and cooperation among academics, and developing specialised multidisciplinary lecturers.

Therefore, it is recommended that higher education institutes further expand their cross-disciplinary assessment practices within postgraduate CM programmes. Means of doing so can include creating super modules to combine related modules, modules being assessed in combination with what was delivered in prerequisite modules, and having separate modules to bring different subject domains together, for example an integrated/multidisciplinary project module. It is important that barriers hindering the application/further application of a non-modular approach are addressed appropriately. The need for academia to work closely with industry and vice versa was highlighted in order to reap the potential benefits of the non-modular approach. Given the government initiative to make applications of BIM widespread, the opportunities presented by the technology can be utilised effectively to expand the application of non-modular assessment.

This was an exploratory study and is the first step towards further research in this area. It explored the perspective of academics involved in designing and delivering undergraduate CM programmes. A limitation of the study is that the findings reported are limited to the stakeholders involved: the academics. Whilst it can be argued that academics have been able to provide an account of all stakeholders involved as a result of their overall understanding of undergraduate CM education, a study involving all major stakeholders would be a suggestion for future research. A further descriptive study can be undertaken to investigate the perspective of the diverse stakeholders involved, such as the industry, professional institutes, university management and students. Given that the construction industry that recruits CM graduates includes a wide variety of firms representing contracting, consultancy, property development and so on, and which range in size (over 95% of construction firms are small to medium-sized enterprises), the views of all such industrial sectors will have to be represented in such a study. This will provide an overall perspective on whether the approach is favoured by all stakeholders involved. Further, the sample of academics involved in the study was small. A further suggestion would be to undertake an expanded study involving more academics and using the deductive approach to test the initial observations made in the study. The findings reported here thus need to be interpreted in light of the limitations of the current study.

Disclosure statement

No potential conflict of interest was reported by the author.

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