Mapping the Information Systems Curricula in UK Universities

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ABSTRACT

Information Systems (IS) undergraduate student numbers in the UK have reduced by half in the last five years. An increasing number of researchers have been pondering the possible relationship between the modernity of IS curricula and its attractiveness to potential students. To support the debate about IS curricula in the UK and elsewhere, this study provides a comprehensive review of the provision of IS courses across the UK which has not been carried out before on such a large scale. The review focuses on classifying IS courses using two separate classification methods, one of which draws on the UK Quality Assurance Agency's (QAA) Subject Benchmark Statement for Computing (SBSC), and a second that is based on the well established IS 2002 model curriculum. Results are compiled by attributing subjects to categories that have been extended to ensure the accurate reflection of the content of courses, taking into account the variations that exist in terms of module sizes, naming conventions and core/option module relationships. Overall, programming, project management and database design are shown to be the most popular IS subjects offered in the UK. The analysis of the results incorporates limitations that affect the interpretation of the data by highlighting the inherent complexities that exist in trying to measure wide-ranging curricula that borrow subjects from different fields. The findings presented should support IS academics, researchers and course designers in their quest to improve curricula and the IS discipline whose future prospects are tied to the recruitment of adequate numbers of students.

Keywords: Curriculum Design, IS Education, IS Curriculum Classification, Information Systems Curricula, IS Model Curriculum, Subject Benchmark Statement in Computing

1. INTRODUCTION

The phenomenon of decreasing IS (Information Systems) as well as computing student numbers has been causing concern to academia worldwide for some time (Aken and Michalisin, 2007; Foster, 2005; Plice and Reinig, 2007; White and Irons, 2007). The potential causes of the decline have been documented extensively by researchers who have highlighted the burst of the dotcom bubble, the impact of outsourcing, and the inappropriateness of the IS curriculum, as possible reasons for the downward trend in IS student applications (Granger et al., 2007; Hirschheim, 2007; Panko, 2008; Kung et al., 2006; Walstrom et al., 2008). Originally the impact of falling student numbers was seen as an issue affecting universities and the changing ratio of academics to students. However, the impact of low student numbers is now beginning to reach the IT industry which has been struggling to find well qualified IS graduates (Foster, 2005).

In the UK, industry and government alike have been concerned about diminishing student numbers in key subject areas, resulting in various initiatives of corrective action. The size of the undergraduate IS student population in the UK, according to the most recently published figures by the Higher Education Statistics Agency (HESA), in 2008/09 was 16,850, a decrease of 7.9% from the previous year. The trend of declining numbers in the UK started around 2004/05 when the IS student population peaked at 34,010 making that year the largest cohort since HESA data was made available (http://www.hesa.ac.uk/index.php/component/option,com_datatables/Itemid,121/task,show_category/catdex,3).

One of the by-products of this decline, not just in the UK but across the world, has been an increase in the number of publications by academics (mostly in the US) who have tried to ascertain the likely relationship between outdated IS curricula and the diminishing numbers of IS student applicants (Gill and Hu, 1999; Hirschheim, 2007; Hirschheim and Klein, 2003; Impagliazzo and McGettrick, 2007; Lightfoot, 1999; Plice and Reinig, 2009; Walstrom et al., 2008; Wei, 2007; Wilson and Avison, 2007). Complementing this work, academics from around the world have been trying to highlight ways of improving existing IS curricula by ensuring that while academic pedagogy is maintained to the highest standard, contemporary undergraduate programmes are injected with an appropriate amount of transferable or subject specific skills, thus increasing the recruitment opportunities of graduates seeking employment.

Establishing whether the curriculum of a discipline as diverse as IS would benefit from updating in terms of making it more attractive to prospective students is a complex issue. IS itself is exhibiting some uncertainty as to its identity, and questions as to whether it is indeed a discipline, and which direction it should take for the future have been asked (Davis et al., 2005; George et al., 2004; Fitzgerald, 2003; Neufeld et al., 2007). Research on updating IS curricula to make it more attractive covers three inter-related areas that map to individual stakeholders: relevant IS skills (industry), value of accreditation of IS courses (professional bodies) and IS curriculum modernity (academics and academic societies). Examples of such work can be found in (Nelson et al., 2007; Snoke, 2007; Sooun and Xiang, 2007) highlighting the importance of matching industry expectation of skills for graduate positions to the skills embedded in undergraduate courses in IS. At the same time, (Challa et al., 2005; Reichgelt and Gayle, 2007) consider the merits of accreditation and the quality assurance benefits it offers to IS curricula, while (Granger et al., 2007) argue for the need to overhaul IS curricula in order to rekindle student interest. However, convincing research in this area in the UK is hampered by a lack of comprehensive data concerning the curriculum, and the number and types of courses that currently exist. Thus, the main aim of the research on which this paper is based is to address this deficiency.

The first objective is to provide an original and comprehensive view of the overall IS undergraduate curriculum in the UK. This is done by undertaking a module classification exercise using a classification method based on a UK subject benchmarking model and the definitions of IS provided by the UK Academy for Information Systems (UKAIS, 1999). Thus providing a clear view of how UK course developers have interpreted the benchmark through the process of course design, curriculum development and course validation. The second objective concerns the deeper analysis of the curriculum by filtering the captured data through the well established IS 2002 model curriculum that has been established and well used outside of the UK. The third and final objective considers the merits of the classification methods and encourage a meaningful debate in the IS community about the future direction of curriculum development. The benefits of this research will be for UK academics to be able, for the first time, to gain a broad understanding of the state of the IS discipline in terms of course and curriculum variation which will hopefully form the basis to improve future IS course development and future research in the areas of course accreditation and its influence on IS curricula, student perceptions of IS curricula, and the relationship between IS academy and employers.

2. METHODOLOGY

Two models or standards were adopted as the basis or method for the classification of undergraduate IS courses in this study.

The first model or method adopted for analysis was the UK QAA (Quality Assurance Agency) SBSC (Subject Benchmark Statement for Computing)[1]. According to the QAA, "Subject benchmark statements (SBS) provide a means for the academic community to describe the nature and characteristics of programmes in a specific subject. They also represent general expectations about the standards for the award of qualifications at a given level and articulate the attributes and capabilities that those possessing such qualifications should be able to demonstrate." (QAA, 2007). The original SBS in Computing (SBSC) was published by the QAA in 2000 and was subsequently revised in 2007 in line with the QAA's commitment to periodic reviews. It was developed by UK academics whose area of expertise spanned the breadth of the computing discipline. The purpose and intended use of benchmark statements are relatively wide, although it is commonly accepted that these statements are the driving force behind the quality assurance and enhancement processes employed by UK universities and a point of reference for Higher Education (HE) providers engaging in course development. Apart from academics and industry, the purpose of benchmark statements also extends to students who are given the opportunity to review them in relation to courses offered by universities. Even though the QAA SBSC was not specifically designed to offer a mechanism with which IS undergraduate courses could be classified, an initial attempt to classify courses in Greater London by the authors offered promising results and demonstrated its feasibility and appropriateness (Stefanidis and Fitzgerald, 2010).

The second model or method adopted as a basis of analysis in this research was the IS 2002 curriculum model. In the US such curriculum models and recommendations have a long history of almost 50 years. IS '95 (Gorgone et al., 1994) was one such early effort by the ACM and the AITP (Association of Information Technology Professionals). Through continuous incorporation of new ideas and feedback, IS '95 was revised to IS '97 (Davis et al., 1996) before it was developed further into IS 2002 (Gorgone et al., 2002) and this has become the standard for US researchers in measuring, analysing or simply cataloguing the provision of IS courses (for example, Kung et al., 2006 and Lifer et al., 2009). (At the time of writing, the draft IS 2010 document is pending ratification by the ACM and AIS boards. Appendix 3 offers a short description of IS 2010 and a comparison with IS 2002). IS 2002 has also been used in many other ways, for example, to address implementation issues relating to the development of better IS curricula (Albrecht et al., 2009), measuring the degree to which accredited IS courses match the recommendations of

IS 2002 (Williams and Pomykalski, 2006), and individual case studies demonstrating the practical applications of IS 2002 (Dwyer and Knapp, 2004 and Soe and Hwang, 2007). There is also evidence that IS 2002 has had international appeal as demonstrated by (Mesaric and Dukic, 2005 and Balaban et al., 2010). IS 2002 has been endorsed by the Association for Computing Machinery (ACM), the Association for Information Systems (AIS), the Association of Information Technology Professionals (AITP) as well as the wider academic community. Thus, it is argued to be an important and appropriate model for use in this study.

The advantages of using two separate classifications methods are three-fold. Firstly, the accuracy of the findings can be validated by cross-referencing the categories of modules which exhibit similar characteristics. Secondly, given that the QAA SBSC classification method has not been applied before, it is important to ensure that it can be compared with a well established classification method, e.g. IS 2002. Finally, in addition to the findings offered by IS 2002, the QAA SBSC classification method should provide a more unique UK perspective that may not be present in IS 2002 which was designed for the US market with minimum international input. However, whilst there are significant differences between the US and the UK HE systems there are also a fair amount of similarities. The more recently developed UK QAA SBSC is not without its limitations either especially considering the statement which describes the Body of Knowledge that makes up computing: "The following list of topics is seen as defining the scope of the broad area of computing. It is not intended to define curricula or syllabi, it is merely provided as a set of knowledge areas indicative of the technical areas within computing." (QAA, 2007). Despite these limitations, each of the module classification methods presents a reasonably robust way of cataloguing modules. So, utilising both methods in the study seemed the most appropriate approach to overcome the limitations of each and enabled the cross-referencing of the data to enhance the validity of the results.

3. CUSTOMISED APPROACH

Ensuring the accurate collection of data that offers as precise a picture of the IS undergraduate provision as possible, poses two fundamental problems: identifying the correct courses and obtaining sufficient data about them. The adoption of an appropriate method for the correct identification of IS courses began by reviewing similar previous studies. The findings revealed different approaches with a varying degree of accuracy in the selection methods. In some cases the selection of courses was made based on lists of institutions offering programmes accredited by the International Association to Advance Collegiate Schools of Business (AACSB) and the Association of Collegiate Business Programs (ACSBP) (Lifer et al., 2009; Williams and Pomykalski, 2006). In other cases, a similar selection method was based on the College Blue Book academic course inventory (Kung et al., 2006), while another referred to analogous published sources (Anthony, 2003). Traditional survey questionnaires have also been used successfully (Gill and Hu, 1999). Even though there is merit in all these approaches none would work well in the case of this study for a number of reasons. Firstly, the British Computer Society (BCS), which is the major accreditation body for ICT courses in the UK, offers accreditation to individual courses and not institutions or departments, therefore, it is possible for two IS courses in the same department to have different accreditation status. Secondly, the BCS does not consider IS courses as a separate category with its own set of specific accreditation criteria. Therefore there is no list of accredited IS courses in the UK similar to the AACSB and ACSBP lists of IS courses offered in the US. Even if all current BCS accredited courses were considered, it would still be necessary to put them through an elaborate course selection process in order to ensure that only IS courses were chosen while avoiding courses in general computing, software engineering or networking, for example. Finally, selecting IS courses through the Universities & Colleges Admissions Service (UCAS), which could be viewed as the UK equivalent to the College Blue Book, is not without its limitations given that a search for 'Information Systems' yields 443 courses, including course titles such as BSc Film Studies and Smart Systems.

3.1 Course Selection

Wanting to avoid the problems of a course selection method that would be somewhat arbitrary, the inclusion of the total number of universities in the UK became necessary. Universities underwent a process of elimination based on their offering of IS courses residing in Computing or Business schools. The course identification and selection was carried out during the 2009/10 academic year. It involved examining over 160 UK university and college websites while cross-referencing the UCAS course listing for 2010/11 to ensure that selected courses had been confirmed to run. At the time of conducting the survey UCAS had ceased the listing of 2009/10 courses. In a similar manner, the majority of the university websites examined were listing courses for the 2010/11 academic year only. The measure by which courses were deemed to belong to the IS as opposed to wider computing or business family of courses, involved comparing each of the course descriptions to UKAIS's definition, domain of study and the scope of domain of study of IS (UKAIS, 1999). In cases where course descriptions were inadequate either because they were not sufficiently detailed or they were too specific, an inspection of the on-line module details was carried out to provide a better understanding of the course title.

As each course was selected, further data was sought about its content. The mode of study (full-time or part-time), duration (3-years, 4-years or in some cases 5-years), the entry requirement expressed as a tariff in terms of A-Level point score, the modules offered by each course, the level at which modules were offered and a description for each module were recorded for all courses. The majority of course information gathered was available on departmental or university websites. Most universities provide comprehensive on-line information about their courses, often presented in course or module handbooks. Additionally, most universities publish Programme Specification documents which offer detailed course descriptions along with module outlines. While the majority of Programme Specifications do not list the content of modules, they invariably include a detailed list of modules titles and their corresponding credit weighting per year of study. Despite the plethora of information on university websites there were a small number of cases where not all relevant information could be obtained on-line. To ensure the essential accuracy and completeness of the dataset, approximately a dozen successful attempts were made to contact academic colleagues via email, requesting help with obtaining data about their courses.

3.2 Extending Classification Categories

Cataloguing modules in a systematic way exposed a problem present in both the IS 2002 and the QAA SBSC classification approaches. While the categories of each method of classification were reasonably unambiguous to enable accurate codification, there were a significant proportion of modules that did not fit any of the categories available. Moreover, the final year project, which was found in virtually all courses either as a core or sometimes option module, had no specific category in the QAA SBSC classification method, unlike IS 2002 which has a Project Management and Practice category which incorporates final year projects. Previous studies that have used IS 2002 have concentrated on classifying modules based on the eleven categories available without explicitly discussing those modules that fall outside the scope of those categories. Wanting to avoid compromising the comprehensiveness of the results and, by implication, any subsequent conclusions drawn from them, it was decided to extend the classification of both methods by introducing a common new category. Conveniently named ‘unclassified’, the new category was made up of three subjects which were further broken down into constituent units (Table 1). The broad subjects chosen to reflect the content of the unclassified modules were Business, Computing and Other. In deciding the breakdown for each subject care was taken not to include too many unit titles that would make subsequent statistical data too small to be of significance.

Business	Computing	Other
General	General	Geographic IS
Management	Multimedia	Study Skills
Accounting	Games	Law
Marketing	Graphics	Languages
Econ/Finance		Mathematics
HR		Research Methods
		Work-Based Learning
		Education
		Teamwork/Consultancy

Table 1. Subjects making up the unclassified category.

Addressing the issue of the final year project under the QAA SBSC classification method required a similar solution for two reasons. Firstly, since IS 2002 already offered a category for projects it would make sense to have a comparable category for the QAA SBSC method, albeit an artificial one, to enable direct comparison of results. Secondly, the only other credible option for dealing with projects apart from discarding them would be to infer that they are in essence the culmination of the skills and knowledge of the taught part of a course, and thus, assign their credit weight to the rest of the corresponding modules of that course. Such an assumption, however, would be dangerous as it is an oversimplification of the nature of undergraduate projects. But even if the assumption was based on fact, it would still be intrinsically difficult to devise a generic formula that would accurately reflect the correct distribution of project credits to the taught modules of 228 courses with varying assortments of modules. The introduction of the Work-Based Learning and Teamwork/Consultancy units in the unclassified category further strengthened the case for measuring the frequency of project modules separately since a significant number of project-like modules could now be categorised more accurately. A similar benefit was offered by the inclusion of the Research Methods unit which was designed to capture modules that often act as a precursor to the final year project.

The variation in module credit weighting was wide both within individual courses but also across the board. Broadly speaking, the credits assigned to a module give an indication of the amount of work a student has to perform for that module in relation to the level of difficulty of the learning. Examples of typical modules encountered included general study skills or business maths modules (neither of which can be easily classified under either of the classification methods employed) being worth 10 credits, while in the same year of study a programming or systems analysis module would be worth twice or three times as many credits. In order to circumvent the inevitable distortion of the data that a simple count of individual modules would cause, modules were normalised using a standard 15-credit measurement by converting the total sum of credits per subject into 15-credit units. The range of module credits encountered spanned from 7.5 to 60 credits. Using 15 credits as the measurement of one unit or module, 7.5 credits are worth 0.5 of a module whereas 60 credits are worth 4 modules.

4. RESULTS

There are three ways in which the results in this study support the understanding of the IS curriculum provision. Firstly, a breakdown of the combined core and option modules across all degrees based on the QAA SBSC and IS 2002 model curriculum classification methods is presented. Secondly, the data is further broken down to distinguish between core and option modules. Thirdly, the classification of those modules that fall outside the scope of the classification method categories is presented, supporting a more holistic analysis of the data.

Overall, 228 courses from 85 UK universities were catalogued with a total number of 7,452 modules (all subsequent figures presented annotated with ‘*’ have been rounded for simplicity and as a result may sometime present small arithmetic inconsistencies). Of those, 4,585 were core modules with the remaining 2,867 being option modules (Table 2). The distribution of courses in relation to the country in which their respective universities reside was as follows: 194 courses (85%) were offered in England, 19 (8%) in Scotland, 14 (6%) in Wales and 1 (<1%) in Northern Ireland. Modules contributing to courses vary significantly in terms of credit weighting depending on the emphasis attributed to the subjects they cover but in all cases, with the exception of courses offered by Scottish universities, the total number of credits for a course is 360, with an equal split between the three years of study. Scottish universities operate under a different system requiring a further year of study which is worth an additional 120 credits.

	Total no of modules	%	Avg. modules per course
Core	4,585	62	20
Option	2,867	38	13
Total:	7,452	100	33

Table 2. Overall module data and breakdown.

The majority of the identified courses bear titles that suggest a clear focus on IS. Courses whose titles and content suggest the combination of sub-disciplines were included provided the overall course description and the constituent sub-disciplines were as close as possible to the UKAIS definition and description of IS. For instance, a 3-year full-time BSc in Business Computing and Information Systems was judged to be a course worth including while an LLB in Law and Information Systems was excluded given that the IS component of the course was classified as a minor. Top-up courses, most of which are 1-year long, were also excluded on the basis that they do not offer a coherent and complete programme of study which is comparable to degrees of conventional length. Moreover, top-up courses often accept students with a variety of backgrounds, some of which may not be IS related, thus making the overall programme of study followed by top-up students likely to be a mixture of IS and other business or computing areas. Courses featuring either a compulsory or an optional year in industry were treated as any other course.

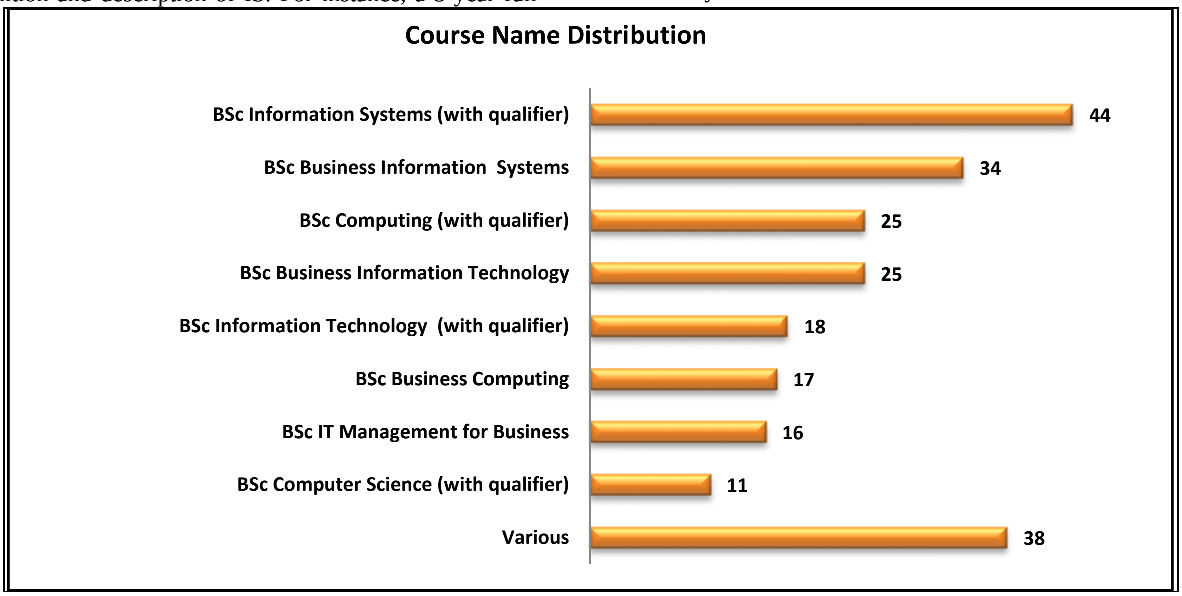

Table 3. Popularity of IS course titles.

The naming of university courses is not an exact science especially for a dynamic discipline such as IS. Naming IS courses is a balance mostly between a reflection of the content of a course and the prevailing terminology promoted by the IT industry. Given the close association between technology and IS, prospective students of IS are bound to be influenced by the course names they encounter. For a loosely defined discipline such as IS which inherits many of its subjects from a variety of computing and business topics, it is difficult to provide a name that accurately encompasses all its different elements. A title such as *BSc Information Systems* which has the highest frequency of occurrence among the 228 courses examined is arguably the most accurate (Table 3). Interestingly, many of those 44 (19%) courses with this title carry name qualifiers in an attempt to give prospective students a better impression of what they encompass. Titles such as *BSc Business Information Systems* (15%) or even *BSc Business Information Technology* (11%) offer less of an indication that they are attributed to IS courses. *BSc Computing* (with qualifier) (7%) is possibly one of the least descriptive titles and more likely to be misconstrued as a computing course title. The majority of courses are classified as BSc courses with only 5 listed as BA and a further 2 as BA/BSc. Seven courses classified as MComp were included in the study since they are listed by UCAS as undergraduate degrees despite their 4-year duration which leads to a Master of Computing qualification. The category shown as *Various* was populated by 38 course titles which feature small variations of a few key names such as *Computer Information Systems* and *Information and Communication Technology*.

Closer examination revealed that sometimes courses with visibly different titles, such as *BSc Information Systems* and *BSc Business Computing*, have closely matched contents. The majority of courses featured the term “business” either in the title name itself or the qualifier of the title. As such, there was an expectation that most of the 228 courses resided in business departments, schools or faculties. Despite the frequency of “business”, 203 (89%) of courses belong to computing departments and the remaining 25 (11%) to business departments. This is in contrast to the situation in the US where the majority of IS courses, or Management Information Systems (MIS) as they tend to be known, reside in business schools (Pierson et al., 2008). A small number of courses were presented as collaborations between computing and business departments but in all such cases one department was featured as the lead department, most likely for administrative reasons.

Apart from the impact that course titles have on attracting prospective students, the reputation, location and quality of facilities of institutions are also important selling points. A further parameter with a high impact factor is the entry requirement or entry level qualification, often expressed as the UCAS Tariff which universities utilise to express course entry requirements. Entry requirements stipulate the minimum level of achievement in specific A-Level or A-Level equivalent points. Universities offering IS courses accept a variety of qualifications such as A-Levels, Scottish Qualifications, International Baccalaureate, Irish Leaving Certificate, Access Qualifications, BTEC Higher National Diploma, BTEC National Diploma, Advanced Diploma or Cambridge Pre-U. A range of international qualifications are also considered to enable EU home and overseas students to gain places. The analysis of the entry level points needed for the 225 courses of this study –3 of the courses feature no formal UCAS Tariff– revealed an average of 246 points (two A grade A-Levels are worth 240 points which is equivalent to 3 C grade A-Levels with a median value of 240 (Table 4); for a comprehensive list see: http://www.ucas.com/students/ucas_tariff/). A significant number of courses express minimum as well as preferred achievements. For instance, a course entry requirement may specify as a minimum 240 points which is equivalent to two grade A A-Levels, yet the preferred option would be 3 A-Levels with a total of 240 points or more. Similar constraints are expressed by most courses in terms of additional achievements in GCSE English Language and/or Mathematics. The highest tariff score of 340 points was found in 12 courses (5%), almost 3 times higher than the lowest score of 120 points which was set by 2 courses (1%). More than half (55%) of the courses examined require a minimum of 240 points or more.

A-Level Points	Number of courses	%
120	2	1%
150	4	2%
160	22	10%
180	10	4%
200	24	11%
220	17	8%
240	39	17%
260	33	15%
280	24	11%
300	12	5%
320	26	12%
340	12	5%
Total:	225*	100%*

Table 4. Entry level points breakdown.

4.1 QAA SBSC Classification Data

The data using the first classification method based on the QAA SBSC is now discussed (see Table 5 for the overall classification data). The analysis of the 7,452 modules catalogued revealed that 1,871 (25%) of core and option modules were judged to be unclassified. The next category with the highest occurrence was QAA8 - Development, Implementation and Maintenance of IS with 1,340 (18%) modules confirming programming, project management and testing as one of the most popular subjects of IS. A further 905 (12%) of modules were dedicated to databases, database design and object oriented analysis and design (QAA2). At the opposite end of the spectrum, a mere 19 (<1%) and 10 (<1%) of modules were found to cover QAA16 – Digital Libraries and QAA12 – Content Management Systems respectively.

The breakdown of modules into core and option provides a more informative view of the emphasis that is placed upon different subjects. By capturing what students must study as opposed to what they could choose to study, the breakdown provides a strong indication of what IS course developers consider essential subjects which in turn could help identify the core skills that IS graduates are expected to possess. This is best demonstrated by the project module (Table 6), coded Project (17) which has the highest ratio of core to option (9.1: 1) confirming that over 90% of project modules are classified as core, effectively forcing the vast majority of students to undertake projects. A more balanced split between core and option is found in QAA9 – ICT, whose 1.4 : 1 ratio reveals that over 40% of modules in the category that spans networking, operating systems, hardware and security, are offered as choices to students, often supplementing introductory core modules of the same subject. Similarly QAA2 and QAA8, that broadly cover databases and programming respectively, have relatively low ratios which are the result of introductory modules in the first year of study, followed on by more advanced and often optional modules in later years. A further noteworthy observation concerns the ratio between core and option unclassified modules. With the majority of unclassified modules offered as options, it appears that option modules are being used to supplement what is considered core IS teaching by introducing topics which may be important but peripheral to IS.

Demystifying the content of the 1,871 (25%) unclassified modules (Table 7) reveals a clear but not so profound difference in the distribution of subjects. With 42%, *Business* is the area with the most subjects in the unclassified category, followed by 35% in the *Other* category and 23% in *Computing*. While the distribution of subjects in the *Business* area is equal between core and option, the opposite is true for subjects in the *Other* area showing a clear bias towards core modules. Setting aside the two categories of Business - General and Computing - General worth 21% and 13% respectively, attention should be paid to the two highest scoring categories of Maths and Study Skills that follow. This shows that in each of the two categories there are 150 (8%) modules, giving noticeable prominence to both subjects. Averaging out the number of modules for each category across all courses, suggests that each of the 228 courses in this study contains just over one and a half study skills modules and just over one and a half maths modules.

Other popular subjects include Marketing (7%), Accounting (5%), Multimedia (5%) and Teamwork/Consultancy (5%). Computer Games (2%) maintains a relatively small presence in the overall pool of unclassified modules, yet it demonstrates that popular subjects always find a way even into courses that have little academic use for them.

QAA SBSC code	Description of categories	Total number of modules	% of total
QAA1	Theoretical Underpinnings	297	4%
QAA2	Data, Information and Knowledge Management	905	12%
QAA3	Information in Organisational Decision Making	56	1%
QAA4	Integration of IS with Organisational Strategy and Development	260	3%
QAA5	Information Systems Design	352	5%
QAA6	Systems Approaches	312	4%
QAA7	Compression Technologies	4	<1%
QAA8	Development, Implementation and Maintenance of IS	1,340	18%
QAA9	Information and Communications Technologies (ICT).	593	8%
QAA10	Decision Support	136	2%
QAA11	Management of Information Systems and Services	124	2%
QAA12	Content Management Systems.	10	<1%
QAA13	Organisational and Social Effects of ICT-Based IS	352	5%
QAA14	Economic Benefits of ICT-Based Information Systems	122	2%
QAA15	Personal Information Systems	51	1%
QAA16	Digital Libraries	19	<1%
Project (17)	Final Year Project	648	9%
Unclassified	Unclassified	1,871	25%
	Total:	**7,452**	**100%***

Table 5. QAA SBSC overall data classification.

QAA SBSC code	Core modules	% of total core	Option modules	% of total option	Core : Option ratio	% of category core	% of category option
QAA1	210	5%	86	3%	2.4 : 1	71%	29%
QAA2	571	12%	334	12%	1.7 : 1	63%	37%
QAA3	36	1%	20	1%	1.8 : 1	65%	35%
QAA4	173	4%	87	3%	2.0 : 1	66%	34%
QAA5	205	4%	147	5%	1.4 : 1	58%	42%
QAA6	254	6%	58	2%	4.4 : 1	81%	19%
QAA7	0	0%	4	<1%	-	0%	100%
QAA8	964	21%	376	13%	2.6 : 1	72%	28%
QAA9	341	7%	252	9%	1.4 : 1	58%	42%
QAA10	82	2%	54	2%	1.5 : 1	60%	40%
QAA11	74	2%	49	2%	1.5 : 1	60%	40%
QAA12	7	<1%	3	<1%	2.2 : 1	69%	31%
QAA13	231	5%	122	4%	1.9 : 1	65%	35%
QAA14	60	1%	61	2%	1.0 : 1	50%	50%
QAA15	19	<1%	32	1%	0.6 : 1	37%	63%
QAA16	5	<1%	14	1%	0.3 : 1	26%	74%
Project (17)	584	13%	64	2%	9.1 : 1	90%	10%
Unclassified	770	17%	1101	38	0.7 : 1	41%	59%
Total:	**4,585***	**100%***	**2,867***	**100%***			

Table 6. QAA SBSC classification breakdown with module ratios.

4.2 IS 2002 Classification Data

The data from the second classification method based on IS 2002 is now discussed (see Table 8 for the overall classification data). As can be seen with 2,305 (31%) modules, the unclassified category dwarfs the second most popular category by just over 2.5 times. IS 2002.10 is the second most popular category with 894 (12%) of combined core and option modules across 228 courses dedicated to project management final year projects. IS 2002.3 which focuses on organisations, strategy and decision making is a close third with 837 (11%) followed by programming and databases which receive less prominence. Unsurprisingly, the number of modules that fall under IS 2002.0 (Elementary IT skills) is extremely small given the nature of the category which over the years has become obsolete due to the advancement of IT skills and technology.

The core to option ratios are relatively low with the exception of the IS 2002.10 confirming that the final year project along with project management are the two subjects that 88% of all IS students will be expected to take in order to complete their studies (Table 9). IS 2002.1 that captures modules dealing with introductory IS concepts features a relatively small number of combined modules (433), the vast majority of which are understandably offered as core. Reassuringly, programming and systems analysis feature heavily as core modules. A reasonable number of options for these two categories suggest that the teaching of both subjects is reinforced further, a clear sign of their significance.

Unclassified Modules QAA SBSC	% Overall	% Core	% Option
Business			
General	21	17	23
Management	3	4	2
Accounting	5	6	4
Marketing	7	7	7
Economics/Finance	2	3	2
HR	4	4	3
Business total:	42*	41*	41*
Computing			
General	13	9	16
Multimedia	5	5	5
Games	2	1	2
Graphics	3	<1	5
Computing total:	23*	15*	28*
Other			
Geographic IS	<1	<1	<1
Study Skills	8	18	2
Law	2	1	2
Languages	4	0	6
Maths	8	11	6
Research Methods	3	6	1
Work-Based Learning	3	1	4
Education	2	<1	4
Teamwork/Consultancy	5	6	4
Other total:	35*	43*	29*
Overall total:	**100***	**100***	**100***

Table 7. QAA SBSC classification method percentage breakdown of unclassified modules.

Business subjects are dominant in the breakdown of unclassified modules with 2 out of 5 (40%) in this category devoted to them (Table 10). The core option split of business subjects is identical at 41%. Similar to the QAA SBSC method results, study skills and maths are considered important core subjects with 15% and 12% of unclassified modules respectively being dedicated to them. Computer games (2%) is only slightly less popular than research methods which stands below teamwork/consultancy, a subject that tries to promote skills necessary for working in the real world, making it perhaps one of the most vocational subjects of the list.

5. DISCUSSION

5.1 Classification Methods

The results generated by the two classification methods offer an important insight into the relative emphasis that IS course developers place on individual subjects. A direct comparison between them, however, should be carried out with caution because of the incompatibility of the categories in terms of the combination of subjects. Consider as an example the subject of programming, the discrepancy between the results of the QAA8 and IS 2002.5 categories is large, capturing 1,340 and 589 15-credit modules respectively. Even though the categories may appear broadly the same, QAA8 has a much wider scope since it captures modules related to project management, web development and testing, whereas project management is part of IS 2002.10 which also includes final year projects. Similar discrepancies are found in other categories. Although the inconsistencies in the categories of the methods impede efforts to carry out direct comparisons, they highlight the importance of maintaining a high level view when analysing the data and attempting to draw conclusions from it. Would a hypothetical breakdown of the 1,340 modules under the QAA8 category into subcategories make a great difference in terms of enhancing our collective understanding of the importance of programming in IS? Perhaps it would to a small extent but this is one occasion when the devil is not in the detail.

IS 2002 course	Description	Total number of modules	% of total
IS 2002.0	Elementary IT skills	21	<1%
IS 2002.1	Fundamentals of IS	433	6%
IS 2002.2	E-commerce, e-business and web development	704	9%
IS 2002.3	Organizations, strategy and decision making	837	11%
IS 2002.4	Operating systems, hardware and architecture	214	3%
IS 2002.5	Programming	589	8%
IS 2002.6	Networks and communications	271	4%
IS 2002.7	Systems analysis and design	482	6%
IS 2002.8	Databases, data mining	543	7%
IS 2002.9	Development	157	2%
IS 2002.10	Project management, final project/dissertation	894	12%
Unclassified	Various/unclassified	2,305	31%
	Total:	**7,452***	**100%***

Table 8. IS 2002 overall data classification.

IS 2002 course	Core modules	%	Option modules	%	Core : Option ratio	% of category core	% of category option
IS 2002.0	11	<1%	9	<1%	1.2 : 1	55%	45%
IS 2002.1	370	8%	63	2%	5.9 : 1	85%	15%
IS 2002.2	396	9%	308	11%	1.3 : 1	56%	44%
IS 2002.3	523	11%	314	11%	1.7 : 1	63%	37%
IS 2002.4	159	3%	55	2%	2.9 : 1	74%	26%
IS 2002.5	430	9%	159	6%	2.7 : 1	73%	27%
IS 2002.6	145	3%	126	4%	1.2 : 1	54%	46%
IS 2002.7	377	8%	105	4%	3.6 : 1	78%	22%
IS 2002.8	367	8%	176	6%	2.1 : 1	68%	32%
IS 2002.9	83	2%	74	3%	1.1 : 1	53%	47%
IS 2002.10	787	17%	107	4%	7.4 : 1	88%	12%
Unclassified	934	20%	1372	48%	0.7 : 1	40%	60%
Total:	**4,585***	**100%***	**2,867***	**100%***			

Table 9. QAA classification breakdown with module ratios.

Unclassified Modules IS 2002	% Overall	% Core	% Option
Business			
General	21	18	23
Management	3	4	2
Accounting	4	6	4
Marketing	6	6	6
Economics/Finance	2	2	2
HR	4	5	4
Business total:	**40***	**41***	**41***
Computing			
General	19	14	22
Multimedia	4	4	5
Games	2	<1	2
Graphics	3	<1	4
Computing total:	**28***	**18***	**33***
Other			
Geographic IS	<1	<1	<1
Study Skills	7	15	1
Law	2	1	3
Languages	3	<1	5
Maths	9	12	6
Research Methods	3	5	1
Work-Based Learning	2	1	3
Education	2	<1	3
Teamwork/Consultancy	4	5	3
Other total:	**32***	**39***	**25***
Overall total:	**100***	**100***	**100***

Table 10. IS 2002 classification method percentage breakdown of unclassified modules.

Looking beyond the module data that conforms to the prescribed categories, it is important to consider the significance of the unclassified categories captured by both methods. In terms of difference, IS 2002 captured 434 more unclassified modules than the QAA SBSC method. The most obvious explanation rests with the difference in the number of categories between the methods. The scope of the QAA SBSC method encompasses subjects such as mobile computing, decision support systems, content management systems, e-government, legal issues and many more, which are not equally represented in IS 2002 (see Appendix 1 and 2). A comparison between the three main areas of *Business*, *Computing* and *Other* of the unclassified category reveals that both methods capture similar numbers of business related subjects given that the overall percentages for Business are 42% for the QAA SBSC method and 40% for IS 2002. The gap widens slightly for subjects in the *Other* category and reaches a 5% difference for *Computing* subjects, suggesting that IS 2002 has a narrower scope in relation to computing modules, beyond those already included within the existing IS 2002 categories. It is difficult to make conclusive judgments about the effectiveness of the two classification methods since neither the IS 2002 model curriculum nor the QAA SBSC was intended to be used in this way, as discussed earlier. Criticism reserved for the large percentage of unclassified modules which appears to skew the overall results could be mitigated by incorporating the subjects of the unclassified category as new categories to both methods, thus presenting a unified set of extended results. A similar attempt to extend IS 2002 by incorporating additional subjects has been made in the past (Tastle et al. 2008). By taking an alternative perspective, unclassified modules can be seen as making up part of the representative capabilities and knowledge expected for IS graduates which IS 2002 justifies as the exit characteristics of IS graduates, necessary to produce well rounded professionals (Gorgone et al., 2002). In doing so, a significant number of modules captured by the *Other* category map closely to what IS 2002 refers to as Analytical and Critical Thinking, and Interpersonal Communication and Team Skills. Conversely, modules in the *Business* area are closely related to Business Fundamentals, and *Computing* to Technology.

Modules that cover general study skills tend to focus on presentation, academic writing, professionalism and career skills, often presented as transferable skills. Maths modules are in their majority designed to address the specific skill set that students studying fundamental computing and IS topics such as programming, networking, hardware and software need to master. Often maths modules are presented as quantitative methods for business, discrete maths for computing or introductory statistics. Research methods modules almost exclusively appear as preparatory modules for the final project. They cover a range of topics such as referencing, conducting background research, selecting research topics, lines of enquiry and investigation techniques. Modules appearing under the Law heading are either focused on business law or legal issues relating to IT, or they cover general introductory law, making it more difficult to relate them to IS topics. Two more noticeable categories that offer transferable skills are populated with modules that cover work-based learning and work experience or consultancy. In both cases these modules concentrate on enhancing the employability skills of students by exposing them to the world of business and its expectations of new graduates. Foreign language modules are almost exclusively offered as options. In their majority they offer introductory or intermediate language training, with the small exception of language for engineers or science offering language skills tied to relevant professions.

It is to the credit of universities in the UK that over the years they have chosen to offer an ever increasing amount of useful course information on-line, ranging from general course descriptions to detailed individual module assessment components. Invariably, the amount of information provided by universities differs. Often, information availability fluctuates significantly between different schools or departments within the same institution. At times, finding the necessary information was only possible by carrying out detailed searches using composite keywords using popular search engines, bypassing complex webpage navigation structures. Securing the necessary data in a small number of cases was only possible by directly contacting helpful colleagues via email to request the data. Although every effort was made to ensure the accuracy of the information collected, it is important to note some limitations. Most of the course and module data harvested from November 2009 to March 2010 was describing courses on offer in the 2010/11 academic year. In some cases, course data described as 2010/11 was unavailable, most likely due to website update tardiness, which resulted in collecting course data about the 2009/10 academic year. Although course changes from year to year tend to be small, there is always the possibility that a given course went through revalidation, which could cause its content to change considerably, after the snapshot was taken. However, in this research an important safeguard was in place to ensure course eligibility by consultation of UCAS to confirm the actual availability of courses in the 2010/11 academic year.

5.2 Limitations

The significant number of unclassified modules that both classification methods exposed makes the issue of relevance of the methods prominent. But judging the success of either of the classification methods should not necessarily depend on the amount by which the data conforms to the suggested categories. The purpose of the classification methods is to provide the means by which the content of courses can be catalogued as accurately as possible, taking into consideration the inherent difficulties that exist as a result of wide-ranging modules which often mix different topics, based on sound academic reasons. Consider the following example: Software Project Management is a module worth 7.5 credits, with a module description that states that students will gain an understanding of the difficulties of managing complex projects and some of the technical and social problems that might arise; they will develop transferable skills to aid them in dealing with human factor issues and technical complexities of large projects. As one of the smallest modules recorded in terms of credit weighting, Software Project Management has a clear focus on project management which is evident both in its name as well as the module description, making its classification under either method straight-forward. At the opposite end of the spectrum, Business Functions in Context is a 60 credit module with a description that suggests this integrated module focuses on the essential organisational functions of human resources, marketing, operations management, information management, accounting and finance. Furthermore, in this module students are expected to examine their key practices, processes and thinking, and their contributions to organisations and their operations – with a strong emphasis on practice-based learning. Given the size of Business Functions in Context which is eight times that of the Software Project Management, choosing the appropriate classification category can have a significant impact on overall classification of the course, as this module alone constitutes 50% of academic credits in one year of study. Upon closer examination of the description, it becomes evident that the content of the module spans multiple categories, most of which fall within the unclassified band. One way to ensure accurate classification in this case requires that the module is broken up into smaller parts such as human resources, marketing, operations management and other, with each part being assigned a corresponding number of credits out of the total of 60. However, such an approach is not without its own problems as it would be virtually impossible to ascertain correctly the credit value of each constituent part of the module unless the module handbook with the necessary breakdown was available. Despite the significance of this issue, it is important to remember that the problem presented does not lie in the inadequate design of the classification methods but in the intrinsic complexity in the nature of modules which were not intended to be quantified in a simplistic way.

An aspect of the use of the classification methods that could attract criticism relates to the combination of topics within certain categories, such as in the case of IS 2002.10 that combines the final project with project management or QAA2 that combines object oriented analysis and design with entity relationship modelling and databases. Such criticism, however, would be misplaced in the case of IS 2002 because it was merely designed to offer curriculum recommendation and not to act as an oversimplified array of groupings. Similarly, the UKAIS Scope of Domain of Study that largely informed the QAA classification method does not encourage such use. Combining closely related subjects together is sensible as well as desirable. Having a list of categories, each of which covers an atomic subject, may make the classification of modules easier but not necessarily more academically justifiable as it would be difficult to see why grouping networking and hardware as one category (IS 2002.6 and QAA9) is less meaningful than having two separate categories, one for networking and one for hardware.

A rather obvious but nevertheless significant observation needs to be made about the interpretation of data regarding option modules. The relationship between the course average of 20 core and 13 option modules confirms that option modules make up approximately 39% of undergraduate degree courses. Given such a high percentage, students may opt to avoid certain thematic groupings of option modules because they consider them hard, outdated or simply not sufficiently 'cool'. In doing so, students could miss out on important areas of knowledge and skills with a detrimental effect on their subsequent professional lives. While it is beyond the scope of this paper to examine whether the ratio of core to option modules in IS is adequate or comparable with other disciplines, it is important to note two points. Firstly, the existence of option modules is paramount if course developers are to be allowed to offer valuable specialisations which enhance the appreciation of IS. Secondly, 'choice' is a contemporary phenomenon that seems to be permeating most aspects of modern life, and IS curricula are no exception. By reducing it, there is a possibility that students could be alienated, triggering a further fall in student recruitment. Accepting the inevitable importance of choice through option modules should not, however, assume the removal of the necessary pedagogical safeguards that ensure the appropriateness of the overall learning outcomes of option modules in an IS course. At the same time, it is important to remember that too much choice may potentially result in students on the same course graduating having mastered demonstrably different areas of expertise. Some implied criticism of option modules may be unwarranted and easily mitigated, especially when option modules have been chosen according to sound academic principles. As an example, many of the 228 courses encountered offer predictable patterns of 'growth' from early core to late option modules where in the first year of study core introductory modules cover systems analysis, databases and programming, followed in later years by multiple option modules that cover advanced topics in the aforementioned subjects. Yet, it is difficult to reconcile the structure of a course with a fairly consistent spread of credits across modules, in which 28 of the 39 modules are options, or another where 56 out of 60 modules are listed as options. In conclusion, the interpretation of the importance of the classification of option modules and any extrapolation about their value should be carried out with care.

5.3 Curriculum Observations

Borne out of the authors' long teaching and course development experience, certain observations are made below about the state of the IS curriculum and its future in the UK, despite the lack of a previous study that would have enabled a direct comparison of past and present data, in terms of how IS curricula in the UK have changed. Over the years there has been increased pressure on UK universities to ensure their graduates are not only successful in securing employment, but they do so within a relatively short period of time following graduation. University league tables, which in recent years have been attracting more public attention, use graduate employment statistics as part of their ranking formulae. Consequently, it appears that offering transferable skills to students has become a prominent feature for the majority of courses which often carry more than one core module in this area. Skills are broadly separated into two categories: study skills and employability skills. Study skills are delivered through first year modules addressing personal and professional development, general study skills and communication and presentation skills. Through study skills, students, especially those from non-traditional backgrounds whose exposure to traditional further or higher education may be limited, are given support to develop learning approaches that meet the demands of undergraduate degree courses. As students approach graduation they are presented with employability skills designed to support their transition from academia to business as much as possible. Both sets of skills, while often delivered through modules with titles such as *Professional Skills Development* or *Employability Skills*, are frequently found embedded in various other modules, including research methods and final year projects. Employability skills which promote career development principles are delivered through modules on entrepreneurship, work-based development and team work or consultancy. Courses which enjoy close relationships or affiliations with industry often feature modules that are delivered in partnership with employers, giving students the opportunity to undertake assessments that are based on real life case studies. Apart from the teaching and learning opportunities such relationships afford to students, there is also an obvious course marketing advantage for universities.

Maths and its many incarnations, such as quantitative modelling, maths for business, maths for computing or formal methods, are gradually becoming an integral part of IS degrees. Interestingly, most IS courses do specify a minimum maths component, normally at GCSE level, as one of the necessary entry criteria for students. Many academics teaching programming or business modelling have been privately voicing their concerns for some time about the level of maths undergraduate students possess. Arguments mainly relate to the level, type and extent to which maths need to be taught to first year undergraduate students as opposed to whether maths should be part of the curriculum. Where maths modules exist they tend to be presented either as maths geared towards computing or maths relevant to business, including statistics and forecasting. In some cases maths skills are included in generic skills modules which package maths along with study and professional skills. Research methods is another topic that is gaining in popularity across the IS curriculum. A large number of research methods modules are offered as core prior to the commencement of the final year project. Their content covers the broad areas of techniques and skills needed to ensure that final year projects have a sufficiently strong academic dimension that goes beyond the usual development of an artefact which often involves some form of prototyping.

6. CONCLUSIONS AND FURTHER RESEARCH

One of the issues affecting the IS discipline has been the sustained decline in undergraduate recruitment both in the UK and other countries. Specifically in the UK the number of IS students has been halved since 2004. This paper has reported on work to establish a basis for better understanding the issues behind this decline and has sought to establish in detail and comprehensively the number and types of IS courses in the UK that currently exist together with an analysis of their content, for the first time.

Quantifying the provision of IS courses was carried out through the application of two different classification methods, one with a design bias towards the US model of IS education, IS 2002, and another based on categories derived from the widely endorsed QAA SBSC, a UK specific model.

The QAA SBSC classification method was designed based on the body of knowledge of IS endorsed by the UK academic community and the work that has been carried out by the UK Academy for Information Systems (UKAIS). The results produced by the classification methods are comparable but with certain noticeable features highlighted. As each classification method utilises different categories to classify modules, discrepancies in the presentation of the data are noted to support a better understanding of the results.

The majority of work that has been carried out in the past in the US has concentrated on cataloguing and analysing module data that conforms mainly to the prescribed categories of IS 2002. A significant part of this research has been devoted to cataloguing and analysing module data that did not conform to any of the pre-existing categories, thus offering a more aggregated view of the curricula. New categories were developed to accurately capture the range of topics which are borrowed from traditional disciplines such business and computing. In doing so, the results show the clear distribution between core IS, business, computing and other generic topics which make up the IS degrees in UK universities. Traditional IS subjects such as systems analysis, IS theory, IS practice, programming, databases and project management were confirmed as the most popular across the 228 IS courses indentified. Beyond those, the balance between business and computing subjects is skewed towards business, while a number of other subjects, such as study skills and maths, have a strong presence in the core teaching of the curriculum.

The results of the study are presented in conjunction with an analysis of the entry requirements set by universities for IS degrees. While the average of 246 UCAS tariff points is equivalent to just over 3 grade 'C' A-Levels, the range of entry level requirements stretches from 120 to 340 tariff points. A further analysis was carried out to reveal the course title naming convention used by the 85 UK universities offering the 228 IS degrees. The most popular course name is BSc Information Systems, a title which often carries a qualifier in brackets denoting a particular specialisation. A significant number of courses bear titles that are not sufficiently unambiguous, making the distinction between a conventional computing and an IS degree difficult. 'Business' is the keyword with the highest frequency of use in all the titles and their qualifiers even though 89% of all IS courses are placed within computing departments.

The research presented here offers for the first time a holistic categorisation of the IS curriculum, providing the basis for further research of various kinds. One line of inquiry could focus on the distribution of modules according to year of study and the relationship between core and option modules through the three or four years of study. Additional research could examine how courses offered in different parts of the UK compare in terms of their focus on certain key IS concepts and, by implication, employability skills. With the comprehensive mapping of modules in place, further work could examine how well the IS courses in the UK match the needs of industry in various ways and whether a closer match would impede academic freedom and upset the balance between vocation skills and academic pedagogy. Further, issues relating to employability, transferable skills, and the changing employment market might yield important insights into the debate about curriculum modernisation. Specifically, the issue of whether or not the current IS curriculum is to be blamed, and to what extent, for the reduction in student demand could be addressed. For example, additional work might establish the correlation between what IS undergraduate degrees offer to the professionals of the future and what expectations industry has of the graduates entering the IS employment arena. Such work would also need to establish the correlation between student perceptions of IS as a profession with future career potential and their understanding of the IS curriculum offered by universities at the time of applying to university. The value of the work presented in this paper lies in providing the basis for such subsequent work.

7. ACKNOWLEDGEMENTS

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8. ENDNOTE

Appendix 4 contains a brief explanation of the commonly used terms and organisation names for people who are not familiar with the UK Higher Education system.

9. REFERENCES

Aken, A. and Michalisin, M. D. (2007), "The impact of the skills gap on the recruitment of MIS graduates." Presented at SIGMIS-CPR 2007 - Proceedings of the 2007 ACM SIGMIS CPR Conference: The Global Information Technology Workforce, Saint Louis, MO

Albrecht, C. C., Romney, M., Lowry, P. B. and Moody, G. (2009), "The IS Core: An Integration of the Core IS Courses." Journal of Information Systems Education, Vol. 20, No. 4, pp. 451-468

Anthony, E. (2003), "Computing education in academia: toward differentiating the disciplines". Proceedings of the 4th conference on Information Technology Curriculum. ACM: Lafayette, Indiana, USA, pp. 1-8

Balaban, M. E., Kirlidog, M. and Ayvaz-Reis, Z. (2010), "Perceived importance and resource constraints of graduate information systems courses in Turkey." International Journal of Information and Communication Technology Education, Vol. 6, No. 1, pp. 67-80

Challa, C. D., Kasper, G. M. and Redmond, R. (2005), "The Accreditation Process for IS Programs in Business Schools." Journal of Information Systems Education, Vol. 16, No. 2, pp. 207-216

Davis, G., Massey, A. and Bjoern-Andersen, N. (2005), "Securing the Future of Information Systems as an Academic Discipline." Presented at International Conference on Information Systems, Las Vegas, USA

Davis, G. B., Gorgone, J. T., Couger, J. D., Feinstein, D. L. and Herbert E. Longenecker, J. (1996), "IS '97: model curriculum and guidelines for undergraduate degree programs in information systems." SIGMIS Database, 28(1), 101-194

Dwyer, C. and Knapp, C. A. (2004), "How Useful is IS 2002? A Case Study Applying the Model Curriculum."

Journal of Information Systems Education, Vol. 15, No. 4, pp. 409-416
Fitzgerald, G. (2003), "Information systems: a subject with a particular perspective, no more, no less." European Journal of Information Systems, Vol. 12, No. 3, pp. 225-228
Foster, A. L. (2005), "Student Interest in Computer Science Plummets." Chronicle of Higher Education, 51(38), A31-A32
George, F. J., Valacich, S. J. and Valor, J. (2004), "Does Information Systems still matter? Lessons for a maturing discipline." Presented at Twenty-Fifth International Conference on Information Systems, Washington DC, USA
Gill, T. G. and Hu, Q. (1999), "The Evolving Undergraduate Information Systems Education: A Survey of U.S. Institutions." Journal of Education for Business, 74(5), 289
Gorgone, J., T., Davis, G. B., Valacich, J., S., Topi, H., Feinstein, D., L, and Longenecker, H. E. (2002), "IS 2002 - Model curriculum and guidelines for undergraduate degree programs in information systems". Available from: http://www.acm.org/education/is2002.pdf
Gorgone, J. T., Couger, J. D., Feinstein, D., Kasper, G. and Herbert E. Longenecker, J. (1994), "Information systems '95 curriculum model: a collaborative effort." SIGMIS Database, 25(4), pp. 5-8
Granger, M. J., Dick, G., Luftman, J., Van Slyke, C. and Watson, R. T. (2007), "Information Systems Enrollments: Can They Be Increased?" The Communications of the Association for Information Systems (CAIS), Vol. 20
Hirschheim, R. (2007), "The Looming Crisis for the IS Field: Where have all the students gone?" Wirtschaftsinformatik, Vol. 49, No. 3, pp. 232-234
Hirschheim, R., and Klein, H. K. (2003), "Crisis in the IS Field? A Critical Reflection on the State of the Discipline." Journal of the Association for Information Systems, Vol 4, pp. 237-293
Impagliazzo, J., and McGettrick, A. (2007), "New models for computing education." Presented at Frontiers in education conference - global engineering: knowledge without borders, opportunities without passports, 2007, FIE '07
Kung, M., Yang, S. C. and Yi, Z. (2006), "The Changing Information Systems (IS) Curriculum: A Survey of Undergraduate Programs in the United States." Journal of Education for Business, Vol. 81, No. 6, pp.291-300
Lifer, J. D., Parsons, K. and Miller, R. E. (2009), "A Comparison of Information Systems Programs at AACSB and ACBSP Schools in Relation to IS 2002 Model Curricula." Journal of Information Systems Education, Vol. 20, No. 4, pp. 469-476
Lightfoot, J. M. (1999), "Fads Versus Fundamentals: The Dilemma for Information Systems Curriculum Design." Journal of Education for Business, Vol. 75, No. 1
Mesaric, J. and Dukic, B. (2005), "Implementing international IS curricula in the Croatian universities." ITI 2005: Proceedings of the 27th International Conference on Information Technology Interfaces, 313-318
Nelson, H. J., Ahmad, A., Martin, N. L. and Litecky, C. R. (2007), "A comparative study of IT/IS job skills and job definitions." Presented at SIGMIS-CPR 2007 - Proceedings of the 2007 ACM SIGMIS CPR Conference: The Global Information Technology Workforce, Saint Louis, MO
Neufeld, D., Fang, Y. and Huff, S. L. (2007), "The IS identity crisis." The Communications of the Association for Information Systems (CAIS), 19, Vol. 19, No. 19
Panko, R. R. (2008), "IT employment prospects: beyond the dotcom bubble." European Journal of Information Systems, Vol. 17, No. 3, pp. 182-197
Pierson, J. K., Kruck, S. E. and Teer, F. (2008), "Trends in Names of Undergraduate Computer-Related Majors in AACSB-Accredited Schools of Business in the USA." Journal of Computer Information Systems, Vol. 49, No. 2, pp. 26-31
Plice, R. K. and Reinig, B. A. (2007), "Aligning the Information Systems curriculum with the needs of industry and graduates." Journal of Computer Information Systems, Vol, 48, No. 1, pp. 22-30
Plice, R. K. and Reinig, B. A. (2009), "Leveraging Alumni and Business Community Relations to Assess the Information Systems Curriculum." Journal of Education for Business, Vol. 84, No. 3, pp. 142-150
QAA. (2007), "Computing - Subject Benchmark Statement". Available from: http://www.qaa.ac.uk/academicinfrastructure/benchmark/statements/computing07.pdf
Reichgelt, H. and Gayle, Y. (2007), "Accountability and Accreditation: Putting Information systems Accreditation into Perspective." Communications of the Association for Information Systems (CAIS), Vol. 20, No. 13
Snoke, R. (2007), "Generic attributes of IS graduates -An Australian IS academic study" Australasian conference on Information Systems City: Toowoomba, Australia
Soe, L. L. and Hwang, D. (2007), "Career Track Design in IS Curriculum: A Case Study." Information Systems Education Journal, Vol. 5, No. 29
Sooun, L. and Xiang, F. (2007), "Perception Gaps Between IS Students and Recruiters About the Entry-Level Skill Requirement." Presented at Wireless Communications, Networking and Mobile Computing, 2007. WiCom 2007.
Stefanidis, A. and Fitzgerald, G. (2010), "Information Systems curricula in the UK: A Survey of Undergraduate Courses (research-in-progress)." Italics, Vol. 9, No. 1
Tastle, W. J., White, B. A., Valfells, A. and Shackleton, P. (2008), "Information Systems, Offshore Outsourcing, and Relevancy in the Business School Curriculum." Journal of Information Technology Research, Vol. 1, No. 2
UKAIS. (1999), "The definition of Information Systems". Available from: http://www.ukais.org/
Walstrom, K. A., Schambach, T. P., Jones, K. T. and Crampton, W. J. (2008), "Why Are Students Not Majoring in Information Systems?" Journal of Information Systems Education, Vol. 19, No. 1, pp. 43-54
Wei, Z. (2007), "Why IS: Understanding Undergraduate Students' Intentions to Choose an Information Systems Major." Journal of Information Systems Education, Vol. 18, No. 4, pp. 447-458
White, S. and Irons, D. A. (2007), "Informatics in the UK: Current Perspectives." Italics, Vol. 6, No. 3
Williams, C. and Pomykalski, J. (2006), "Comparing Current IS Curricula to the IS 2002 Model Curriculum." Information Systems Education Journal, Vol. 4, No. 76

Wilson, N. and Avison, D. (2007), "Double Jeopardy: The Crises in Information Systems, an Australian Perspective "18th Australasian Conference on Information Systems City: Toowoomba, Australia

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APPENDIX 1 – QAA SBSC CLASSIFICATION CATEGORIES

[Table largely adopted from http://www.ukais.org/about/definitionIS.aspx and http://www.qaa.ac.uk/academicinfrastructure/benchmark/statements/computing07.asp#p10]

Category	Name	Description
QAA1	Theoretical Underpinnings	Systems theory and relevant theories from the domains of computer science, software engineering, linguistics, cybernetics, management science, information science, ergonomics, economics, management, sociology, anthropology, learning, psychology, philosophy, organisation behaviour, ethics.
QAA2	Data, Information and Knowledge Management	Theory, e.g. data, information and knowledge; data modelling, e.g. entity-relationship models and normalisation; file design and organisation; object-oriented design; distributed databases; data mining and data warehousing; tool support, e.g. database management systems and query languages, data dictionaries and systems repositories; technology, e.g. database machines; information resource management, e.g. planning, control and security, privacy issues; information seeking behaviour and information use; people support, e.g. knowledge, information, data and database management in organisations; developing databases, expert systems and AI applications; products and services.
QAA3	Information in Organisational Decision Making	Definition of information, information policy, information management, information structures and relationships; sources of and delivery of information, internal, external, information media; properties of information, e.g. accuracy, currency, timeliness, completeness, conciseness, relevance, etc.; information access and security; nature and significance of decisions and decision making activities and processes and decision time scales; characteristics of decision makers - individuals, groups, organisations and the cultural context; decision analysis; decision support systems.
QAA4	Integration of IS with Organisational Strategy and Development	Analysis of business and organisational strategic implications of IS; business/IS strategy derivation, alignment, implementation and review; IS planning (applications, resources, services, technology); investment appraisal/evaluation; risk management; benefit realisation; organisational change management; sourcing decisions and organisational structuring of IS resources/activities.
QAA5	Information Systems Design	Domain for change; design fit with organisational context, structure; requirements elicitation and analysis; logical and physical design; non-computer process definition; procedures, task and job design; computer/non-computer boundaries, input design, human-computer interface and output design; roles of people and skills required (e.g. users, analysts, designers, programmers); role of prototyping in design; feasibility analysis and selection of solutions to match design - application packages, tailor-made or mixed.
QAA6	Systems Approaches	Approaches to IS analysis, design, development and implementation; structured, approach; soft systems approach; OO approach.
QAA7	Compression Technologies	Software related compressions technologies supporting the management of data within IS systems.
QAA8	Development, Implementation and Maintenance of IS	Types of organisation and business processes and information systems applications; information systems life cycle - feasibility study, investigation, analysis, design, development, review and maintenance; specification for programming and system construction and testing; programming constructs and code design, data conversion and operations planning; types of methodologies and frameworks - systems, process, data, object, prototyping, human-oriented and contingency approaches; development environments and tools (e.g. CASE, RAD, etc.); methodology products and suppliers; project management frameworks and methodologies; training; implementation options and change management; maintenance and enhancement, change control, systems performance review; documentation.
QAA9	Information and Communications Technologies	Computer hardware; systems software; application software; communication technologies; network configuration and management; systems architectures; communication software and protocols; programming languages and environments; security; communications interfaces; communications media; middleware.

QAA10	Decision Support	Support for decision making through the use of computerised systems providing relevant IS-related information.
QAA11	Management of Information Systems and Services	The definition of roles and activities, development and acquisition of IS/IT skills and competencies; organisation and deployment of resources; relationships with external suppliers; relationship and service management between IS/IT specialists and other organisational activities; management of IS/IT specialist personnel; operational performance evaluation of IS, corporate governance of IS/IT, accounting for IS/IT investments and costs, information and systems security and integrity.
QAA12	Content Management Systems	Store, organise, manage and publish electronic media/information; Web and mobile CMS.
QAA13	Organisational and Social Effects of ICT-Based Information Systems	Individual skills, education and training; life-long learning - educational infrastructure, provision and delivery; adaptability and behavioural effects; effects of ICT in the home, leisure; information access and dissemination - the "information society"; health and safety; legal issues (e.g. Data Protection); computer based crime; social surveillance and control; national security; community governance; democratic participation and accountability ("electronic government"); employment patterns; terms and conditions of employment; location of work; organisation of work; teleworking and telecommuting; management processes and structures, empowerment, virtual organisations, learning organisations; job design and reward systems; internationalisation and globalisation.
QAA14	Economic Benefits of ICT-Based Information Systems	ICT industry (computers, telecommunications, software) analysis, its national, regional and global evolution; national and global ICT infrastructures; information-based products and services; effects on industry development and structures (e.g. logistics, financial services); ICT as an enabler of corporate globalisation, mass customisation and the effects of information availability; electronic commerce (intermediation and dis-intermediation effects); effects on financial, commodity and equity markets of global computer-based trading; effects of legislation, regulation and trade agreements; implications of external factors on IS/IT investment patterns.
QAA15	Personal Information Systems	Collecting, storing, managing and using information to address personal 'needs'.
QAA16	Digital Libraries	Digital library content; organisation, management and retrieval of information.
Project(17)	Final Year Project	Final year project

APPENDIX 2 – IS 2002 CATEGORIES

[Table largely adopted from (Lifer et al. 2009)]

Category	Name	Description
IS 2002.0	Personal Productivity with IS Technology	Basic IT/IS skills.
IS 2002.1	Fundamentals of Information Systems	An introduction to systems and development concepts, information technology, and application software.
IS 2002.2	Electronic Business Strategy, Architecture and Design	Linkage of organisational strategy and electronic methods of delivering products, services, and exchanges in inter-organisational, national, and global environments.
IS 2002.3	Information Systems Theory and Practice	Understanding of organisational systems, planning, and decision process, and how information is used for decision support in organisations.
IS 2002.4	Information Technology Hardware and Systems Software	Hardware/software technology background to enable systems development personnel to understand tradeoffs in computer architecture for effective use in a business environment.
IS 2002.5	Programming, Data, File and Object Structures	Algorithm development, programming, computer concepts, and the design and application of data and file structures.
IS 2002.6	Networks and Telecommunication	Knowledge of data communications and networking requirements including networking and telecommunications technologies, hardware, and software.
IS 2002.7	Analysis and Logical Design	Systems analysis, design and systems development and modification process.
IS 2002.8	Physical Design and Implementation with DBMS	Information systems design and implementation within a database management systems environment.
IS 2002.9	Physical Design and Implementation in Emerging Environments	Physical design and implementation of information systems applications in emerging distributed computing environments.
IS 2002.10	Project Management and Practice	Project management of information systems development and final year projects.

APPENDIX 3 – IS 2010 UPDATE

IS 2010 is the latest incarnation in a series of IS model curricula. The ratification and publication of IS 2010 by the ACM and AIS boards arrived almost nine months after the research presented in this paper was undertaken.

The changes introduced in IS 2010 suggest a significant shift towards a more flexible and relevant set of recommendations with an international dimension and a consideration of the technological advancements in ICT over the last decade. Its predecessor, which has been used as one of the two classification methods in this paper, has itself only been a small revision of IS 97. Thus IS 2010 offers a major re-evaluation of the curricula recommendations that were largely developed more than a decade earlier.

IS 2010 improves the previous set of recommendations in four ways. Firstly, IS 2010 introduces a flexible structure which separates modules into core and options, much like the classification of the modules carried out in this paper. This represents a much more unambiguous view about what constitutes 'essential' IS core knowledge and which specialisations can be chosen to complement it through the use of options. It also enables the development of career tracks that provide an alternative view of the curriculum, aligning it with the expectations of industry and professional bodies. From a student's view point, the identification of career tracks may be seen as a more focused answer to the difficult question: "What job can I get when I graduate from this course?"

Secondly, IS 2010 has been internationalised by taking into account the educational needs as well as variations found in non-US HE institutions. This is an important development that will not only help IS 2010 be better received in Europe and other parts of the world, but also enable a 'common language' that should help unify IS academics and curriculum developers.

Thirdly, the new recommended curriculum is less prescriptive as a result of its new flexible structure, enabling customisations according to local needs, local expertise and local expectations.

Finally, the anticipated outcomes of the new recommended curriculum have been designed in a way that reflect the expected foundation IS knowledge and skills, specific knowledge and skills, and the domain fundamentals which bear similarities to the SBSC domain knowledge as expressed in this paper.

It is the intention of the authors to analyse the data used in this paper using IS 2010 in the future.

[Table taken from http://www.acm.org/education/curricula/IS 2010 ACM final.pdf/]

Structure of the IS Model Curriculum:Information Systems specific courses

Career Track:	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Core IS Courses:																	
Foundations of IS	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Enterprise Architecture	○	●	○	○	○	●	○	○	○	○	●	○	○	○	●	○	○
IS Strategy, Management and Acquisition	○	●	○	○	○	●	○	○	●	○	●	○	○	○	●	○	○
Data and Information Management	●	○	○	●	●	○	○	●	●	○	●	○	●	○	○	○	○
Systems Analysis & Design	●	●	●	○	○	○	●	○	○	○	○	○	○	○	●	●	●
IT Infrastructure	○	○	○	●	○	○	○	●	●	●	○	○	●	●	○	○	○
IT Project Management	●	○	○	○	○	●	○	○	○	○	●	○	○	○	●	●	●
Elective IS Courses:																	
Application Development	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Business Process Management		●	●			○	○	○		○	●				○		
Collaborative Computing						○								○			○
Data Mining / Business Intelligence		●		●	●	○	○	○	●		○	○	○	○	○		○
Enterprise Systems		●	●	○	○	○	●	●	○		●	●	○	○			
Human-Computer Interaction	●					○	○				○					●	
Information Search and Retrieval		○		○	●								○				●
IT Audit and Controls	○		●	○	○	○	○	●		●	○		○	○	○		○
IT Security and Risk Management	○			○	○	○	○	●	●	○	○		●	●	○		○
Knowledge Management		●		○		○	○			○							
Social Informatics													○		○		

A = Application Developer
B = Business Analyst
C = Business Process Analyst
D = Database Administrator
E = Database Analyst
F = e-Business Manager
G = ERP Specialist
H = Information Auditing and Compliance Specialist
I = IT Architect
J = IT Asset Manager
K = IT Consultant
L = IT Operations Manager
M = IT Security and Risk Manager
N = Network Administrator
O = Project Manager
P = User Interface Designer
Q = Web Content Manager

Key:

● = Significant Coverage

○ = Some Coverage

Blank Cell = Not Required

APPENDIX 4 – COMMONLY USED TERMS

British Computer Society (BCS): The Chartered Institute for IT. http://www.bcs.org/

Course: A complete programme of undergraduate study that normally lasts at least three years and is defined by a curriculum. In US terminology courses are called ‘programs’.

Credit: Credit is awarded to a learner in recognition of the verified achievement of designated learning outcomes at a specified level. http://www.qaa.ac.uk/england/credit/creditframework.pdf

Credit level: An indicator of the relative complexity, demand and/or depth of learning and of learner autonomy. http://www.qaa.ac.uk/england/credit/creditframework.pdf

Credit value: The number of credits, at a particular level, assigned to a body of learning. The number of credits is based on the estimated notional learning hours (where one credit represents 10 notional hours of learning). http://www.qaa.ac.uk/england/credit/creditframework.pdf

Foundation Degree: Foundation Degrees integrate academic and work-based learning through close collaboration between employers and programme providers. http://www.qaa.ac.uk/reviews/foundationdegree/benchmark/fdqb.asp

General Certificate of Secondary Education (GCSE): academic qualifications awarded to students aged 14–16 in secondary education. http://www.direct.gov.uk/en/EducationAndLearning/QualificationsExplained/DG_10039024

Higher Education Statistics Agency (HESA): Government agency responsible for managing statistical data about Higher Education in the UK. http://www.hesa.ac.uk/

IS 2002: (Information Systems 2002) - Guidelines for Undergraduate Degree Programs in Information Systems.

Module: A unit of teaching that normally lasts one term or semester. The size (credits) of module can sometimes determine its duration. In US terminology a module is often called a ‘course’.

Programme Specification: A programme specification is a concise description of the intended learning outcomes from a higher education programme, and how these outcomes can be achieved and demonstrated. http://www.qaa.ac.uk/academicinfrastructure/programSpec/default.asp:

Quality Assurance Agency (QAA): UK agency that facilitates checks on university academic standards and quality. http://www.qaa.ac.uk/

Sandwich course: Undergraduate courses that offer students an industrial placement year, normally between the second and third year of study. http://www.qaa.ac.uk/academicinfrastructure/benchmark/default.asp

Subject Benchmark Statement (SBS): Expectations about standards. http://www.qaa.ac.uk/academicinfrastructure/benchmark/default.asp

Subject Benchmark Statement in Computing (SBSC): Standards in computing. http://www.qaa.ac.uk/academicinfrastructure/benchmark/statements/computing07.pdf

Tariff-points (UCAS): Points gained from different qualifications for entry to Higher Education. http://www.ucas.com/students/ucas_tariff/how

Top-up Course: Normally a one-year bridging course between a Foundation Degree and an Honours Degree.

UK Academy for Information Systems (UKAIS): A society trying to promote IS in the UK. http://www.ukais.org/

Universities & Colleges Admissions Service (UCAS): The body responsible for processing and managing applications to universities in the UK. http://www.ucas.ac.uk/

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