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QAA

# QAA Collaborative Enhancement Project Report on badging and micro-credentialing within UK higher education through the use of skills profiles

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# 1. Executive summary

Badges and micro-credentials are gaining popularity within UK higher education. This report presents six case studies from across the UK demonstrating different ways in which badges and micro-credentials can be accommodated either alongside or within existing courses. The case studies make use of a skills profiling approach to granularize existing courses into their skills hours. The report demonstrates how badges and micro-credentials can then be used based on their skills hours. The approaches outlined within this report demonstrate not only a mechanism to incorporate badges and micro-credentials within higher education provision, but also a way to explain more clearly to learners, teachers and employers how such provision aligns with future job roles. In so doing, it opens up opportunities for more flexible personalised learning and earning approaches both within higher education and beyond. A number of recommendations regarding potential next steps to realising these opportunities are provided.

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## 2. Overview

In December 2020, Professor Sue Reece published a discussion paper for the QAA on *modular qualifications (focus on micro-credentials)*, which was referenced in April 2021 in a QAA Quality Compass publication. It outlines, amongst other things, the opportunities for micro-credential approaches to be used to enhance the student learning experience through providing more flexible and granular approaches to learning and achievement.

In Autumn 2021, the University of Huddersfield and Northumbria University became the first two universities in the UK to offer a pathway for recognition of credit for LinkedIn Learning through an accreditation of prior learning route. This initiative was built on existing work by the above institutions, and others across the UK, focusing on a skill-based approach to curriculum development that can better meet the needs of various educational stakeholders such as the learner-earner themselves, employers, accreditation bodies and the QAA. Indeed, this work has already informed the current version of the QAA Subject Benchmark Statement for Computing.

One of the key concerns raised in one of the QAA making use of credit webinars, supporting a QAA publication of the same name, was that developing more granular degree courses would increase assessment workloads. What follows in this report, therefore, is a how-to guide with examples that demonstrates how an existing approach to skills profiling can be used to enable micro-credential and badge-based approaches to be adopted within degree programmes across UK universities without increasing assessment workloads, and in some cases by reducing them significantly whilst also offering more choice and personalised learning opportunities to learners.

## 3. Approaches to UK-based micro-credential models

Computing degree programmes at a set of UK institutions will be used as examples in order to illustrate opportunities for badging and micro-credentialing within UK higher education. In order to present these opportunities, five model approaches outlined by Professor Sue Reece, as shown below in Figure 1, will be considered. These approaches use micro-credentials independently, for course entry, to accredit prior learning and through embedding them into courses either by aligning them to existing content or by generating stackable credit-bearing elements.

In order to demonstrate how these model approaches can be used, existing programmes and modules are translated into a set of 21st century skills categories. Once translated, learning can be combined differently to offer more flexible efficient and personalised approaches to assessment whilst maintaining the quality assurance integrity of the degree programmes themselves.

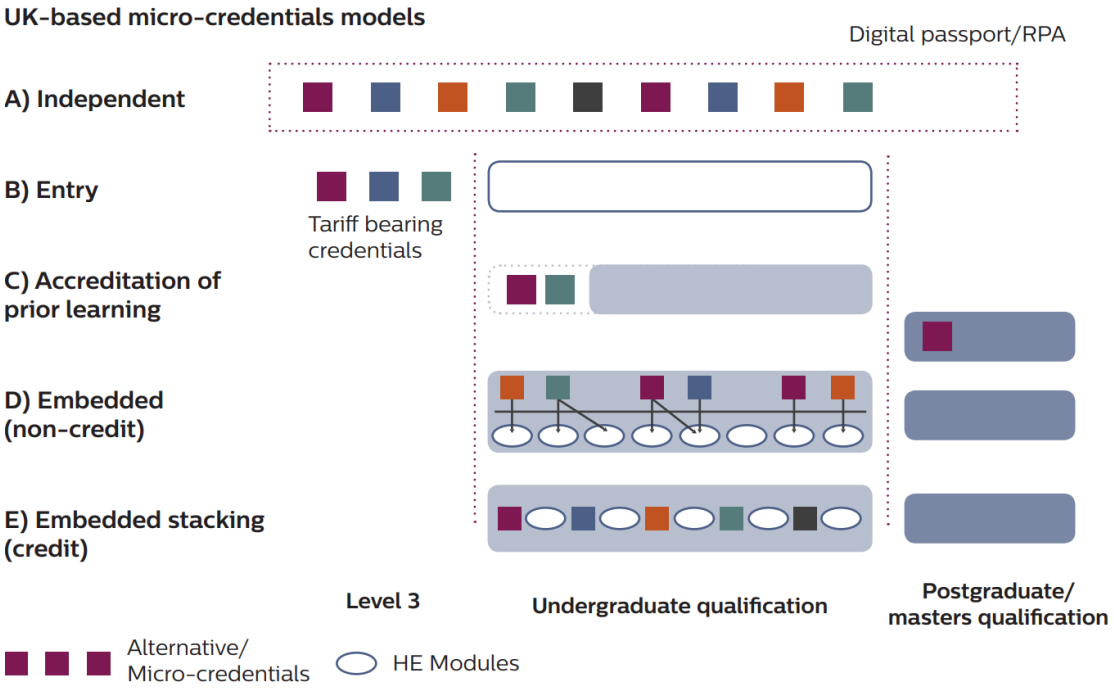


*Figure 1 – Professor Sue Reece's five potential models for UK micro-credentialing*

## Methodology

Programme and module learning outcomes have been translated into 21st century skills using an approach outlined previously by Ward et al. (2021). Six skills themes – A) Understanding, B) Context, C) Solutions, D) Delivery, E) Behaviour and F) Reporting, and 25 skills categories (S1A to S6F and T1A to T19F), as shown in Figure 2, are used to develop skills profiles. By translating learning hours into skills hours, the resulting skills profiles provide greater utility both for micro-credentialing and for employment.

| | SKILLS | SHORT DESCRIPTIONS |
|---|---|---|
| | **Subject-based** | |
| **S1A** | A – Theory | Theoretical subject area knowledge |
| **S2B** | B - Business Requirements and Applications | Business needs and use |
| **S3C** | C – Innovation | New subject area approaches |
| **S4D** | D - Process and Production | Actions or steps taken to achieve a particular result |
| **S5E** | E - Self-Reflection | Contextual analysis within the environment in which the subject area is applied |
| **S6F** | F - Technical Writing | Subject-related writing that requires direction, instruction or explanation |
| | **Transferable** | |
| **T1A** | A - Information Literacy | Integrated abilities encompassing discovery, production and valuing of information |
| **T2B** | B - Business Alignment | Recognition of organisational purpose, aims and objectives |
| **T3B** | B - Entrepreneurship | Developing and managing business ventures |
| **T4B** | B - Numeracy | Use of numbers to solve real life problems. |
| **T5B** | B - Analysis | Gaining improved understanding through simplifying a complex topic |
| **T6C** | C - Creativity | Creating new things |
| **T7C** | C - Problem Solving | Finding new solutions to complex issues |
| **T8D** | D - Technical Proficiency | Apply technical knowledge and skills to specialist roles and responsibilities |
| **T9D** | D - Self-Regulation | Managing oneself in order to achieve goals |
| **T10D** | D - Leadership | Motivating others to perform |
| **T11D** | D - Management | Planning, organising, directing or controlling physical, financial, human and informational resources efficiently and effectively to achieve organisational goals |
| **T12E** | E - Professionalism | Professional status, methods, character or standards |
| **T13E** | E - Ethics | Concepts and principles determining behaviour that helps or harms |
| **T14E** | E - Evaluation | Assessing the amount, number or value of something |
| **T15E** | E - Risk Analysis | Identifying and analysing potential negative impacts on goals |
| **T16E** | E - Sustainability | Maintaining resources in ecological balance |
| **T17E** | E - Social Learning | Understanding and applying behaviours within social contexts |
| **T18E** | E - Collaboration | Processes where two or more people work together to complete tasks or goal |
| **T19F** | F - Communication | Conveying meaning to others |

*Figure 2 - Ward et al.'s skills categories*

The first stage involves calculating subject-specific skills hours by translating each learning outcome into the most appropriate subject-specific skills category. Skills hours are then calculated pro-rata

from learning hours, assessment weightings and learning outcomes. In the example below, a 20 credit module with 200 learning hours has two assessments weighted 60% (asst 1) and 40% (asst2). Figure 3 shows the subject-specific skills hours.

| Module Learning Hours | | 200 | | | |
|---|---|---|---|---|---|
| Asst | Weighting | Asst Learning Hrs | Learning Outcome | Learning Outcome Hrs | Subject-Specific Skills Categories |
| 1 | 60% | 120 | 1 | 30 | S1A |
| | | | 2 | 30 | S2B |
| | | | 4 | 30 | S4D |
| | | | 5 | 30 | S4D |
| 2 | 40% | 80 | 2 | 40 | S2B |
| | | | 3 | 40 | S6F |

| | Subject-specific Skills Hrs |
|---|---|
| S1A | 30 |
| S2B | 70 |
| S4D | 60 |
| S6F | 40 |

*Figure 3 - Example showing subject-specific skills profiling*

A similar approach is used for transferable skills, though several transferable skill categories can be applied to a given learning outcome, and therefore individual transferable totals are summed in Figure 4.

| Module Learning Hours | | 200 | | | |
|---|---|---|---|---|---|
| Asst | Weighting | Asst Learning Hrs | Learning Outcomes | Learning Outcome Hrs | Transferable Skills Categories |
| 1 | 60% | 120 | 1 | 30 | T1A |
| | | | 2 | 30 | T2B, T3B |
| | | | 4 | 30 | T9D, T10D, T11D |
| | | | 5 | 30 | T8D, T11D |
| 2 | 40% | 80 | 2 | 40 | T4B, T5B |
| | | | 3 | 40 | T19F |

| | Transferable Skills Hrs |
|---|---|
| T1A | 30 |
| T2B | 15 |
| T3B | 15 |
| T4B | 20 |
| T5B | 20 |
| T8D | 15 |
| T9D | 10 |
| T10D | 10 |
| T11D | 25 |
| T19F | 40 |

*Figure 4 - Example showing transferable skills profiling*

## Labour Market Information

Alongside analysing course content using subject-specific and transferable skills, it is also possible to do a similar analysis of job postings through the labour market analytics available via Lightcast. In particular, job postings related to the degree courses considered within this report can be collated and the skills that are advertised within these job postings can be compared to those being developed by the courses. In order to do this, the two types of skills data (subject-specific and transferable) are downloaded, duplicates are removed and skills are quantified based on the number of job postings the skills are listed in i.e. the frequency of skills within job postings. A percentage can then be calculated for each skill in comparison to the total number of job postings for all skills. This percentage skills profile distribution can then be compared to a similar percentage skills profile distribution for the course and any variation between the two discussed. An example of both the percentage skills profile distributions and the comparison between them are shown in Figures 5 and 6. We can note an immediate mismatch, where the labour market information provided via Lightcast does not include self-reflection, which is perhaps understandable, or technical writing, which is less understandable, but probably implicit within the job roles. In comparison, a computer science course should include both, and employers would probably be unhappy if graduates could do neither. This highlights challenges not only with recognising skills in higher education, but also with how such skills are identified and expressed within employment.

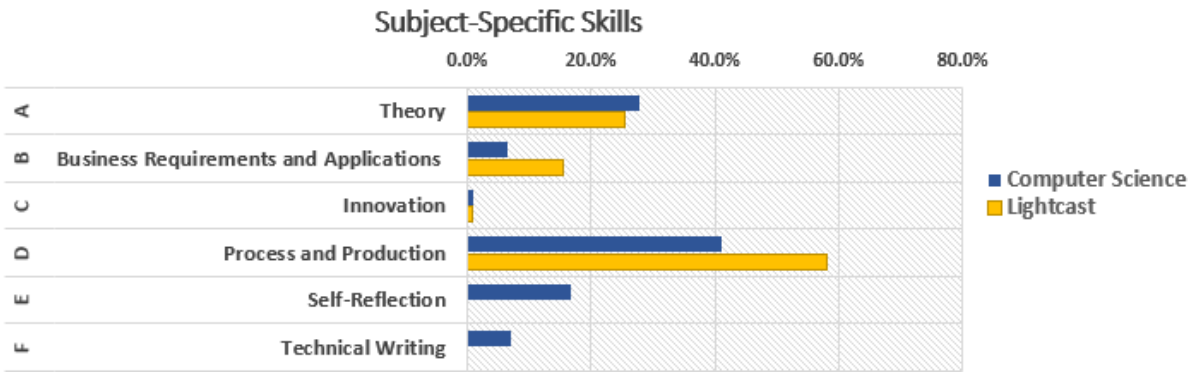


*Figure 5 - Example course and labour market data comparison*

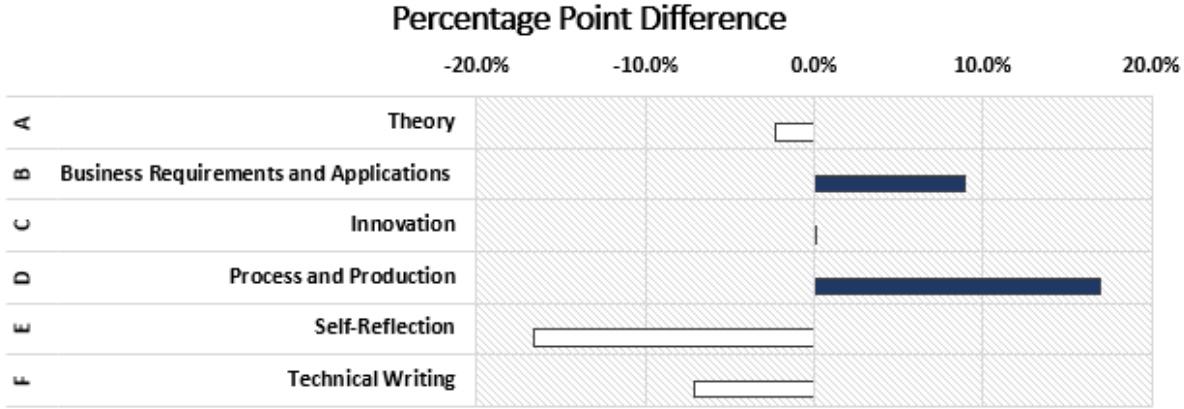


*Figure 6 – Example difference between course and labour market data*

# A. Independent

## A.1. Case Study 1 iDEA @ Manchester Met

BSc (Hons) Computer Science was chosen as the case study course for Manchester Met. BSc Computer Science at Manchester Met covers theoretical and practical aspects of the discipline with an emphasis on programming, data structures and computer architectures. The course was designed in consultation with employers and aims to meet industry needs. The course has been accredited by the British Computer Society. The course has transferable skills embedded and there is an opportunity to work with industry through employer-sponsored "live" projects. The course is three years with an option to take a year's industrial placement after the second year of study (though this option is not considered here – see Recommendations for further comment). The course prepares graduates for a wide range of careers in the computing industry including roles such as software engineer, web developer, data scientist and network engineer. BSc Computer Science was chosen as it recruits the highest number of students of the seven computing related courses within the Department of Computing and Mathematics.

### *Skills profiling*

The skills profiling for BSc Computer Science identified interesting outcomes for both subject-specific and transferable skills. In terms of subject-specific skills (see Figure 7), the vast majority of hours were spent on *Process and Production* and *Theory*, accounting for 39% and 28% of the course respectively. With the aims of the course being to ground students in theory and practice this is to be expected. The other subject-specific skills each accounted for between 6% and 10% of study time. This indicated that skills such as *Innovation*, *Self-Reflection* and *Technical Writing* are areas where students may wish to seek extra-curricular study to strengthen their graduate skills portfolio.

For transferable skills (see Figure 8), there was a high proportion of time devoted to *Technical Proficiency*, *Problem Solving*, *Information Literacy* and *Evaluation*, which was to be expected given the nature of the course. *Leadership*, *Social Learning* and *Collaboration* were all relatively low in terms of emphasis, reflecting the problematic nature of assessing these skills. There was relatively low consideration of *Professionalism* and *Ethics*, but the most surprising finding was that there was no explicit consideration of *Sustainability*. The latter finding probably relates to the emphasis of *Sustainability* at the time of course validation and it is likely that with the growth in importance of Green Computing that the next version of the course will find increased time devoted to this skill.

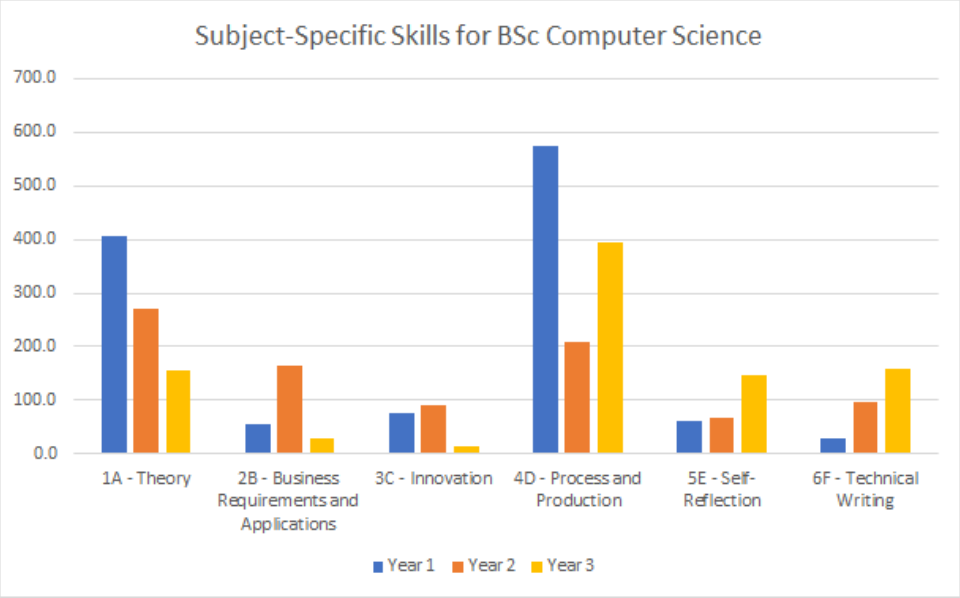


*Figure 7 - Subject-specific skills profile*

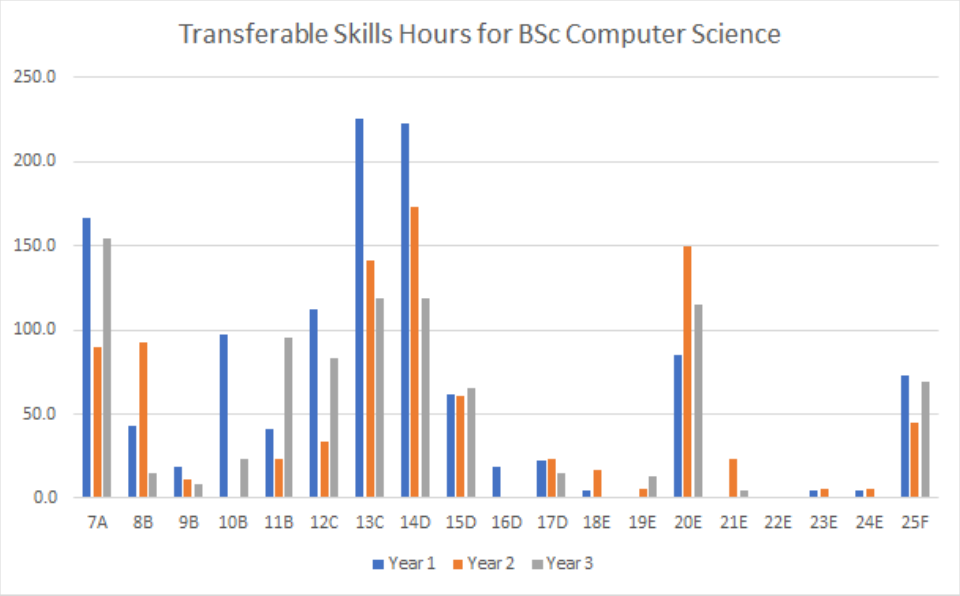


*Figure 8 - Transferable skills profile*

*Comparison with Lightcast*

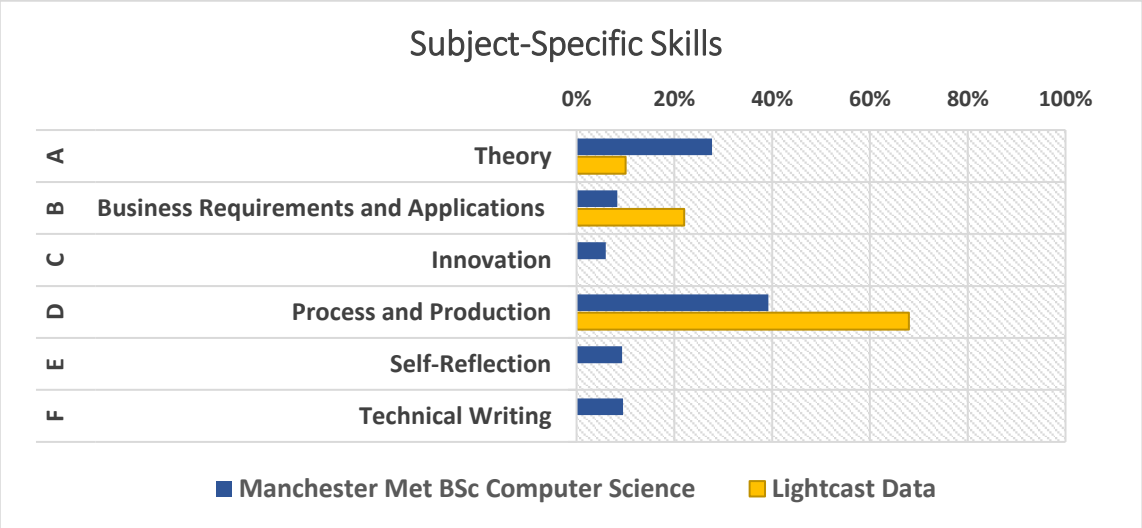


*Figure 9 - Subject-Specific Skills*

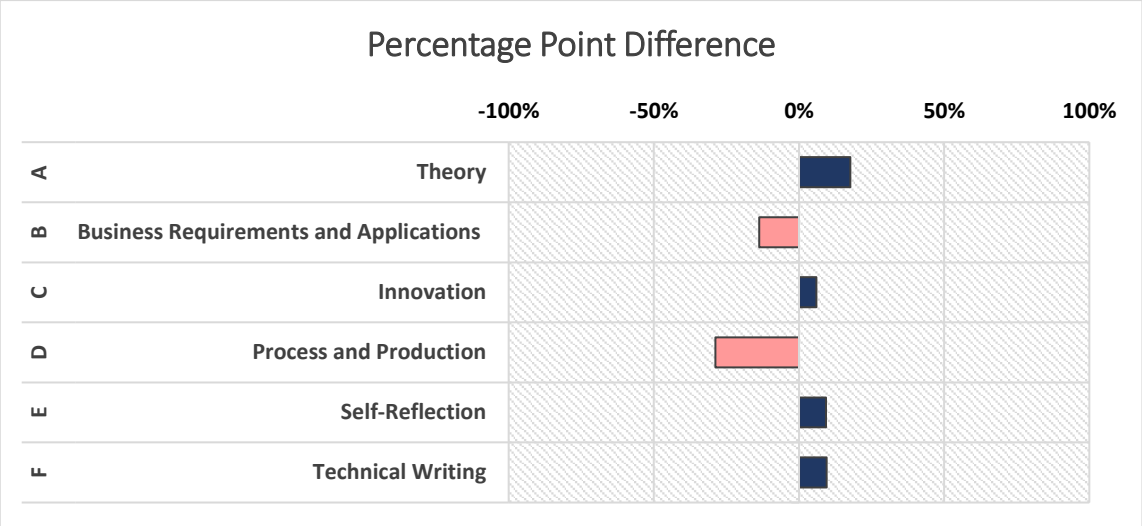


*Figure 10 - Subject-Specific Skills Difference*

The Lightcast analysis identified some interesting areas for development for the BSc Computer Science course at Manchester Met. In terms of subject-specific skills, *Business Requirements and Applications* and *Process and Production* had a lower-than-expected percentage of time devoted to them. A substantial proportion of time is spent on *Process and Production* (almost 40%), however students on the course may benefit from additional micro-credential study. On the positive side the course had a higher proportion of activity on *Theory*, *Self-Reflection* and *Technical Writing*. With respect to transferable skills, Manchester Met's BSc Computer Science course had a higher-than-expected emphasis on *Technical Proficiency*, *Leadership* and *Evaluation*, but more support would be beneficial for *Management*, *Social Learning* and *Sustainability*. The comparison between skills mapping carried out for micro-credentials and skills mapping for job requirements from Lightcast provides useful targeting of extra-curricular study for students.

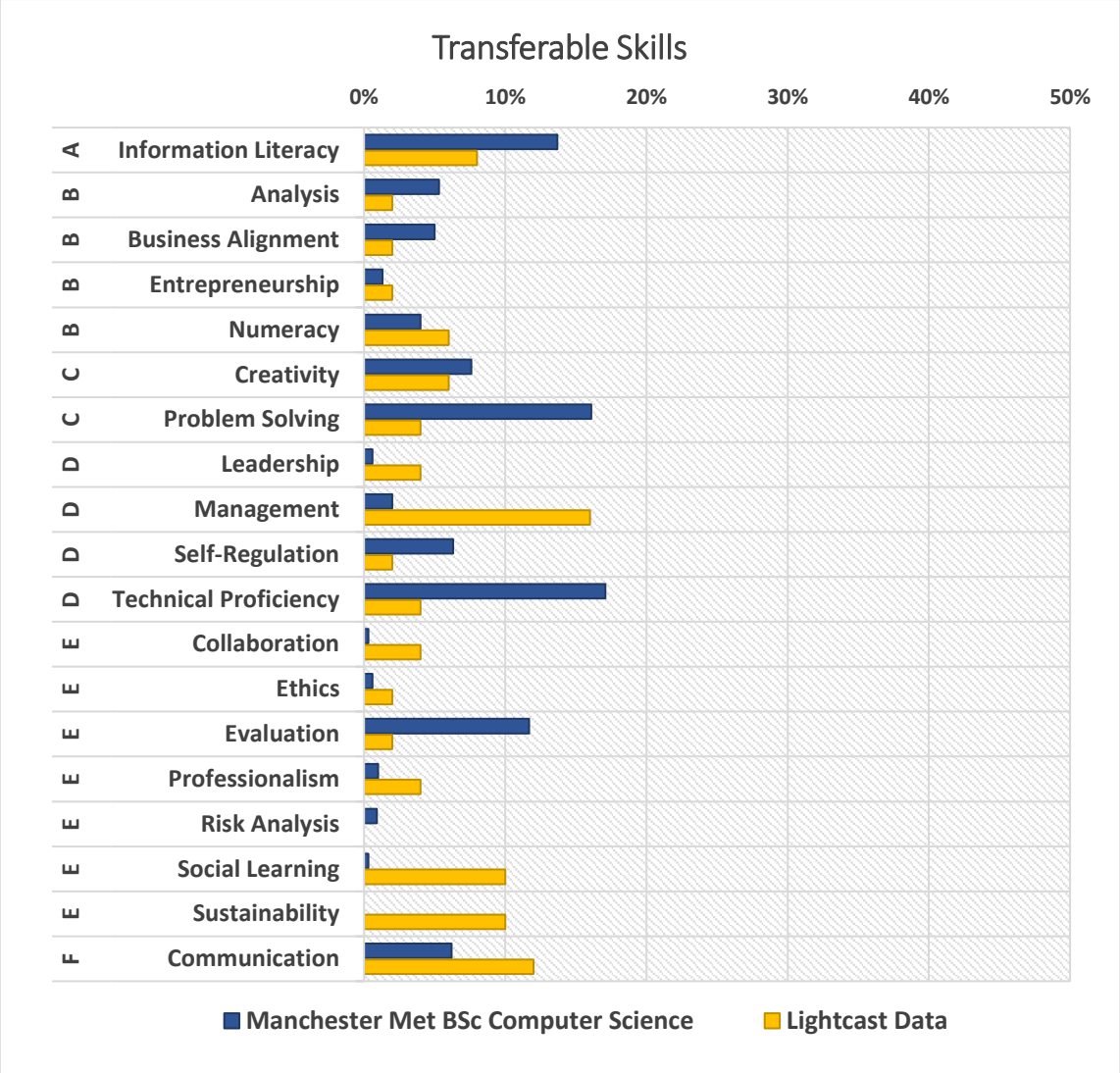


*Figure 11 - Transferable Skills*

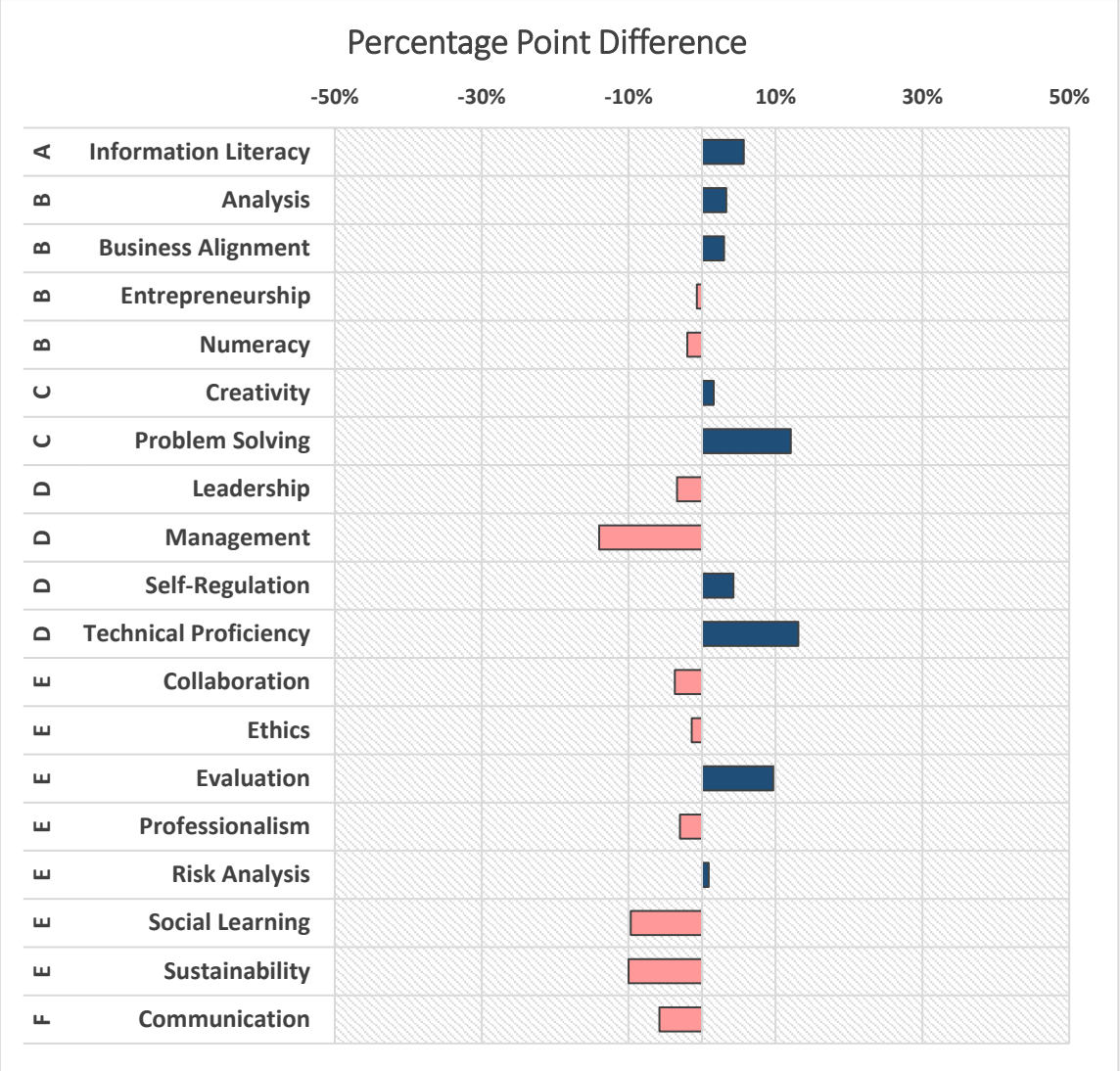


*Figure 12 - Transferable Skills Difference*

### *Micro-credential approach*

The Inspiring Digital Enterprise Award, known as iDEA, is a free online international programme aimed at developing digital, enterprise and employability skills. Participants engage in a series of challenges to gain awards. Manchester Met have championed iDEA as a way of encouraging development of digital skills among students. Learners engage in practical web-based learning activities to gain skills. Examples of activities include building web sites, coding projects, developing entrepreneurial skills and learning about systems administration. Each activity is associated with a number of points and learners accumulate points to gain badges and awards that they can use to market their employability.

In terms of skills mapping, each of the iDEA learner activities are associated with skills. Some examples are given in Table 1 below.

| Activity | Skill(s) |
|---|---|
| Coding solutions | Problem Solving |
| Entrepreneur activation | Leadership, Problem Solving, Creativity |
| Internet of Things | Creativity |
| Systems administration (Sysadmin) | Problem Solving |

*Table 1 - iDEA learner activities and skills*

In this approach to applying micro-credentials, the points associated with iDEA skills can be mapped to skills on courses such as BSc Computer Science to apply exemption. So, for example, a learner can use points gained on iDEA activities for coding solutions, entrepreneur activation and systems administration (sysadmin) for problem solving and set them against transferable skill category T13C Problem Solving on the BSc Computer Science course to achieve micro-credit exemption.

### *Benefits and limitations*

There are several benefits that arise from the approach. Principal benefits are:

- Students can identify areas where they can improve their employability to employers by identifying gaps in their skills base and supplement their course through gaining iDEA awards.
- Applicants who have gained iDEA awards in their school or college may use their achievements to gain micro-credential exemption.
- Students on non-Computing courses can try out digital activities and may be able to use general skills gained with iDEA for micro-credential exemption on their course.
- Students on non-Computing courses can try out digital activities and if they gain sufficient confidence and motivation may choose to take a conversion master's course in an area of demand (see also B.2 Bath case study).

The main limitation is that iDEA, while supported and encouraged by the University, is optional extra-curricular activity. With the many demands on students' time, those engaged in iDEA are a highly-motivated minority group of learners.

### *Possible uses*

Micro-credentials have the potential to be used as a career planning tool in support of employability goals. Many Computer Science courses, along with other disciplines, include curriculum that assists students in developing graduate skills and improving their employment outcomes. Planning for micro-credential study in iDEA could be brought into these modules to enable students to reinforce or gain the skills needed for jobs. In this way it would not be the more highly-motivated students who gain benefit from extra-curricular activity, rather the students who potentially can benefit the most from supporting their study will have a systematic way of gaining skills to develop their careers.

Micro-credentials could be used by students to drive their personalised learning needs. Students can look at areas of skills based on their needs and what is delivered on their course to plan what micro-credentials they can gain on the iDEA programme.

A further possible use is for students on non-Computer Science courses to gain an opportunity to experience the sort of study available within the discipline. With the significant shortage of digital skills noted in many forums, the use of iDEA's digital micro-credentials could act as "taster" study that may encourage more entrants into Computer Science courses to meet the UK's needs for graduates in the discipline. This notion of a taster for digital careers could be used by the iDEA programme to further promote uptake.

A final use could be to include iDEA badges and micro-credentials into the other, more formal, model approaches discussed below.

# B. Entry (tariff bearing)

## B.1. Case Study 2 Undergraduate entry to Abertay University

BA (Hons) Computer Arts at Abertay University is a four-year course where students may enrol in stages one, two or three. They learn a wide array of subject-specific and transferable skills as they learn practical and theoretical knowledge to create a wide range of content, including, but not limited to, digital 3D modelling and sculpting, conceptual artwork, animation, and information design. The course is taught by creative industry professionals from a wide array of fields to prepare students for their future careers in roles such as 3D artist, animator, FX artist, technical artist, conceptual artist, graphic designer and many others. Each stage mandates that students select modules and specialties which may reflect their interests and desires. The course is accredited by ScreenSkills Select, TIGA and PlayStation.First.

### *Skills profiling*

Two approaches to skills profiling were used to illustrate the difference between what staff think is being taught and what learning outcomes state is being learnt. The first methodology was informed by the staff's own understanding of the Computer Arts programme. Skills were matched to each learning outcome based on their prior experience when they undertook the course and completed their assessments. This methodology was defined as perceived skills profiling, as there are a multitude of skills learnt when on the course which do not directly coincide with the learning outcomes. The second methodology was using the approach taken throughout this report, namely translated skills profiling, where only those skills that are directly mentioned/inferred within learning outcome descriptions are recognised. These different interpretations are shown in Figures 13 and 14. Translated skills profiling was then used throughout the remainder of the analysis.

A second analyst, a student, then mapped the skills for the Computer Arts modules, to compare different analysts' interpretations of the translated skills profiles. This showed that whilst there were many similarities between both results, they were not identical. One of the analysts was unaware that a practical-based research model existed and so they understood some of the learning outcomes to be theoretical in nature, while the other analyst was aware of this model and accounted for it in their decision making. The analysts also understood some of the learning outcomes could be open to interpretation in the sense that some skills were passive and also therefore open to interpretation, which the translated skills definition does not account for. These different translations are shown in Figures 15 and 16. Both approaches demonstrate that, as currently expressed, learning outcomes are both open to interpretation and may not fully represent the intent or the reality of the learning itself.

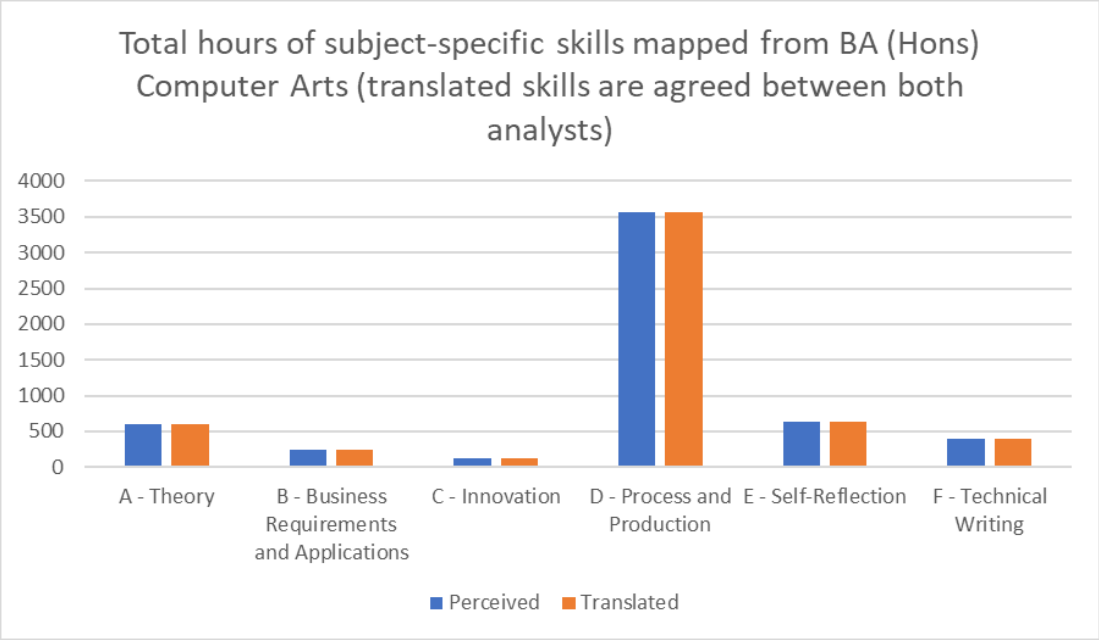


*Figure 13 – Subject-specific skills mapping comparison between perceived and translated (all course specialities)*

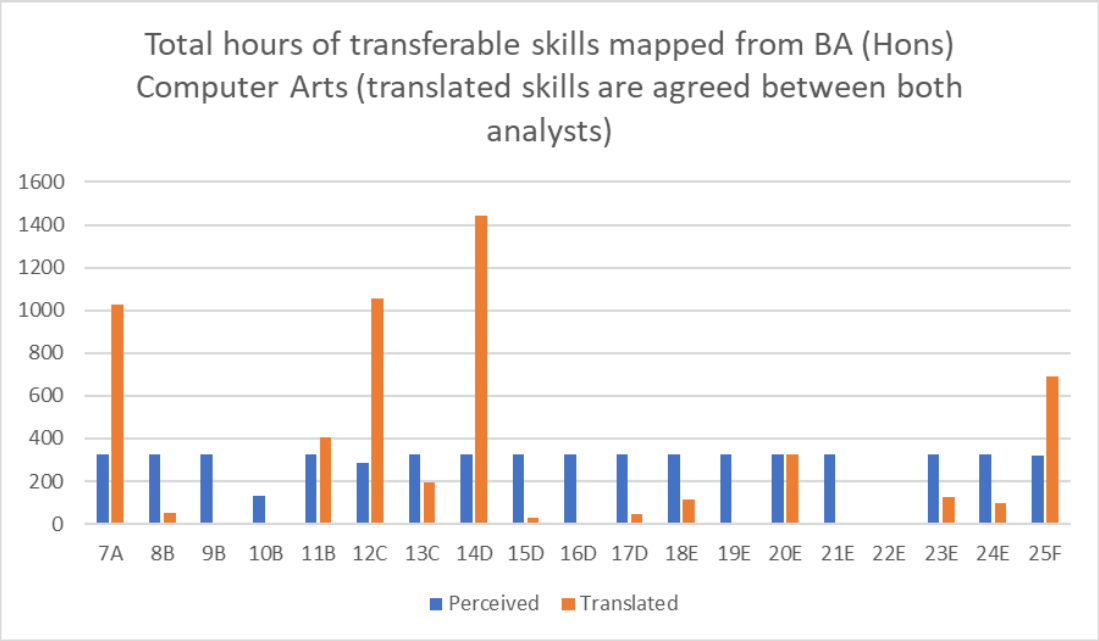


*Figure 14 - Transferable skills mapping comparison between perceived and translated (all course specialities)*

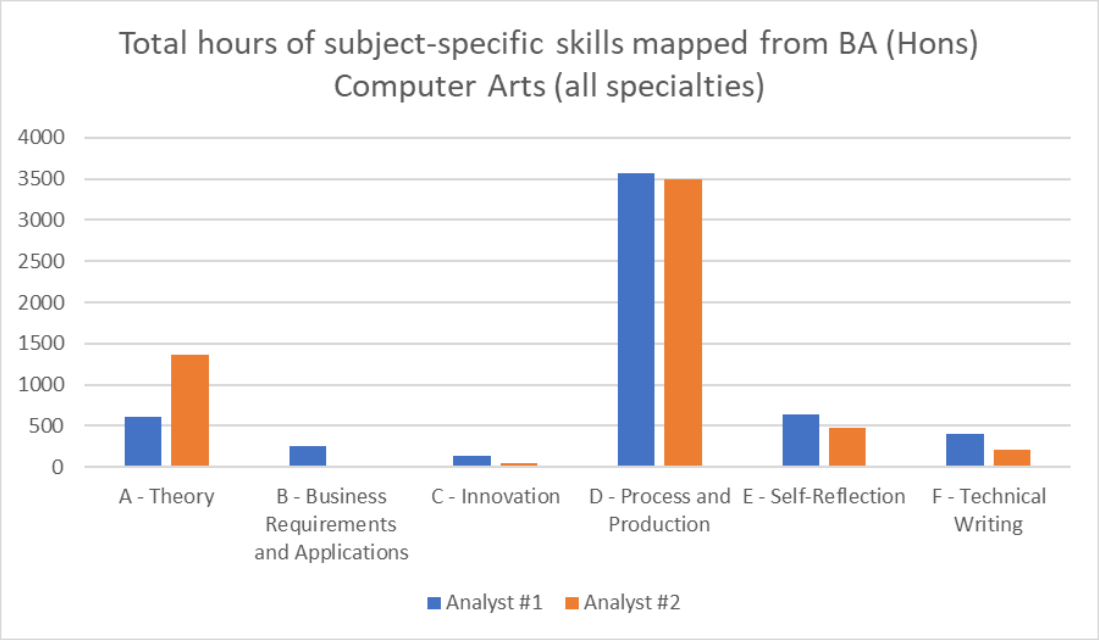


*Figure 15 - Comparison of two analysts' interpretations of subject-specific skills*

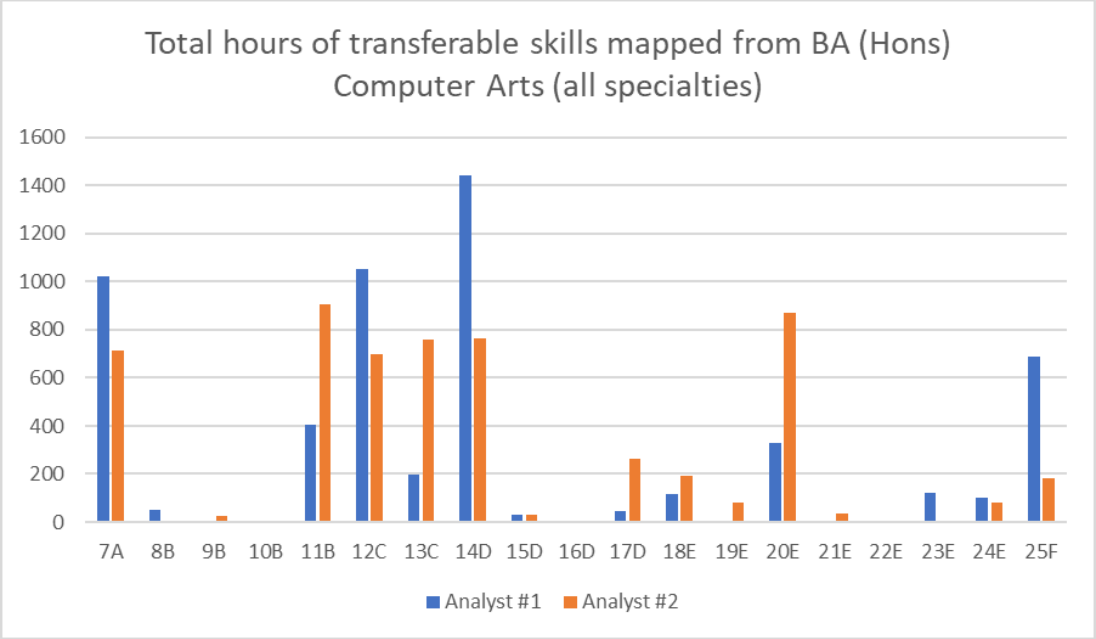


*Figure 16 - Comparison of two analysts' interpretations of transferable skills*

Computer Arts students select one specialism out of four during the first semester of their third year. The four specialtsms are as follows:

- Animation
- Art and Design
- Game Audio
- Game Art

The figures shown above represent all specialtisms mapped together, however variation between the different specialtisms can also be explored. Tables 2 and 3 show that there is very little skills variation between specialism, given that only part of the course is different and that this difference does not lead to huge variations in the types of skills developed, though the specific subjects being studied may vary significantly e.g. audio versus animation.

| | Skills Code – Subject-specific Skills | | | | | |
|---|---|---|---|---|---|---|
| Specialism | 1A | 2B | 3C | 4D | 5E | 6F |
| Animation | 14 | 3 | 3 | 44 | 7 | 6 |
| Art and Design | 13 | 3 | 3 | 45 | 7 | 6 |
| Game Audio | 14 | 3 | 3 | 42 | 7 | 8 |
| Game Art | 13 | 3 | 3 | 46 | 7 | 6 |

*Table 2 - Subject-specific skills variation by specialty*

| | Skills Code – Transferable Skills | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specialism | 7A | 8B | 9B | 10B | 11B | 12C | 13C | 14D | 15D | 16D | 17D | 18E | 19E | 20E | 21E | 22E | 23E | 24E | 25F |
| Animation | 56 | 4 | 0 | 0 | 31 | 48 | 12 | 61 | 1 | 0 | 3 | 6 | 0 | 24 | 0 | 0 | 7 | 5 | 32 |
| Art and Design | 54 | 4 | 0 | 0 | 30 | 46 | 8 | 60 | 1 | 0 | 3 | 6 | 0 | 23 | 0 | 0 | 7 | 5 | 36 |
| Game Audio | 55 | 4 | 0 | 0 | 30 | 45 | 8 | 61 | 1 | 0 | 3 | 6 | 0 | 22 | 0 | 0 | 7 | 5 | 33 |
| Game Art | 55 | 4 | 0 | 0 | 29 | 49 | 8 | 62 | 1 | 0 | 3 | 6 | 0 | 22 | 0 | 0 | 7 | 5 | 33 |

*Table 3 - Transferable skills variation by specialty*

The micro-credential modules support entry onto the Computer Arts course, so that regardless of the specialism students choose in their third year, they are best prepared. The skills students learn during their micro-credential modules set the stage for the practical nature of the course but also the concepts which are indirectly taught such as self-reflection and professionalism. During a student's third year, to make the 'correct' choice for their specialism, students must reflect on what they want from the course. Such a decision is similar to the one a student makes in their first year when they select their micro-credential modules. In both cases, knowing what they want from the course and within themselves aids them in their decision.

*Comparison with Lightcast*

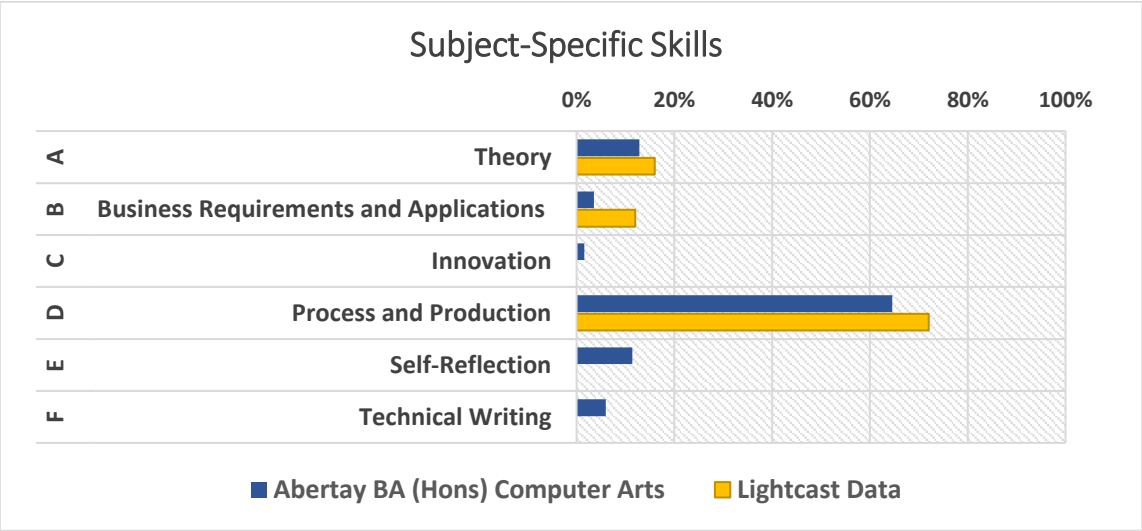


*Figure 17 - Subject-Specific Skills*

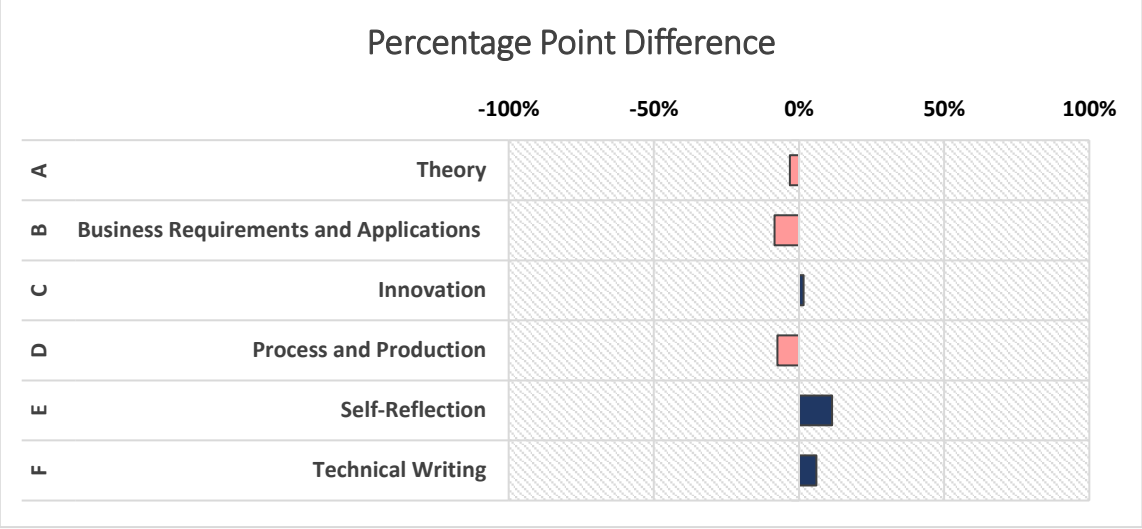


*Figure 18 - Subject-Specific Skills Difference*

Computer Arts at Abertay University aligns somewhat well with the Lightcast data however there are major differences for both the subject-specific and the transferable skills. In terms of the subject-specific skills, the Lightcast data appears to show that students spend most of their time developing their skills in learning a process and producing something, while true, this can be viewed as being too general as the skills of *Self-Reflection* and *Technical Writing* are also learned on the course but not under traditional means. Most modules require students to submit a portfolio of some kind and to explain their process and comment on the work of others. In most cases a student's technical writing is not being directly assessed or taught by the lecturer but such skills are learnt and developed as one undertakes the course and completes assignments. Again, this highlights the issue of learning outcomes not fully expressing the skills being gained.

As for transferable skills on the Computer Arts course, it appears the most prominent of the skills tally up with the Lightcast data however the other skills are up for debate. The skills of *Creativity, Problem Solving* and *Communication* relate to the Lightcast data well with only a minor variance. However, it appears there is a greater variance in the skills of *Information Literacy* and *Leadership*. Everything the students create and review whether it be their own work, or the work of others relates to the discovery of information, while not in the traditional sense, the phrase "a picture is worth a thousand words" holds weight in this respect. Computer Arts students spend much of their time not only creating work but also reflecting on the work they created and how others created their work. The information of said work conveys lessons which can be discovered through asking questions of oneself through reverse engineering the work's creation.

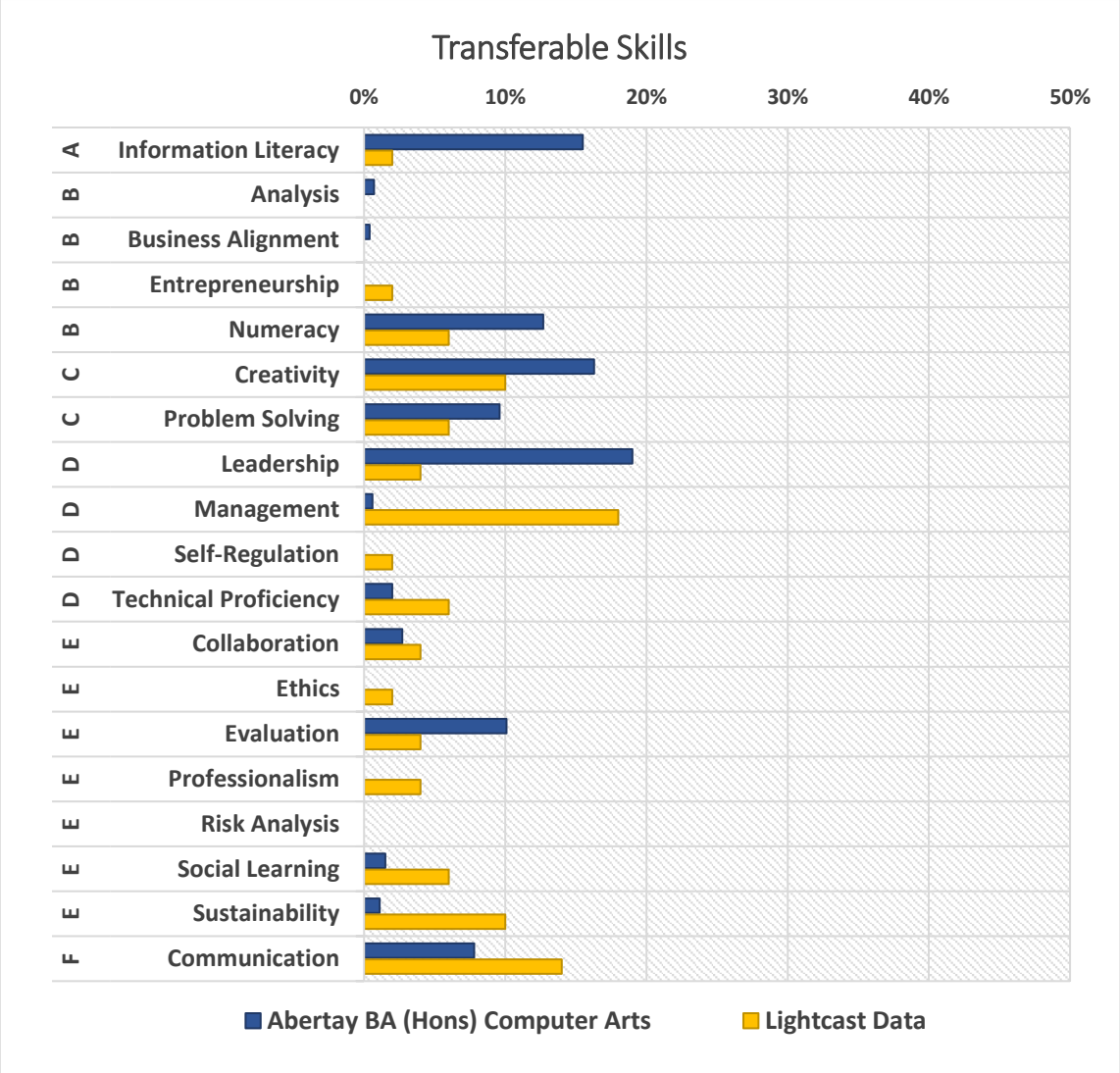


*Figure 19 - Transferable Skills*

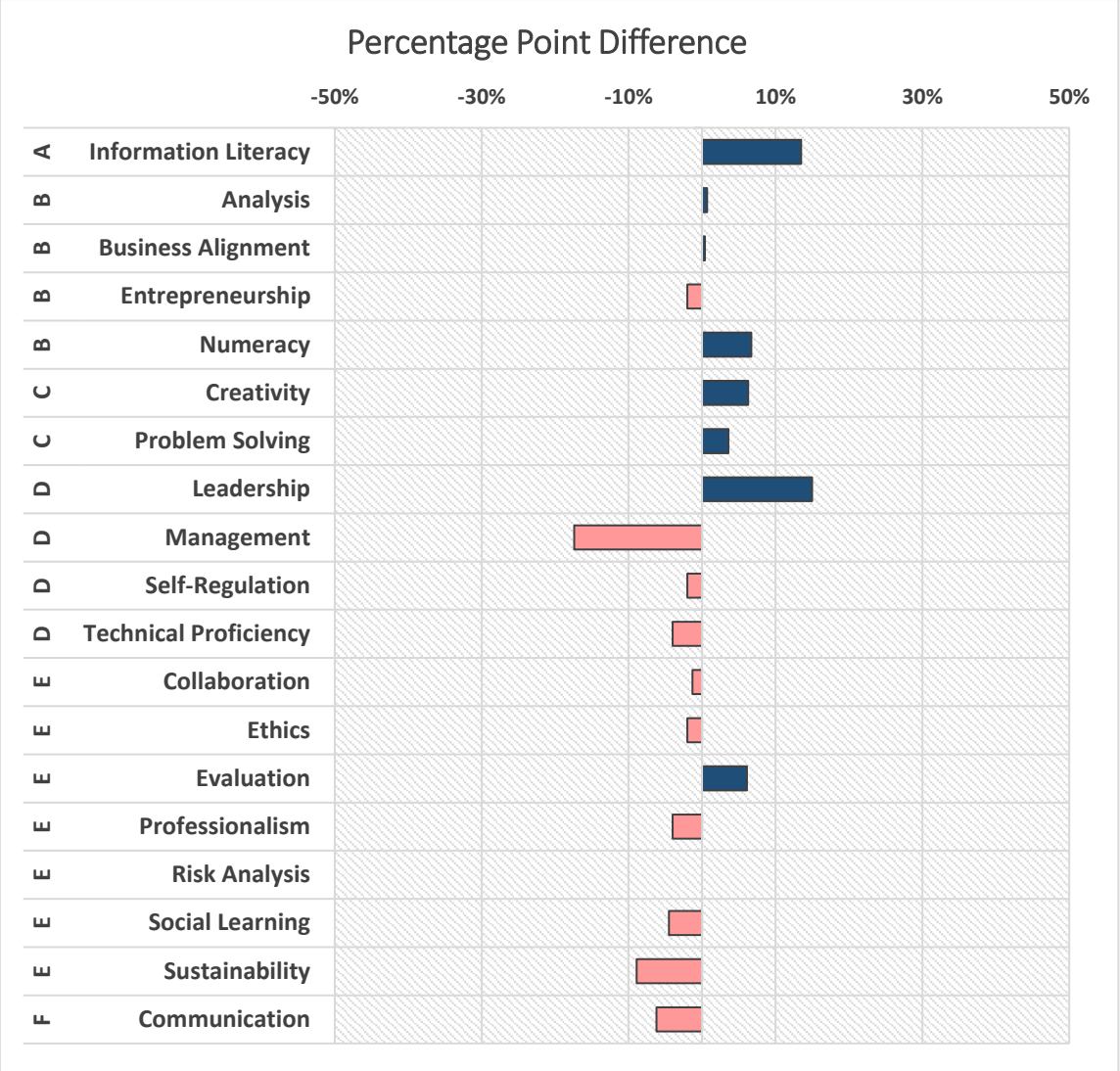


*Figure 20 - Transferable Skills Difference*

### *Micro-credential approach*

At Abertay, micro-credential modules are provided alongside the core modules in year one. The purpose is to build successful academic and social foundations. They serve as a series of supportive modules for students to carry out so that they would be able to respond to the demands of their programmes more successfully. First-year students are mandated to complete four micro-credential modules. They select three modules from a pool of nine and all first-year students are also assigned to complete a fourth mandatory module which is in place before the semester starts – it is known as: ABE101 – Being Successful at Abertay.

### *Benefits and limitations*

Carrying out the micro-credential modules encourages students to plan and reflect on their journey through university. Knowing and later understanding the motives behind why they are studying helps students tailor their university experience to suit their own goals and to make it a personalised experience.

### *Possible uses*

The skills profiles reveal that BA (Hons) Computer Arts is a highly practical course and so, by comparison, students have the option to select micro-credential modules which either supports the practical nature of the core modules on the programme or expands their learning in new areas. The chosen micro-credentials may contain content which is theoretical in nature and students may select them to balance out the skills they will learn, conversely, students may select a practical micro-credential module to 'double down' on the practical nature of the programme. These micro-credentials could be provided as tariff bearing entry materials, though currently they are studied alongside the core modules.

Each stage of the programme requires students to make decisions about their own futures. They are encouraged to plan for steps they will need to take in order to get to the career they want. In terms of the impact of micro-credentials on skills profiling, the skills students learn during the undertaking of the year one core modules are supplemented with the skills students learn from undertaking the micro-credential modules, as shown in Figures 21 and 22. While not stated directly in these figures, the subject-specific skill of *Self-Reflection* is gained through the micro credentials, and is important going forward as students can be self-reflective throughout their university journey. While BA (Hons) Computer Arts is a practical course, the nature of being self-reflective underpins what students study, as this skill keeps one anchored not only to students being 'good students' but also as they learn their own craft. Additionally, each of the transferable skills students gain is further developed as they undertake their core modules, except for *18E – Professionalism*. University is not only a time for people to learn their craft/field but also a time for them to become ready for the wider world and so professionalism is an important skill for one to learn. While not directly taught during the student's first year, professionalism also underpins student's actions as they communicate with others, attend lectures and classes, work to deadlines and so on. Providing such materials ahead of studying the course modules and recognising this content within entry requirements would therefore assist with the subsequent study of core modules, supplementing the skills gained as shown below.

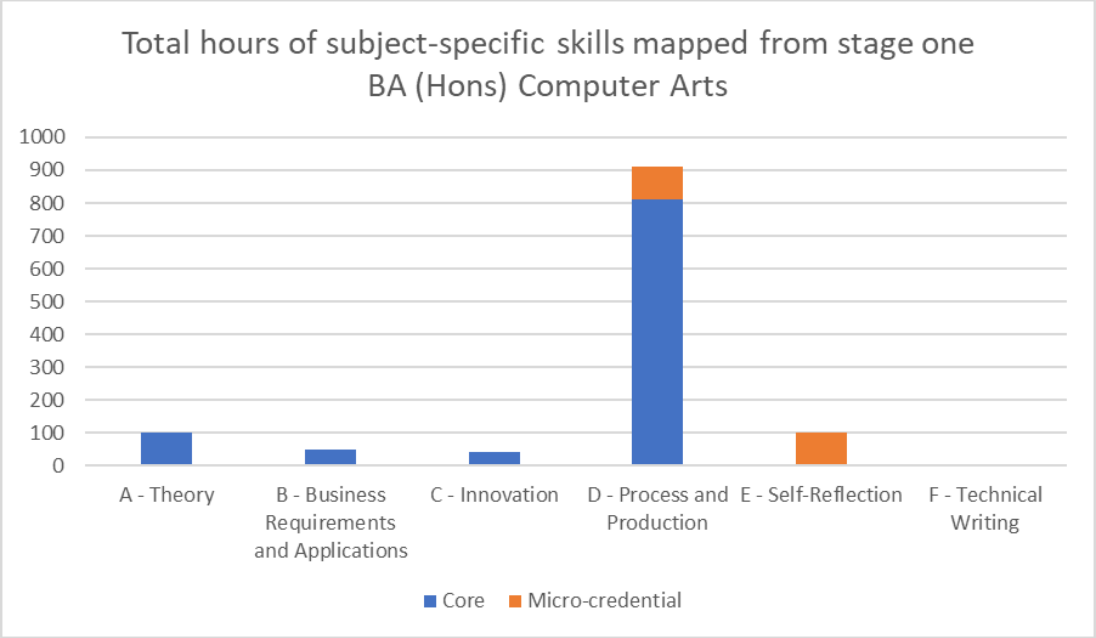


*Figure 21 – Additional subject-specific skills gained through micro-credentials added to the core skills profile*

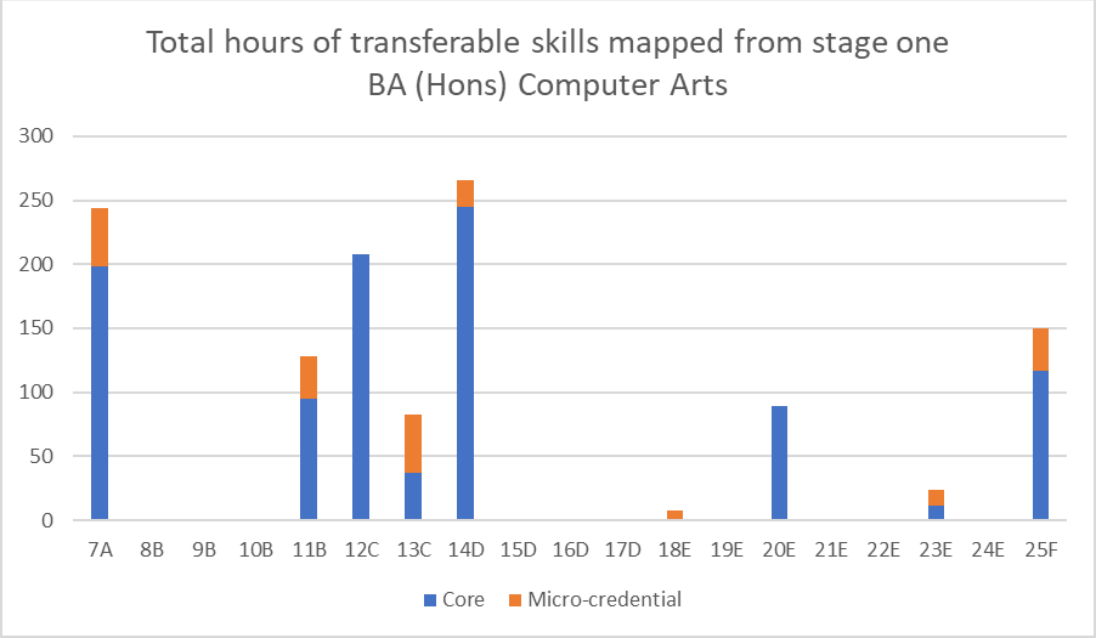


*Figure 22 – Additional transferable skills gained through micro-credentials added to the core skills profile*

## B.2. Case Study 3 Postgraduate entry to University of Bath

MSc Computer Science at the University of Bath is a one-calendar-year (three-semester) generalist course that takes graduate students who have achieved a 2nd or 1st class undergraduate degree in a science-based discipline. The course consists of a mixture of compulsory and optional units during the first two semesters and is followed by a research dissertation in the final summer semester. The compulsory units address the skills required for programming, software engineering and databases whilst also, in parallel, developing the research skills needed to prepare for the summer research dissertation. Optional units include Artificial Intelligence, Cybersecurity, Entrepreneurship and the User Experience.

### *Skills profiling*

Two methodologies for skills mapping were used. Both undertook an analysis of the learning outcomes expressed within the course's modules and mapped them to subject-specific and transferable skills discussed above.

The first method involved searching the modules' learning outcomes for the vocabulary used in skills description as specified in Figure 2 above. The rationale for doing this was with a view to deliberating upon the automation of a skills mapping process. Searching for both an exact match on the vocabulary or a 'rooted' match (e.g. search for *innovat* rather than *innovation*) met with limited success. This is because the vocabulary used to describe the learning outcomes in the Bath modules adopted a high level of abstraction that very often expressed synonyms for the skill being searched for. Consequently, for the results presented below a manual mapping of how the skills expressed in the learning outcomes matched with those specified in Figure 2 was undertaken.

This second method involved using human-based semantic interpretation. Here semantic interpretations were explored in depth. A set of interpretation decisions were identified, for example mapping *2B - Business Requirements and Applications* only to real-world applications/problems/scenarios. A further challenge at Bath was the implications of its compound learning outcomes resulting from restrictions on the number of learning outcomes per module. This meant that initially multiple skills could be identified for a given learning outcome and therefore skills hours were split by learning outcome both for subject-specific and transferable skills. This enabled a smaller set of subject-specific and transferable skills to be associated with each learning outcome. Challenges were highlighted regarding some of the terms and how they can easily overlap within learning outcomes. For example, "new things" within a learning outcome could represent both *6C – Creativity* and *7C – Problem Solving*, and does *8D – Technical Proficiency* apply to most learning outcomes in a computer science course? These, and other questions, highlighted the benefits that a skills-based vocabulary would provide both for semantic interpretation and potentially also for automating skills mapping processes.

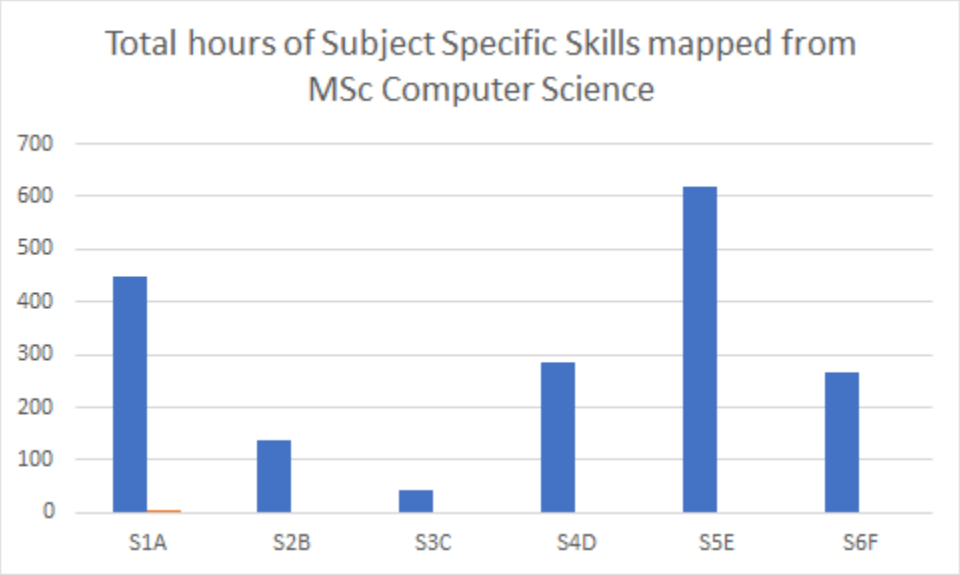


*Figure 23 - Subject-specific skills*

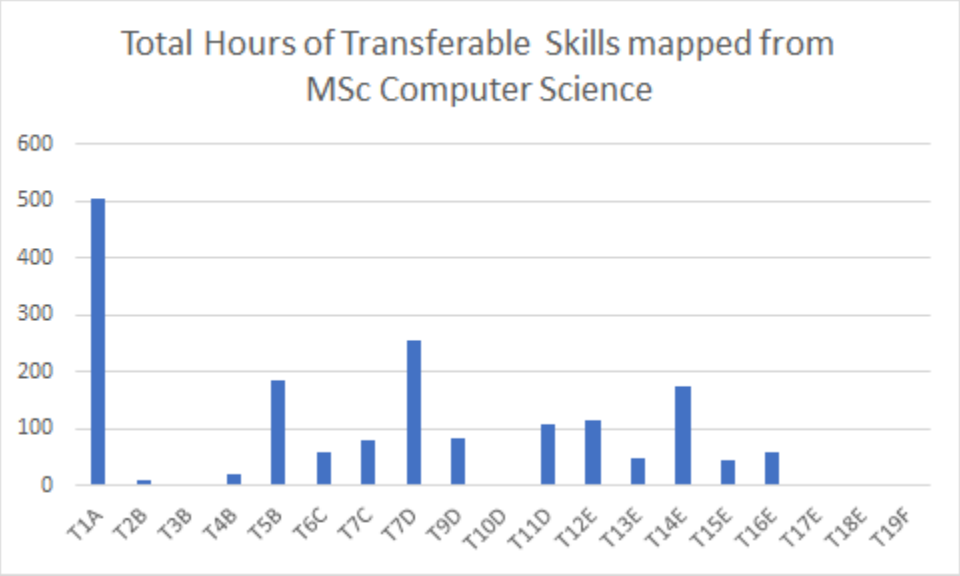


*Figure 24 - Transferable Skills*

*Comparison with Lightcast*

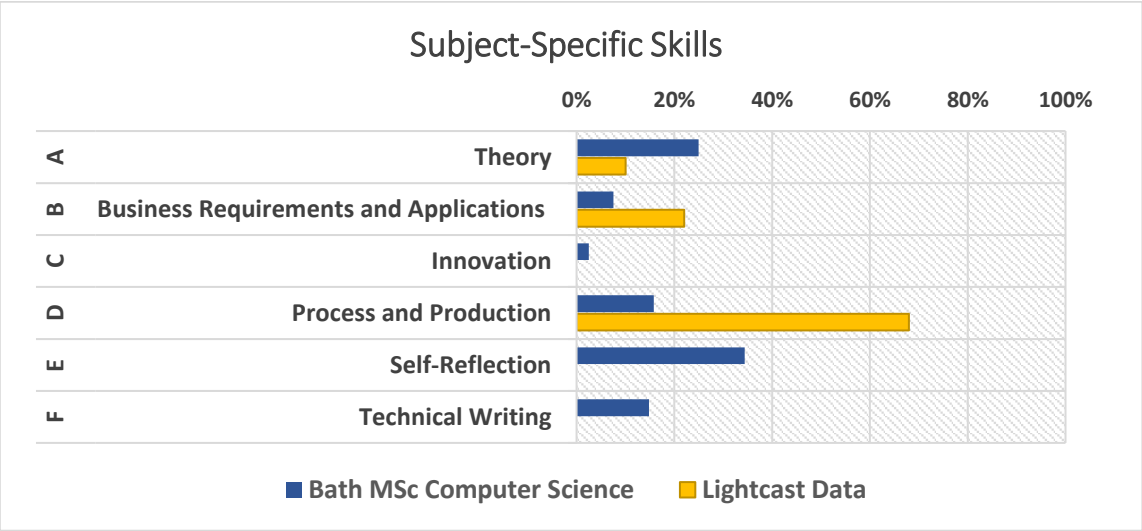


*Figure 25 - Subject-specific skills*

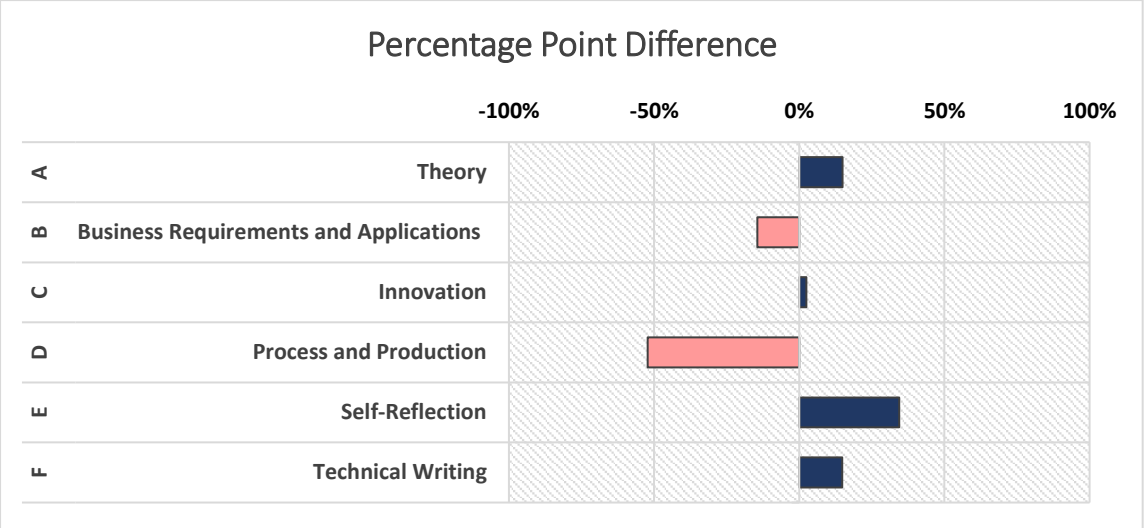


*Figure 26 - Subject-specific skills difference*

Regarding the subject-specific skills, there are some differences between those developed by the generalist MSc degree course and those advocated by the Lightcast data. *Theory*, *Self-Reflection* and *Technical Writing* feature prominently in the Bath course and are representative of the research-intensive nature of the University. Additionally, it is not surprising that the course focuses less on *Process and Production* given the postgraduate nature of the course. However, given its generalist nature, there needs to be an element of the development of these skills and this is reflected in the course but not to the extent suggested by the Lightcast data. It is pleasing to note the presence of innovation skills in the course as it develops the spirit of entrepreneurism needed to support those students who want to start-up their own business/consultancy.

When comparing transferable skills with Lightcast data, the course contains more of a focus on the skills of *Information Literacy*, *Technical Proficiency*, *Numeracy* and *Leadership*. This is consistent with the course focusing upon developing within the students the potential to become the technical leaders of tomorrow. The course performs less well in developing the skills of *Social Learning*, *Sustainability* and *Communication*.

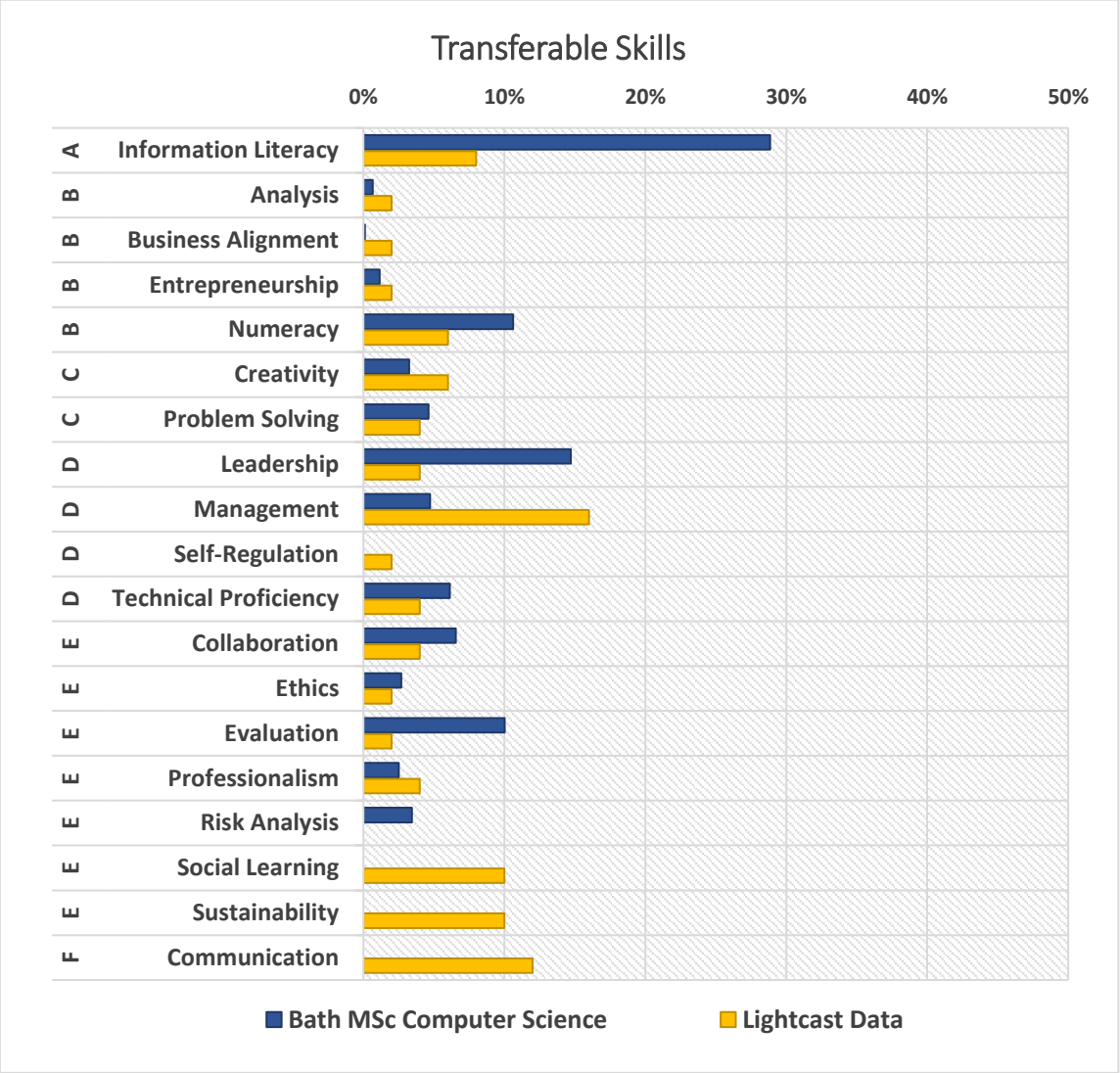


*Figure 27 - Transferable skills*

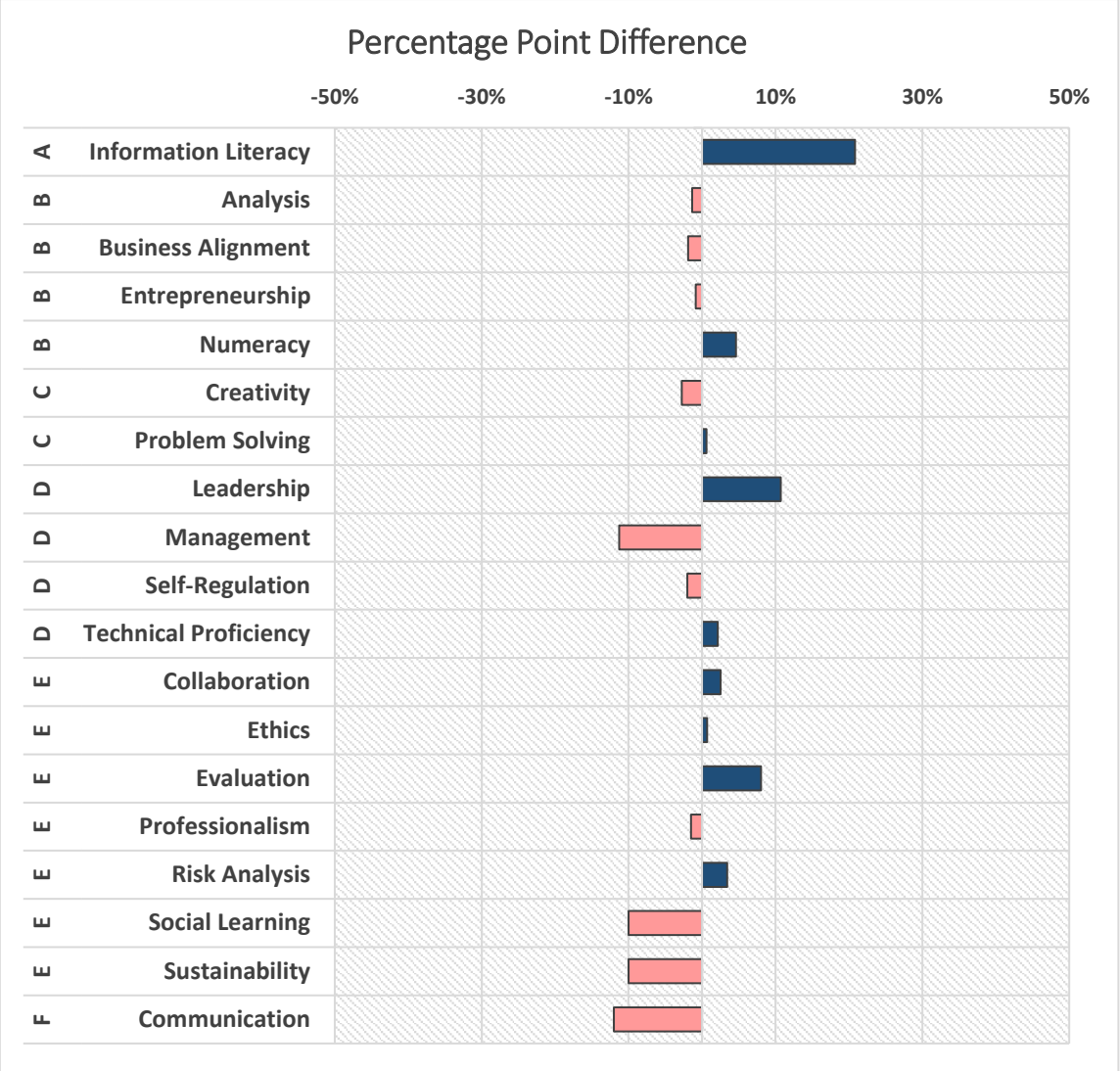


*Figure 28 - Transferable skills difference*

### *Benefits and limitations*

There were three main challenges associated with mapping a module's learning outcomes to the skills categories listed in Figure 2. The first was that, quite often, a single learning outcome was described in a manner that could be mapped to several skills. This was in part the result of an institutional convention constraining the maximum number of learning outcomes for a given module (unit) and hence resulting, in some cases, in several skills being covered in a single learning outcome. As a consequence of this, there was not a one-to-one mapping between a subject-specific skill and an individual learning outcome. The analysis and tabulation of the data reflected this nuance. One recommendation to overcome this, therefore, would be for curriculum developers to avoid describing learning outcomes through the use of multiple skills.

The second challenge is that, from the learning outcomes contained in the module descriptions, it was difficult to ascertain explicitly where and how the skills categories of Figure 2 were assessed. This shows particularly in Figures 27 and 28, where Bath has much more leadership than Lightcast suggests, and conversely, much less Management. Nevertheless, the totals "Leadership+Management" are extremely similar. While it is possible to argue the difference, it is not clear what the difference is at the level of Bath's descriptions. Having said this, Bath's module descriptions contain three main sections entitled Aims, Learning Outcomes and Skills. The section on skills is explicit on where skills are taught, facilitated and assessed. There is scope, therefore, to refine Bath's approach to its separate treatment of skills development and to module learning outcomes.

The third challenge was that the vocabulary used to describe skills within a module were very often synonyms of those listed in Figure 2 (both in a unit's learning outcomes and the skills sections). This made analysis a little subjective. The skills mapping process could have been usefully enhanced if the modules had used the vocabulary expressed in Figure 2.

### *Possible uses*

One of the challenges with admissions to a generalist Masters course is in assessing the range of skills and competencies presented by applicants. Typically, at Bath, we base our admissions criteria on students who present with a STEM-based degree (non-computer science) with a second class (or above) qualification. Our prime rationale for this is that we seek to recruit students who can engage with higher-level mathematics in order to meet the need for some of the modules contained in our course. It is also the case that most STEM-based disciplines will have exposed the students to the concept of programming albeit, most probably, in a modelling or data analysis context. Should Bath wish to broaden its provision to recruit graduates from disciplines that are more arts-based, for example, there is a need to establish whether such students have acquired these skills. Micro-credentials and badges offer the potential to address this issue. Students who present, on application, with an initial non-science undergraduate degree have the potential to demonstrate a competence in these skills through the successful completion of a micro-credential or badge offered, for example, through LinkedIn Learning in the areas of programming and mathematics. Bath could potentially, offer such students a place on its course by recognising both the initial undergraduate degree and a badged competency, using skills profiling as a mechanism to evaluate suitability.

Another use of a skills profiling approach can be seen through an analysis of Figure 24, which shows that learners get little support in developing transferable skills related to social learning, collaboration and communication (T17E, T18E, T19F). This analysis is helpful for the curriculum development team at Bath. There are two possible paths to follow should Bath wish to address this. The first is to use an analysis of the subject-specific and transferable skills to review and update the course accordingly (noting that it may be that Bath's provision addresses these skills, but they are not explicitly expressed in the course's learning outcomes). The review would have the goal of ensuring the transferable skills are addressed in an updated and modified course. The second path would be to identify a badging or micro-credentialing course to supplement the existing Masters provision in these particular transferable skills. This would have the benefit of producing postgraduates from our Masters provision who can demonstrate to a future employer that they have met the criteria of all transferable skills identified in Figure 2.

Figure 24 also indicates that information literacy (T1A) is a skill that is significantly developed on the course. A further use of this approach is that students could be directed to undertake a badge or micro-credential in this skill as a means of preparing themselves for the course. This would provide the students with a significant grounding before the course starts. It also offers the potential of crediting students with this skill through recognising their prior learning.

Hence, as well as tariff-bearing entry onto this course, a similar and more substantial set of badges or micro-credentials could enable learners to be accredited for prior learning for part of their studies, using a similar approach to that outlined in the next case study.

# C. Accreditation of Prior Learning (UG or PG):

## C.1. Case Study 4 Postgraduate entry to Northumbria University

The MSc in Data Science is designed to train and produce data scientists who will fill a range of jobs requiring skills in methodical and statistical data analysis and help organisations (e.g., businesses, healthcare providers, financial institutions, industries) make the most of their huge amounts of data. The programme covers a range of data analysis methods, processes, algorithms, and systems to help make sense of structured and unstructured data.

Students study six taught modules in Machine Learning; Statistical Programming; Advanced Databases; Principles of Data Science; Big Data and Cloud Computing; and Research Methods; then students will complete a final year project allowing specialism in a particular subject area.

The programme can be taken over 12 or 16 months and is suited to those who have an undergraduate degree in computing/information sciences, or mathematical and statistical disciplines with applied computing components. It is ideal for graduates who wish to advance their careers by becoming data scientists. Alternatively, those with a considerable computing background in an industrial / business setting are suitable applicants,

### *Skills profiling*

Skills profiling provided a useful comparison and analysis of the different subjects and transferable skills within the course. As might be anticipated from a technical Masters programme, the largest number of hours in terms of subject-specific skills was for *Process and Production*, as shown in Figure 29. This was shortly followed by *Self-Reflection*, possibly evidencing the reflective practice which is a strong feature of the programme. *Theory*, together with *Business Requirements and Applications* then featured with *Innovation* and *Technical Writing* the smallest components. The programme is very technical in focus and this profile feels in keeping with that.

In terms of transferable skills, Figure 30, *Problem Solving*, *Analysis* and *Technical Proficiency* were the most common. Again, for a practically focused, advanced technical course, this is as you might anticipate. The skills profiling also suggests that introducing *Entrepreneurship*, *Leadership* and *Sustainability* may be beneficial curricula enhancements, and the programme team is currently evaluating how such skills can be addressed. Part of the solution may be via careful signposting, for example, technical leadership is still leadership and technical entrepreneurism is similarly important. Additionally, *Business Alignment*, *Social Learning* and *Collaboration* coverage appear light and the programme team is considering how to extend future coverage.

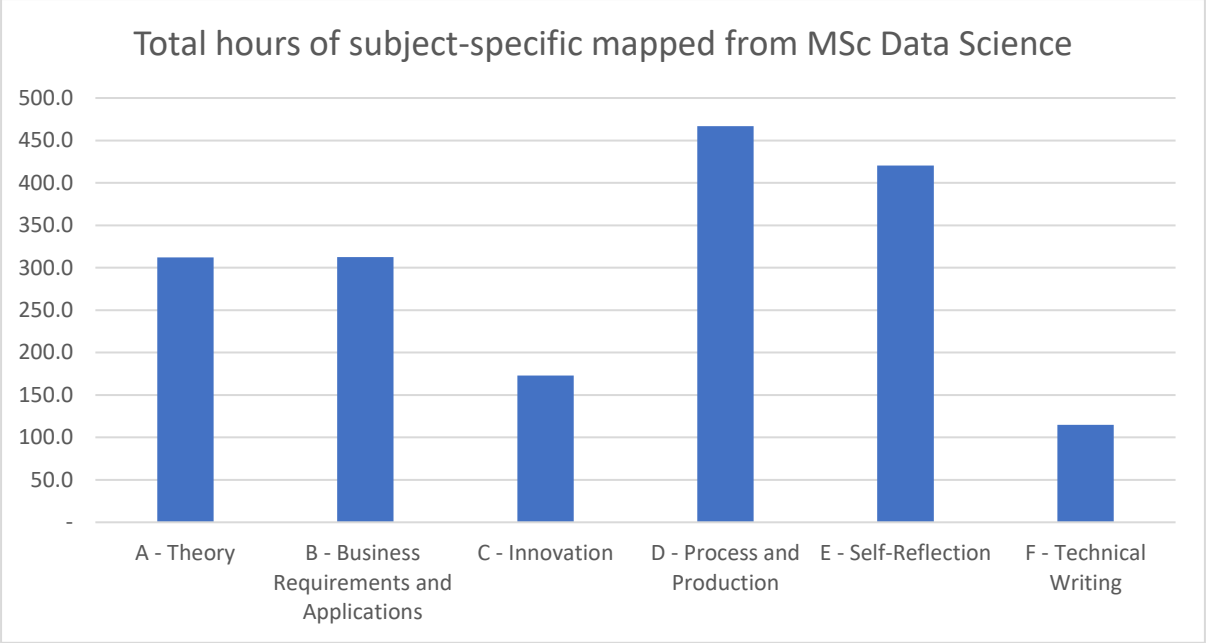


*Figure 29 - Subject-specific skills*

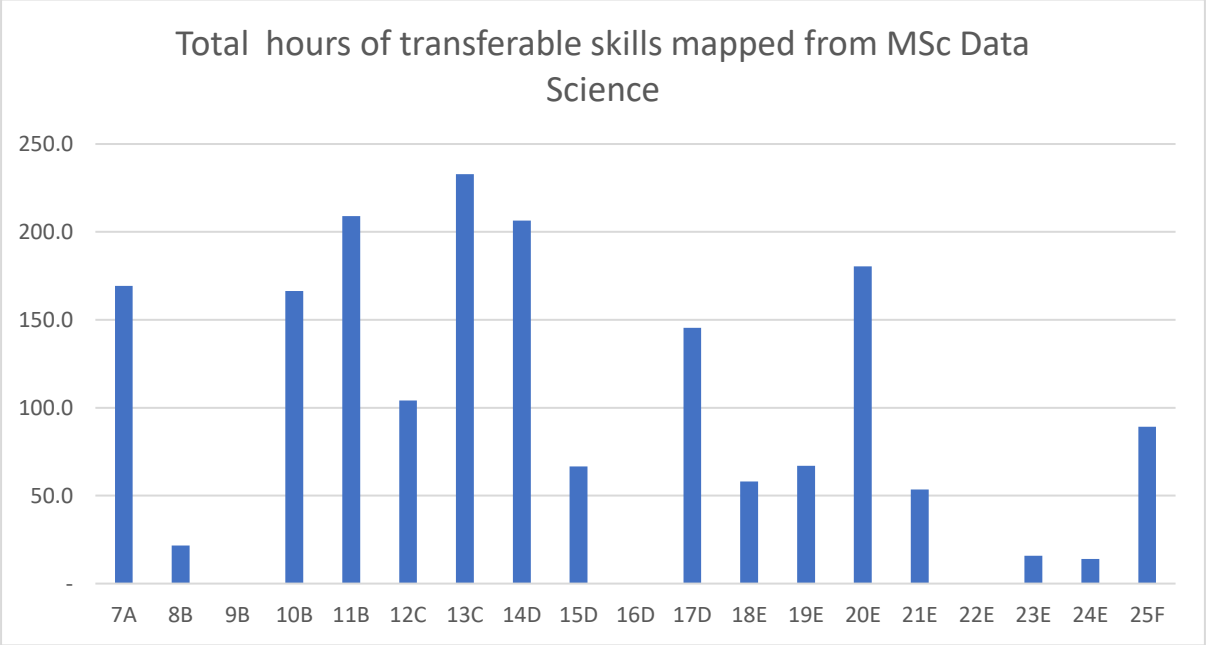


*Figure 30 - Transferable skills*

*Comparison with Lightcast*

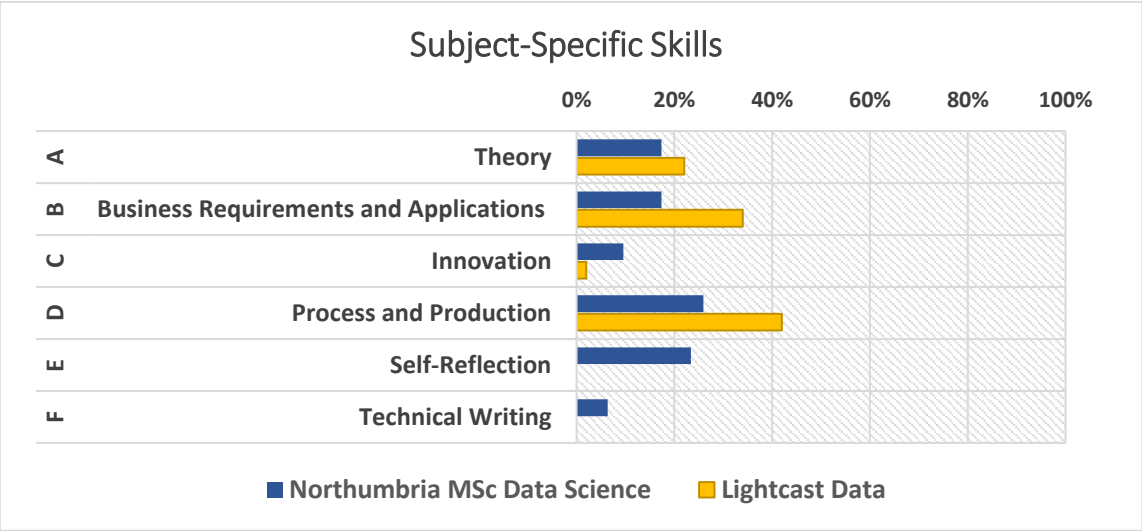


*Figure 31 - Subject-Specific Skills*

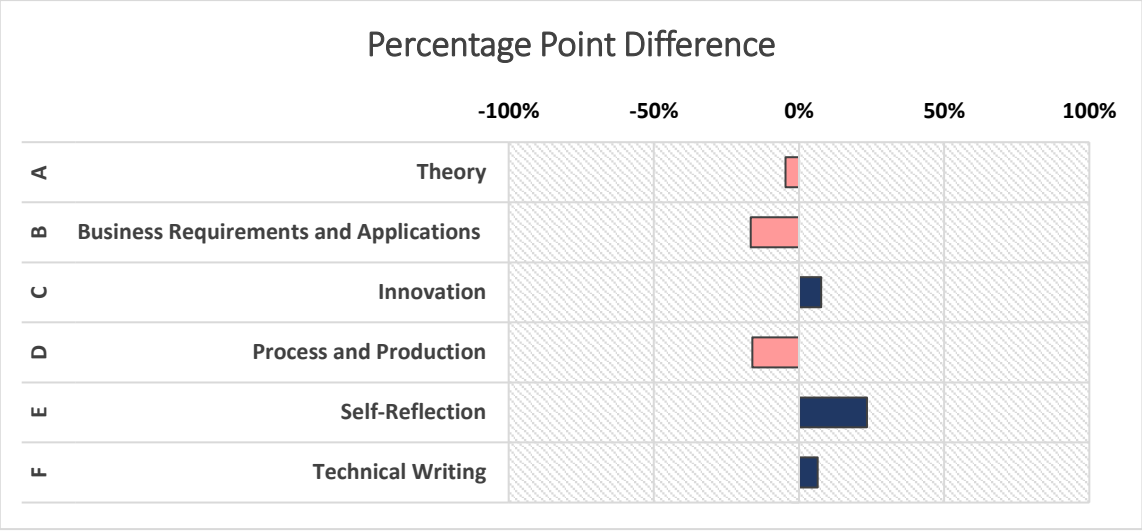


*Figure 32 - Subject-Specific Skills Difference*

Regarding subject-specific skills, there are some minor differences between those developed by the MSc degree programme and those advocated by the Lightcast data. It is essential to note that the process adopted is artificially precise, it calculates skill hours based upon the classification of module learning outcomes, and as such minor differences are expected. This promotes an interesting conversation regarding how much difference should be observed between the two for the difference to be of significance. That said, within the degree, there appears to be significantly more *Innovation*, *Self-Reflection* and *Technical Writing* than is expected for the subsequent job roles. These elements are not surprising as they are common graduate outcomes that might be anticipated from MSc studies. It is possible to secure Data Science roles with an undergraduate qualification, so what is observed here may be that in some ways MSc graduates are slightly over-skilled for some entry-level

data science roles. Additionally, there appears to be less coverage of *Business Requirements and Applications* and *Process and Production*. The programme is very technical, and this suggests that introducing further business context may be beneficial. Having slightly less *Process and Production* content may not be too surprising as such content may not be fully in keeping with the higher-level study expectations of a MSc programme. Transferable skills tell a similar tale. Ignoring the specifics, these too suggest further focus upon certain professional skills, most notably *Social Learning*, *Sustainability*, *Communication* and *Management*, possibly at the expense of some of the technical aspects in order to create a better match with entry-level Data Science roles. Clearly, the educational goals of higher education degree programmes are broader than employment related, so some of the differences observed may be related to the expectations for graduate outcomes from MSc studies e.g. criticality of thought, independence of learning, discipline innovation, technical mastery etc.

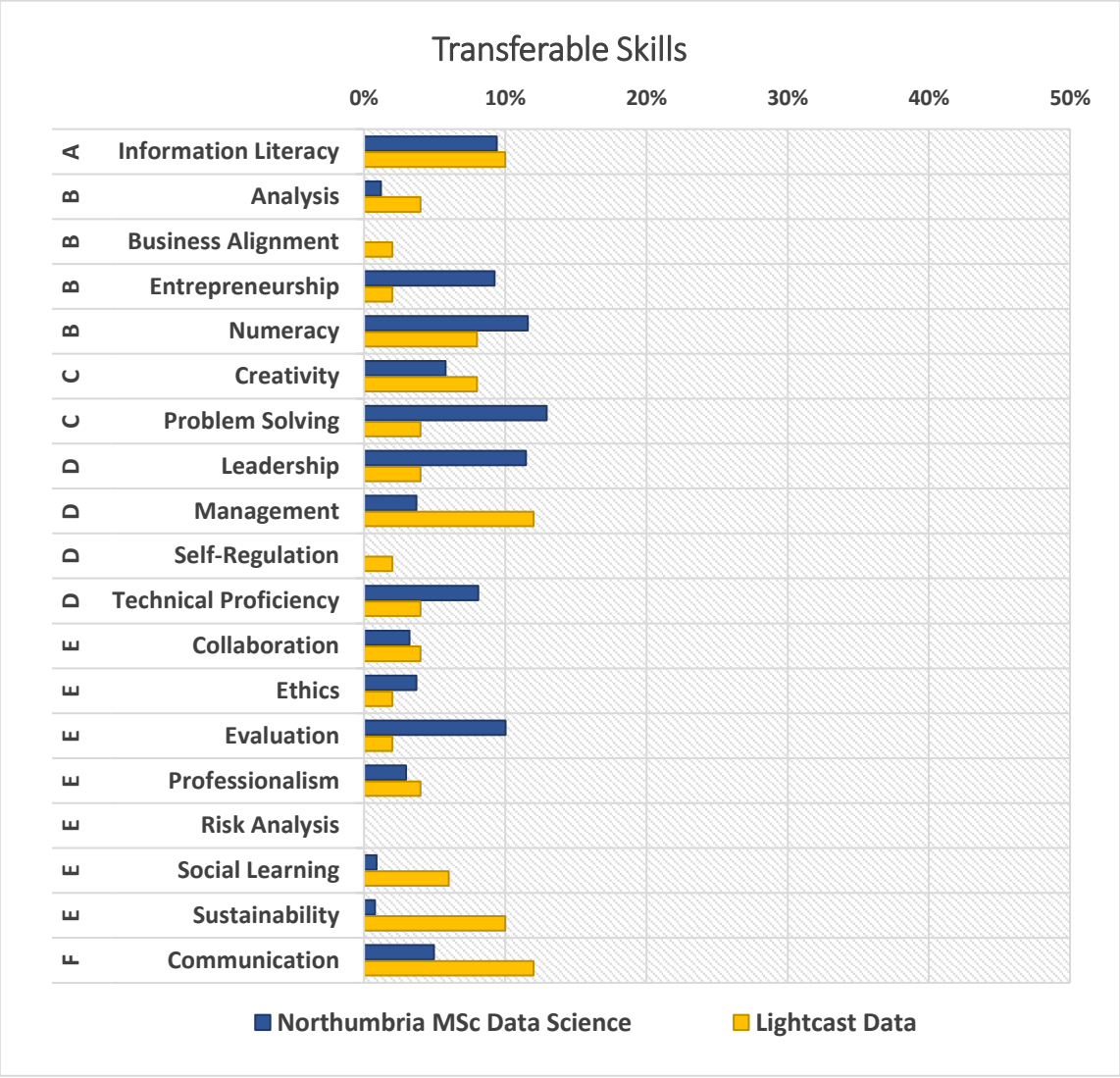


*Figure 33 - Transferable Skills*

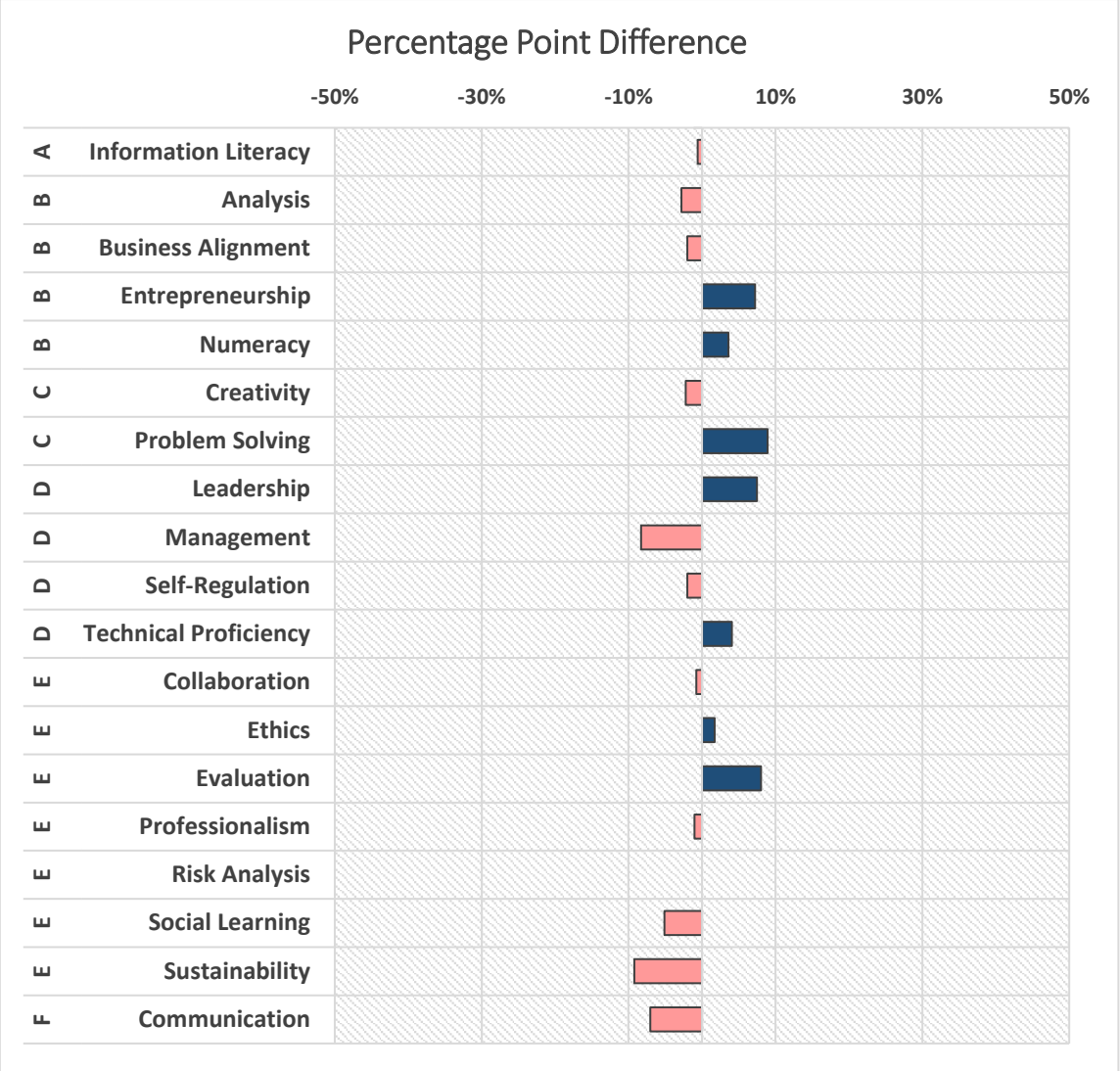


*Figure 34 - Transferable Skills Difference*

### *Micro-credential approach*

Alongside the University of Huddersfield, Northumbria University provides a recognition mechanism for LinkedIn Learning within their MSc course. LinkedIn Learning is an on-demand library of instructional courses covering the latest business, technology and creative skills. It provides personalised course recommendations and is designed to help learners discover the content they need to build the right skills and achieve their full potential.

Within the Computer and Information Sciences department (Faculty of Engineering and Environment) at Northumbria University we explored how we could give credit recognition for entry onto our existing programmes to applicants who had completed relevant LinkedIn Learning content. Within the university, it is already considered appropriate to accredit prior learning where suitable learning has previously taken place, and it was considered appropriate to give exemption from individual modules where possible i.e. to adopt an accreditation of prior learning model.

After exploring several LinkedIn Learning pathways, we identified a range of courses which, at face value, potentially covered similar subject content as modules delivered in some of our postgraduate programmes. The challenge was to ensure the content was equitable in terms of subject matter and level. To ensure this match we undertook a process of mapping the content of LinkedIn Learning pathways with the module-level learning outcomes of our current modules.

We explored several different options and found that learners completing specific learning pathways in data science could be exempt from one of two modules on our MSc Data Science programme, as shown in Table 4.

| Complete:<br>LinkedIn Learning Pathways | Exempt from:<br>Northumbria University Modules |
|---|---|
| *Become a Data Scientist*<br>*Become a Data Analytics Specialist* | Principles of Data Science |
| *Master R for Data Science*<br>*Become a Business Analyst* | Statistical Programming |

*Table 4 - LinkedIn Learning Pathways supporting Northumbria University modules*

When we were satisfied within the department that this was appropriate, the proposal was agreed upon by the Faculty Pro Vice-Chancellor and then passed to our legal team for agreement. Finally, it was approved by our Academic Registry department. A co-operation agreement was signed between Northumbria University and LinkedIn. The MSc Data Science programme was updated to reflect this.

Following successful completion of the stipulated learning pathways, students who meet the published entry criteria can apply for entry to the MSc at which point they will be asked to complete an online assessment to ensure competency in the module they are seeking exemption from. If the application and assessment are approved the student will be accepted on to the programme.

The skills profile for completing the LinkedIn Learning modules *Become a Data Scientist* and *Become a Data Analytics Specialist*, together with related experimentation and consolidation activities, totaling 200 hours, as shown in Figure 35 for subject-specific skills and Figure 36 for transferable skills.

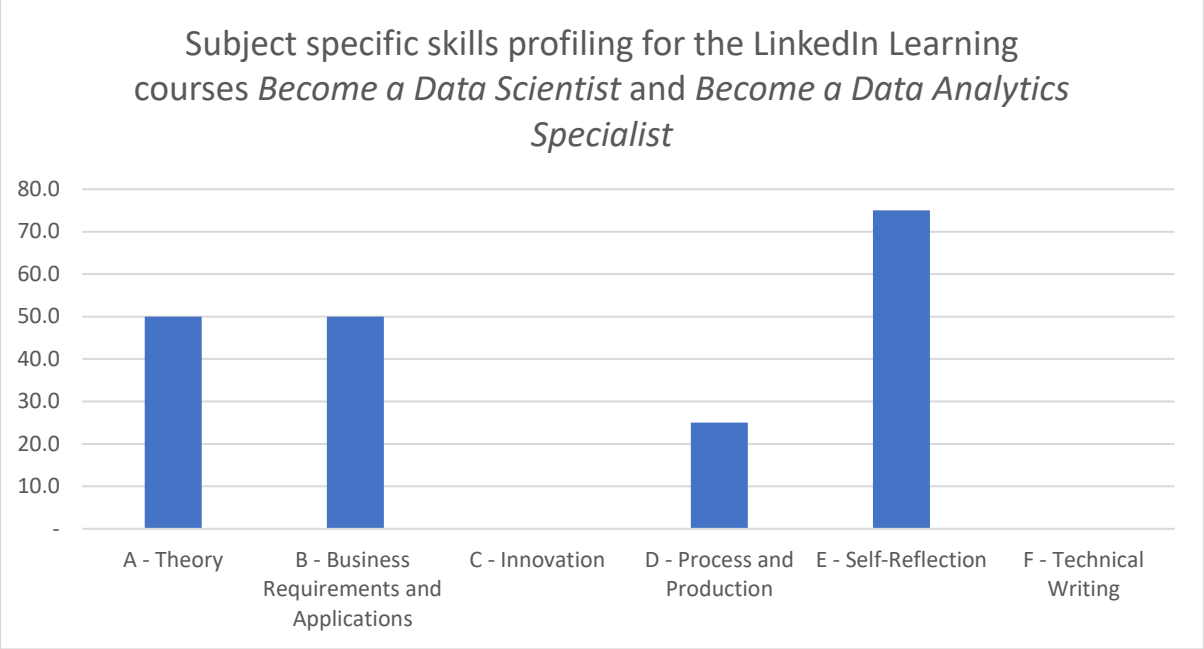


*Figure 35 – Subject-specific skills*

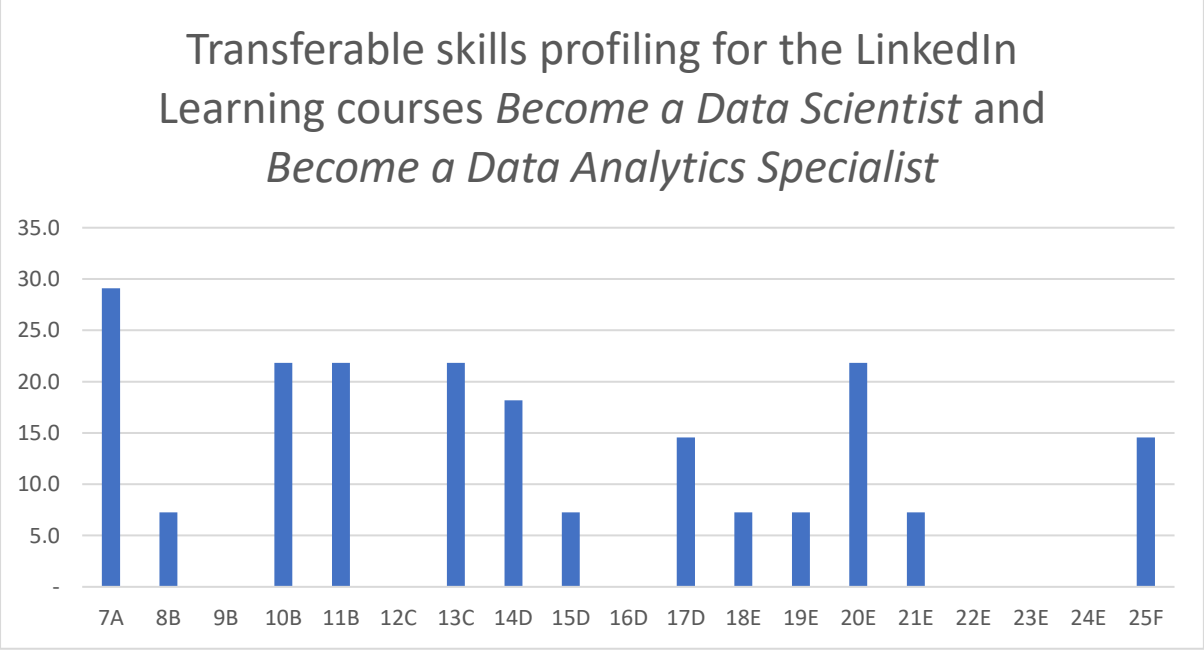


*Figure 36 - Transferable skills*

The skills profile for completing the LinkedIn Learning modules *Master R for Data Science* and *Become a Business Analyst*, together with related experimentation and consolidation activities, totalled 200 hours, as shown in Figure 37 for subject-specific skills and Figure 38 for transferable skills.

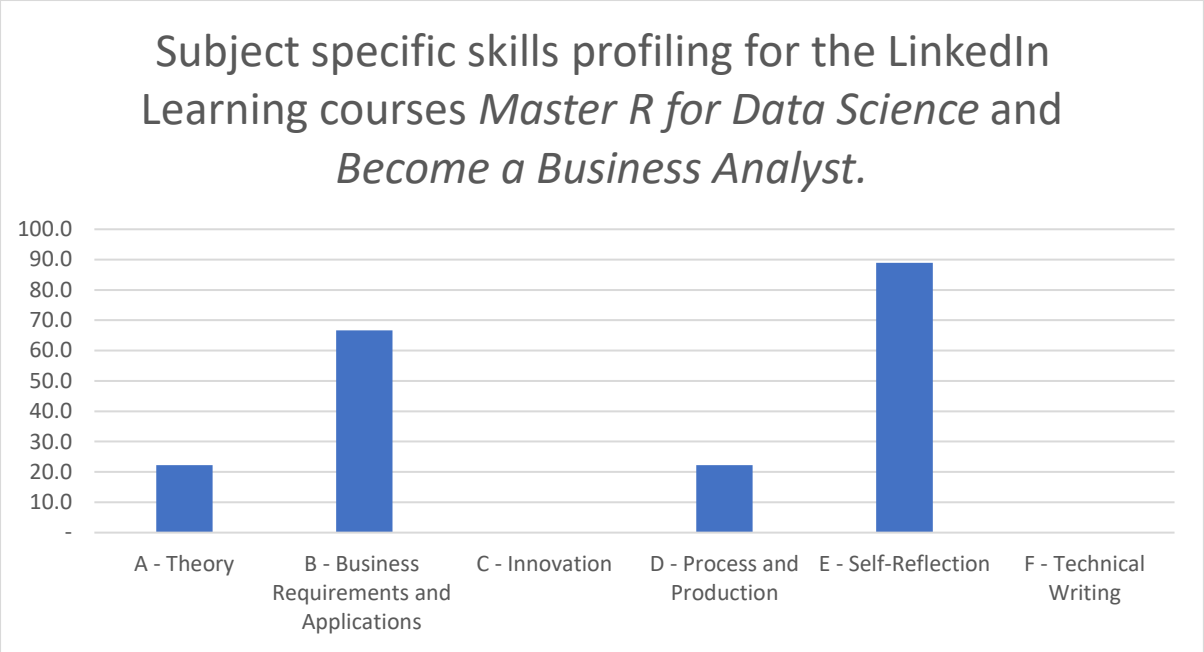


*Figure 37 - Subject-specific skills*

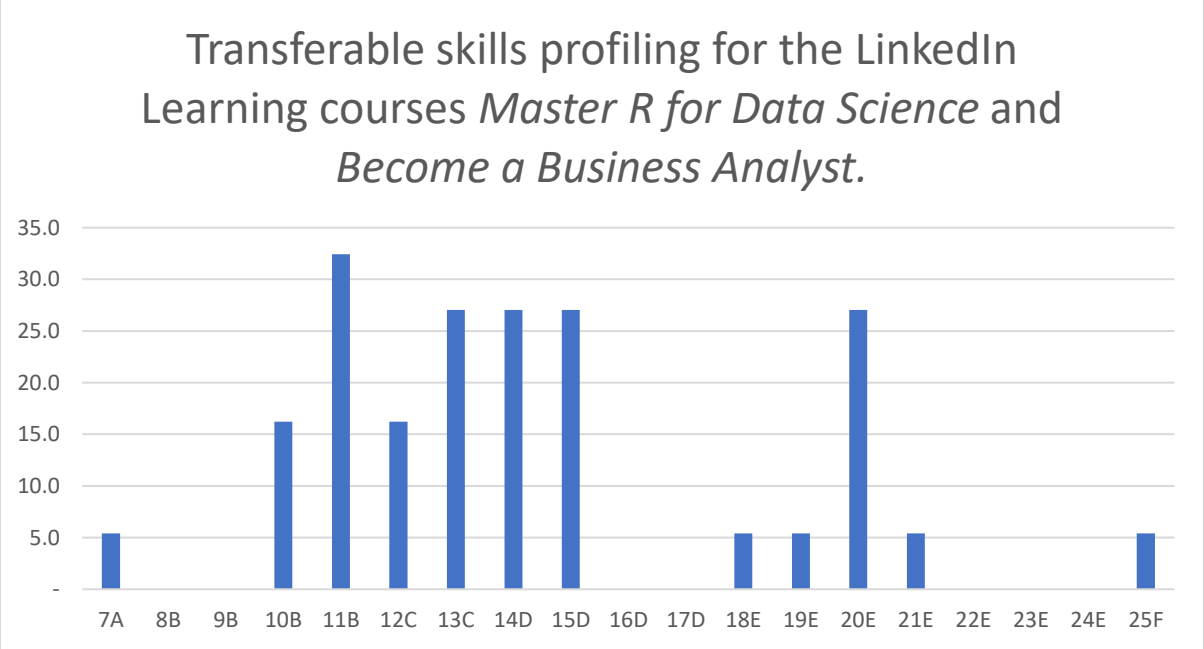


*Figure 38 - Transferable skills*

### *Benefits and limitations*

There are two key benefits of the micro-credential model adopted here. The first is that a new potential market for the MSc is obtained. People undertaking informal education through LinkedIn Learning or similar platforms may not always be directly aware of how more formal education such as an MSc Data Science programme may support their development. The second benefit is, to an extent, the inverse of the first. The inclusion of the alternative entry point via the successful completion of the LinkedIn Learning course may be seen by some as more vocationally relevant than a Master course and serves to highlight the work-ready skills that an MSc programme may generate.

This was a low-risk trial, as only a small number of LinkedIn Learning courses were mapped and only a small number of MSc programmes were considered. This enabled the exploration of the process and challenges involved in a controlled manner. Completing the mapping itself served to provide a comparison and analysis of the different subjects and general skills. In doing so the mappings highlight potential areas for future development.

Northumbria's expectation of between three and five learning outcomes per module has resulted in some occasions in learning outcomes that are rather broad in intent, reflecting a similar issue to that experienced in the B2 Bath case study. One illustrative example, from KV7028 MSc Computer Sciences and Digital Technologies Project, is LO1 *Apply in-depth specialist technical and academic knowledge and critical understanding of research methodologies and project management in the context of an independent academic research project related to your programme of study and at the forefront of the computer science and digital technology field*. This learning outcome maps to three subject-specific skills *1A Theory* / *3C Innovation* / *4D Process and Production*. All the modules mapped had at least one learning outcome that mapped to more than one subject-specific skill. It would be interesting to analyse further whether this is common nationally or may be a consequence of Northumbria University's policy regarding learning outcomes. Indeed, as part of any further projects, it may be appropriate to compare the differing policies across the universities involved.

One potential limitation is that people completing a LinkedIn Learning course, or something similar, may well be employed full-time and are looking for professional development opportunities. They may, therefore, not necessarily have sufficient time or interest to provide the commitment to successfully complete a degree programme. Indeed, one of the key benefits of completing a micro-credential course is that it provides the specific professional development that is sought whereas a degree programme is, by its nature, more wide-ranging. This may therefore limit the uptake of micro-credentials within higher education, as may limitations on the number of progression pathways between micro-credentials and degree courses. To benefit from the potential of this approach there would need to be consideration and mapping to a significant number of courses which with current learning outcome approaches takes some time, but with a move to learning outcomes that more accurately represent the skills gained through them, this could become a much more automated scalable approach.

A further point to note is that completion of a micro-credential is not the end of studying a particular topic, and to fully re-enforce learning, application, experimentation and reflection on learning are required. Such reflection is commonly formally embedded in academic learning via the assessment approaches employed. Current micro-credentials often lack similar scaffolding structures for reflection, for example. To enable better integration between micro-credentials and degrees, learner activities involving application, experimentation and reflection need to be enhanced within micro-credentials.

*Possible uses*

The key driver for involvement, in this particular use of micro-credentials, was to explore whether there was interest from learners completing online courses in completing more formal learning in the form of an MSc. This was attractive, as it was hoped it would reduce the barriers for learner-earners to reengage in formal learning and promote more lifelong engagement with formal education. Current limitations in micro-credentialing highlighted above demonstrate similar challenges to when Massive Open Online Courses (MOOCs) were introduced, namely that without addressing structural learning barriers (such as how learning outcomes are specified) it is difficult to reduce and remove these structural barriers, and administrative overheads become challenging as numbers are scaled. Further research is also required as numbers grow to investigate whether learners who enter via the new routes perform similarly to learners who enter the programme by other entry APL routes, and those who do not apply for APL.

## D. Embedded (non-credit):

### D.1. Case Study 5 Ulster EDGE Award

At Ulster University, micro-credentials can theoretically be used to support an application for Accreditation of Prior Learning (APL), both in the context of APL for admission and APL for exemption from appropriate modules. However, in practice, given micro-credentials typically represent small units of study, they tend to form part of a larger portfolio of evidence rather than a direct one-to-one mapping to admission criteria or module exemption requirements. In the case of module exemption, "APL credit" is awarded rather than credit for the micro-credential itself.

Students can also undertake additional activities beyond the curriculum, including the study of micro-credentials. Recognition for this is given in the form of an additional "award" alongside their degree, but no additional academic credit is granted. This section gives an overview of how the *EDGE Award* can be used to recognise micro-credentials in a non-credit bearing embedded model. It concludes by showing how the skills profiles for a course can be used by students to identify *EDGE Activities* that complement their programme of study.

Ulster's *EDGE Award* reflects employer demand for well rounded, experienced graduates, who are committed to their own ongoing development. The *EDGE Award* gives students the opportunity to demonstrate this commitment by completing extra-curricular and co-curricular activities that help enhance a student's skills, builds their confidence, and expands their networks. Some of the activities that students undertake as part of *EDGE* may be ones they are involved in anyhow, but *EDGE* still provides a mechanism to give recognition for those achievements. For example, a student may volunteer with a society or charity, serve on the committee of a sports club, or complete a placement abroad. They may also take on roles such as being a course representative within the University. All these activities can count towards the *EDGE Award*, as can activities proposed by academic staff, such as completing relevant professional qualifications alongside their academic studies.

Currently there are two levels to the Ulster *EDGE Award*, relating to the number of activities a student undertakes, with the minimum being three for the standard *EDGE Award* and five for the *EDGE Excel Award*. Activities can be undertaken at any point throughout their programme with each consisting of a minimum of 30 hours of engagement by the student. In addition to completing each activity, prior to graduation, students also complete a short reflection piece as part of the application process for the award.

A range of standard activities are defined under the *EDGE* framework. In addition, activities can be proposed by staff and/or students and such suggestions are then considered by a University panel. If approved, they are then made available for students to select. It is important to note that approval must be granted in advance, not retrospectively. Also, the activity usually involves the student submitting a short reflective piece or other agreed form of evidence before their engagement with that activity can be recognised.

*Skills profiling*

Ulster created skills profiles for two programmes:

- BSc Hons Computing Science
- MSc Artificial Intelligence

These programmes were selected so that the outcomes between an undergraduate and a postgraduate programme could be compared. Also, these programmes typically recruit the largest number of students at their respective level and hence are most representative of our graduates.

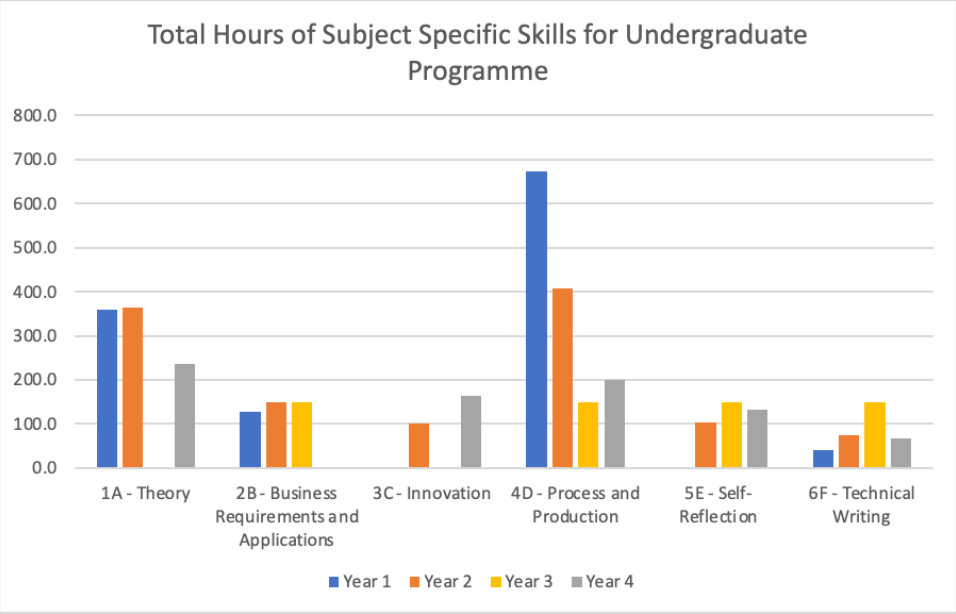


*Figure 39: Total Hours of Subject-Specific Skills for Undergraduate Programme*

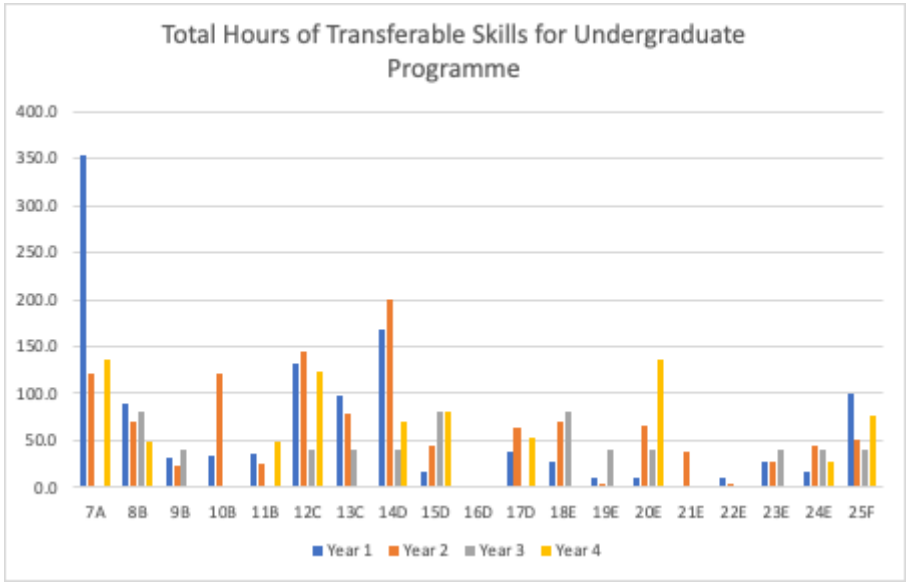


*Figure 40: Total Hours of Transferable Skills for Undergraduate Programme*

Figure 39 and Figure 40 show the relative hours allocated to each subject-specific skill and each transferable skill respectively for the undergraduate programme. Figure 41 and Figure 42 show the same data for the postgraduate programme.

At undergraduate level there is a strong emphasis on *Process and Production* (4D) and *Theory* (1A). At postgraduate level there is more of an equitable balance across the subject-specific skills but a focus on underpinning *Theory* remains.

The least amount of time appears to be devoted to *Innovation* (3C) at undergraduate level, but *Innovation* then becomes more of a focus at postgraduate level. A similar situation is observed when considering *Business Requirements and Applications* (2B), although at undergraduate level, this still represents the third highest number of skills hours.

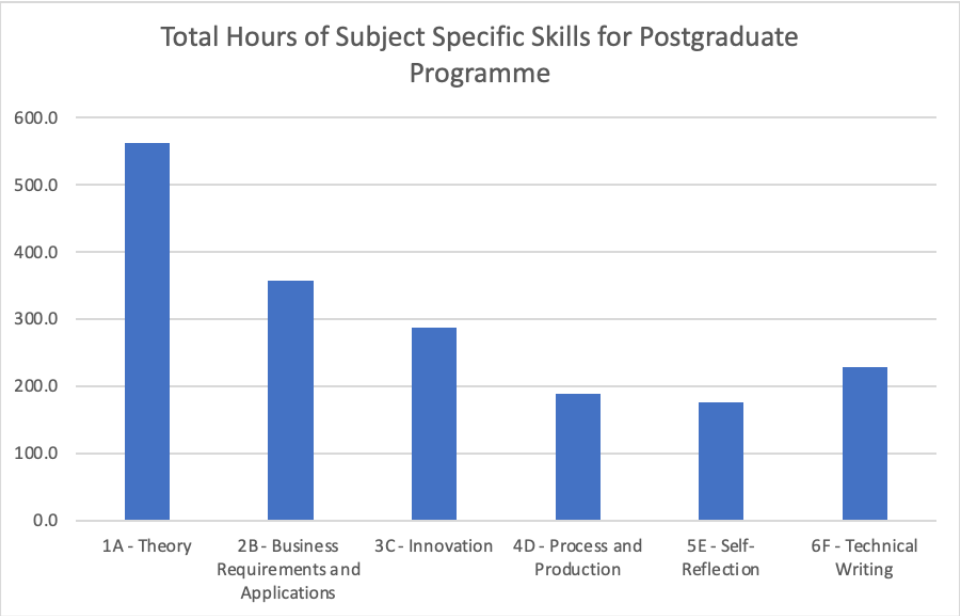


*Figure 41: Total Hours of Subject-Specific Skills for Postgraduate Programme*

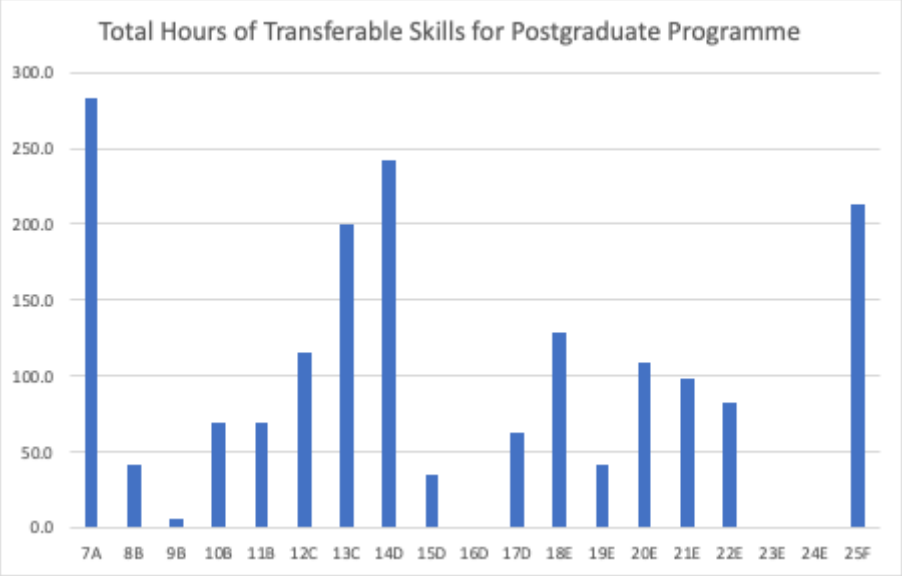


*Figure 42: Total Hours of Transferable Skills for Postgraduate Programme*

Considering the transferable skills (Figure 40 and Figure 42) reveals that at undergraduate level, all the skills are covered except for 16D – *Leadership*. However, as programmes become more specialised at postgraduate level, there are three transferable skills that are not directly apparent from the programme learning outcomes, namely:

- 16D – *Leadership*
- 23E – *Social Learning*
- 24E – *Collaboration*

Whilst *Leadership* is not directly reflected in the learning outcomes, it is "taught" within the programme. However, students will typically be taught "about" *Leadership* and hence gain "knowledge" rather than "something they will be able to do" (a learning outcome). As a result of this insight, the course teams will want to reflect on how they could move the teaching of *Leadership* from the realm of knowledge to the more explicit delivery of a skill and how that could be assessed. However, it is also recognised that where students are taught knowledge, there will be an element of learning (and hence skills development), albeit it learning that is not directly assessed. This links in with the approach adopted by Abertay (see section B.1) where a "perceived skills" profile was considered alongside a "translated" one.

A similar situation could be argued for *Collaboration*. Students will collaborate in groups and hence will develop this skill, but accurately assessing someone's ability to collaborate from, for example, a written report on a group project, is difficult. This could be a reason why module authors may shy away from specific learning outcomes that have to be assessed relating to *Collaboration*. This is reflected in the fact that many students across the sector complain about groupwork assessment as they see it as "unfair".

Contrary to all of this, skills such as *Risk Analysis* (21E) and *Sustainability* (22E) become much more significant at post graduate level. *Information Literacy* (7A) and *Technical Proficiency* (14D) are a strong focus at both levels. Whilst important and reflective of the need to develop technical skills within our programmes, it is also interesting to reflect on the fact that these aspects are also easier to directly assess and hence may be reflected in the learning outcomes more strongly than in the overall student experience. This highlights a potential "bias" in the skills review due to the strong link between assessment and learning outcomes. Again, this highlights an area for course teams to reflect on when developing or reviewing courses, and when considering how and where skills may be gained.

*Comparison with Lightcast*

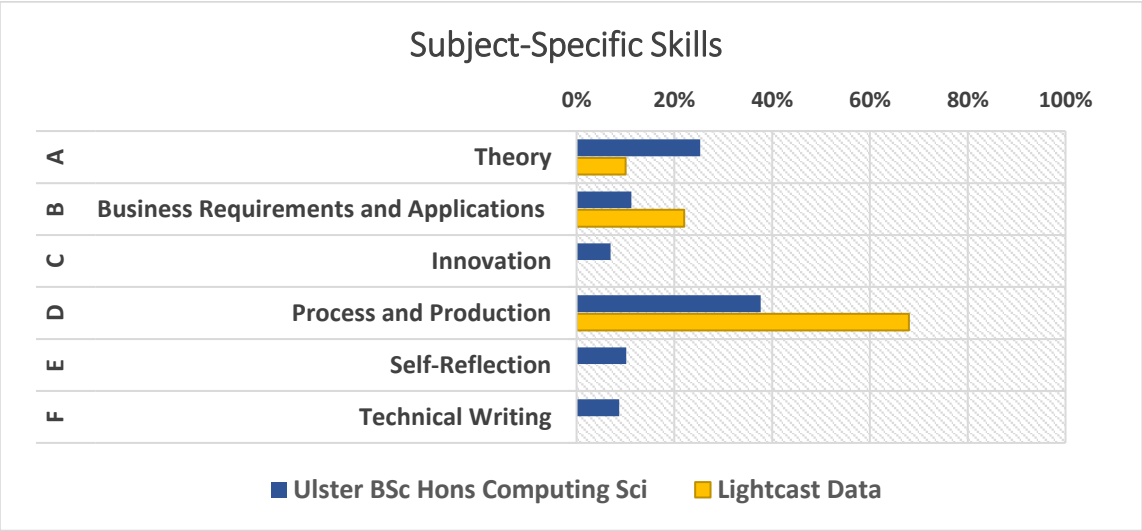


*Figure 43 - Subject-Specific Skills*

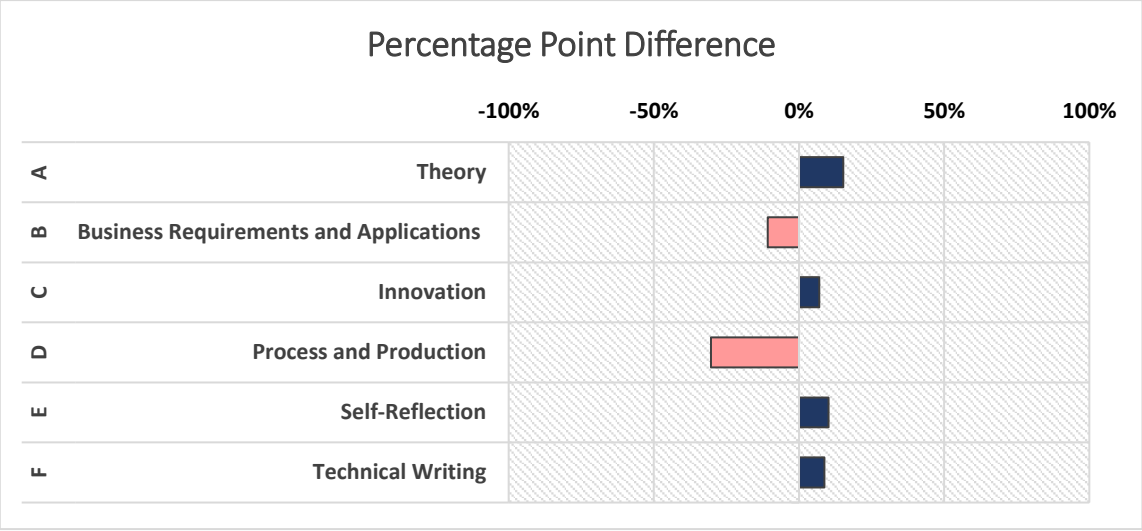


*Figure 44 - Subject-Specific Skills Difference*

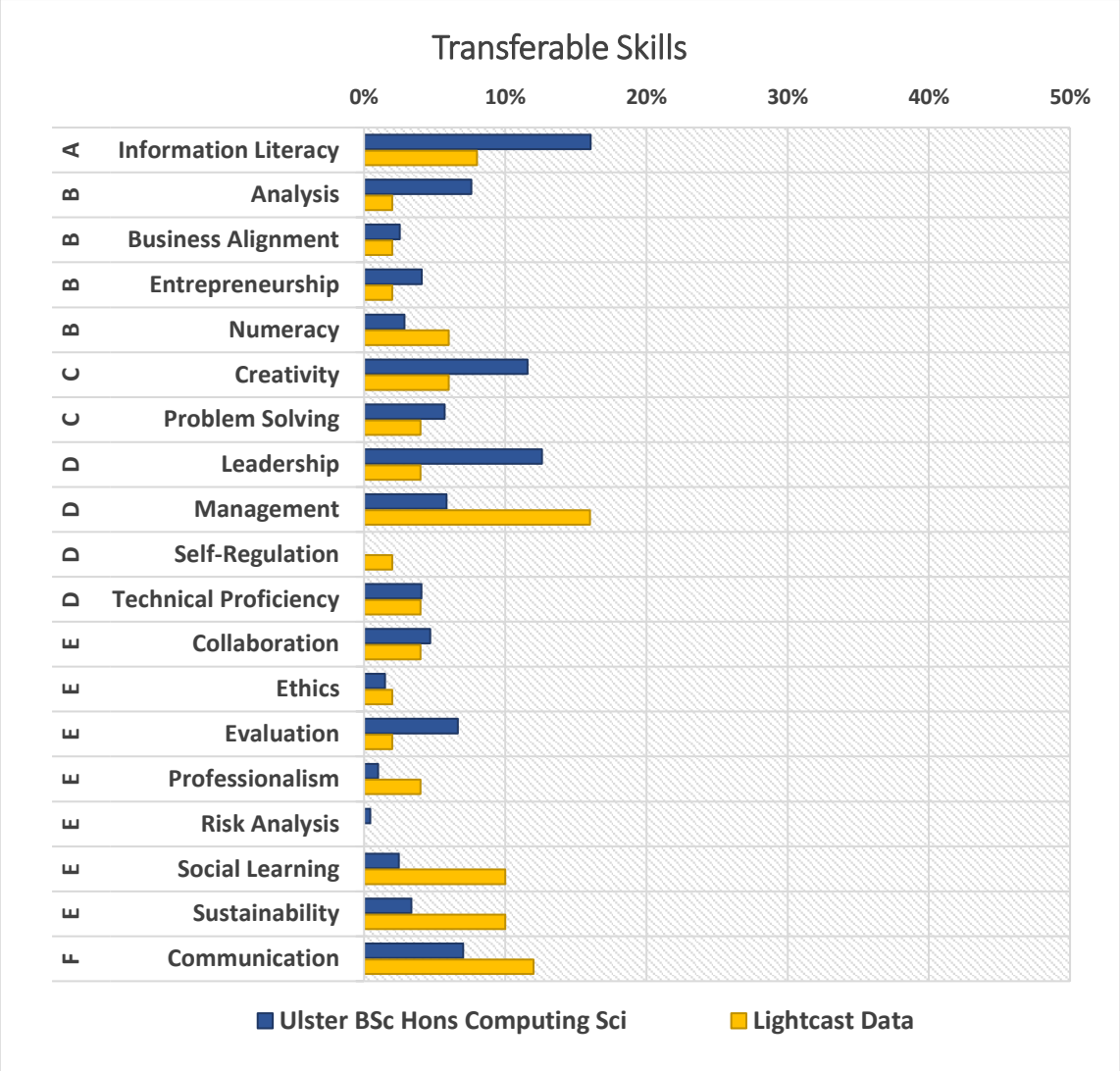


*Figure 45 - Transferable Skills*

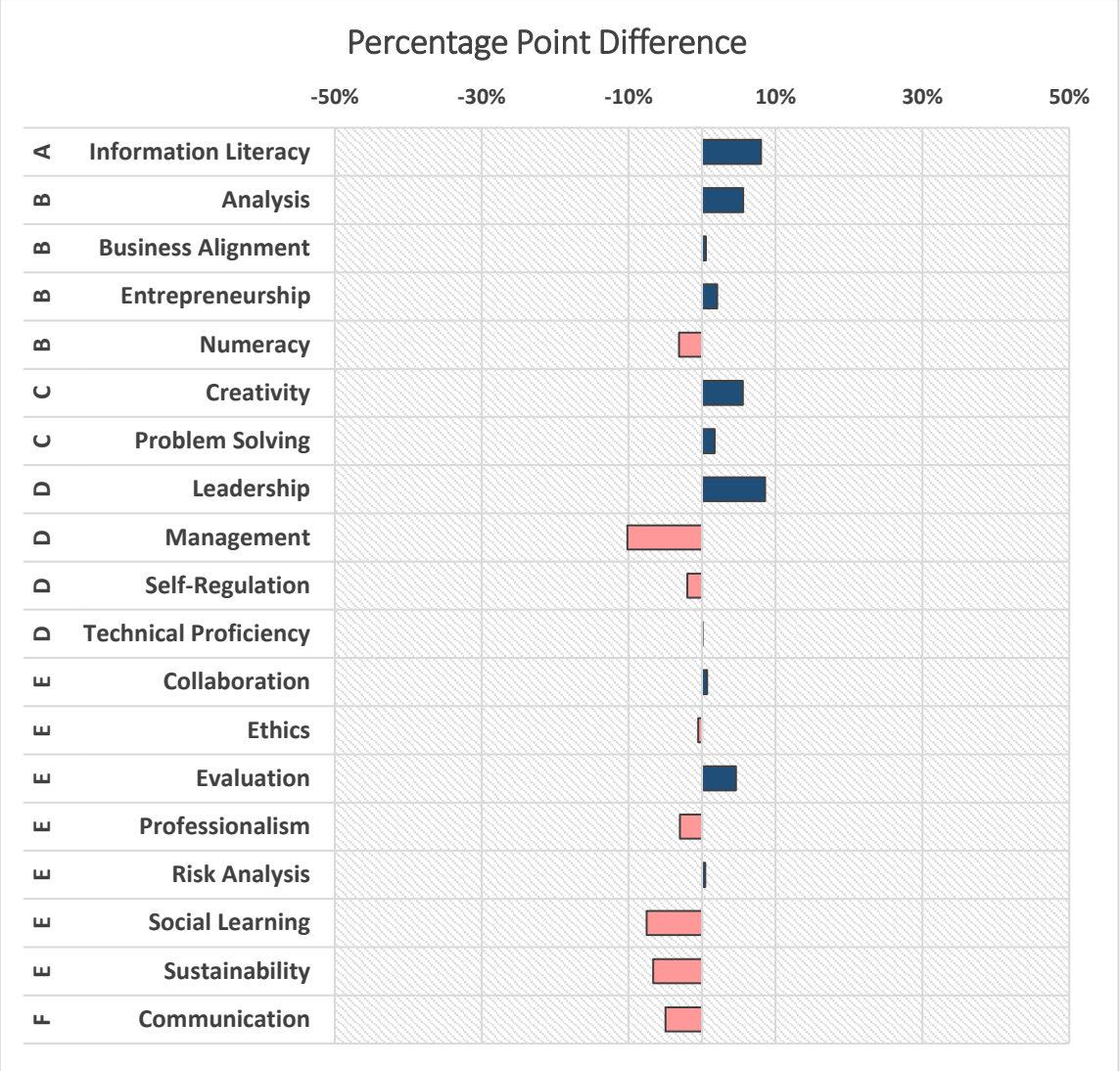


*Figure 46 - Transferable Skills Difference*

In relation to subject-specific skills, the Lightcast data suggests that both the BSc Hons Computing Science and the MSc Artificial Intelligence should have less of a focus on *Theory*, *Self-Reflection*, *Innovation* and *Technical Writing*. Conversely, it suggests there should be a greater emphasis on *Process and Production*. However, *Process and Production* are built on underpinning theory, selection of the "right" process requires reflection, the development of new processes and production of artefacts in the context of a Computing Science programme requires innovation and any process or developed product much be documented, which is likely to involve technical writing. Interestingly innovation, self-reflection and technical writing do not feature in the Lightcast data and hence are perhaps considered part of process and production (in the manner outlined in the previous sentence). Interpreting the data in this way would result in profiles for the courses that are much more aligned to the Lightcast data.

Considering transferable skills, *Management*, *Social Learning*, *Sustainability* and *Communication* stand out as being areas where a greater focus is needed according to the Lightcast data. Whilst Professionalism also stands out as underrepresented at undergraduate level, at postgraduate level it appears to exceed the levels expected. A similar (but opposite) trend exists for *Business Alignment*. It is also interesting to note that across both programmes, *Leadership* is covered to a greater extent than the Lightcast data would suggest is required, but *Management* is significantly less. Whilst *Leadership* and *Management* are different, they are closely related and often used interchangeably in casual conversation. For example, a learning outcome might indicate that at the end of a module, a student would be able to lead a team or that they could manage a team and many people would consider these as largely "equivalent" learning outcomes. However, the learning outcomes would be allocated to different transferable skills in the mappings. Similarly, a job advert might be seeking to recruit an individual who can lead a team or manage a team, but again both forms of wording could be considered the same but would be recorded differently. If both categories are combined, then the outcomes are much more equitable. This would indicate the need for clear definitions of each skill being mapped. It is also interesting to note that *Risk Analysis* does not feature in the Lightcast data, but yet is something that is often considered an important part of management. This would suggest that the Lightcast data may only be identifying out some of the skills required for a particular post, possibly due to the fact that space is often limited in job advertisements.

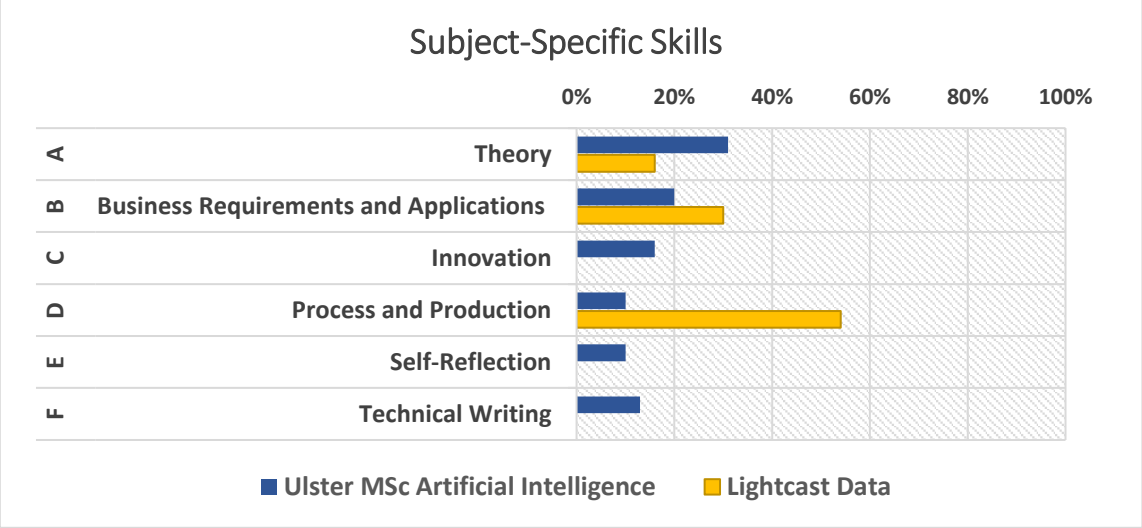


*Figure 47 - Subject-Specific Skills*

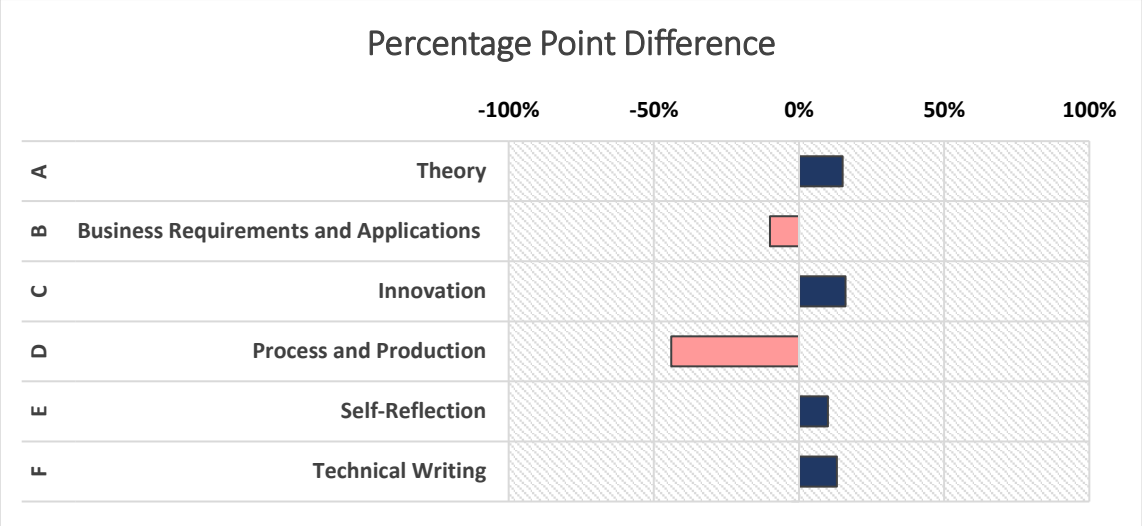


*Figure 48 - Subject-Specific Skills Difference*

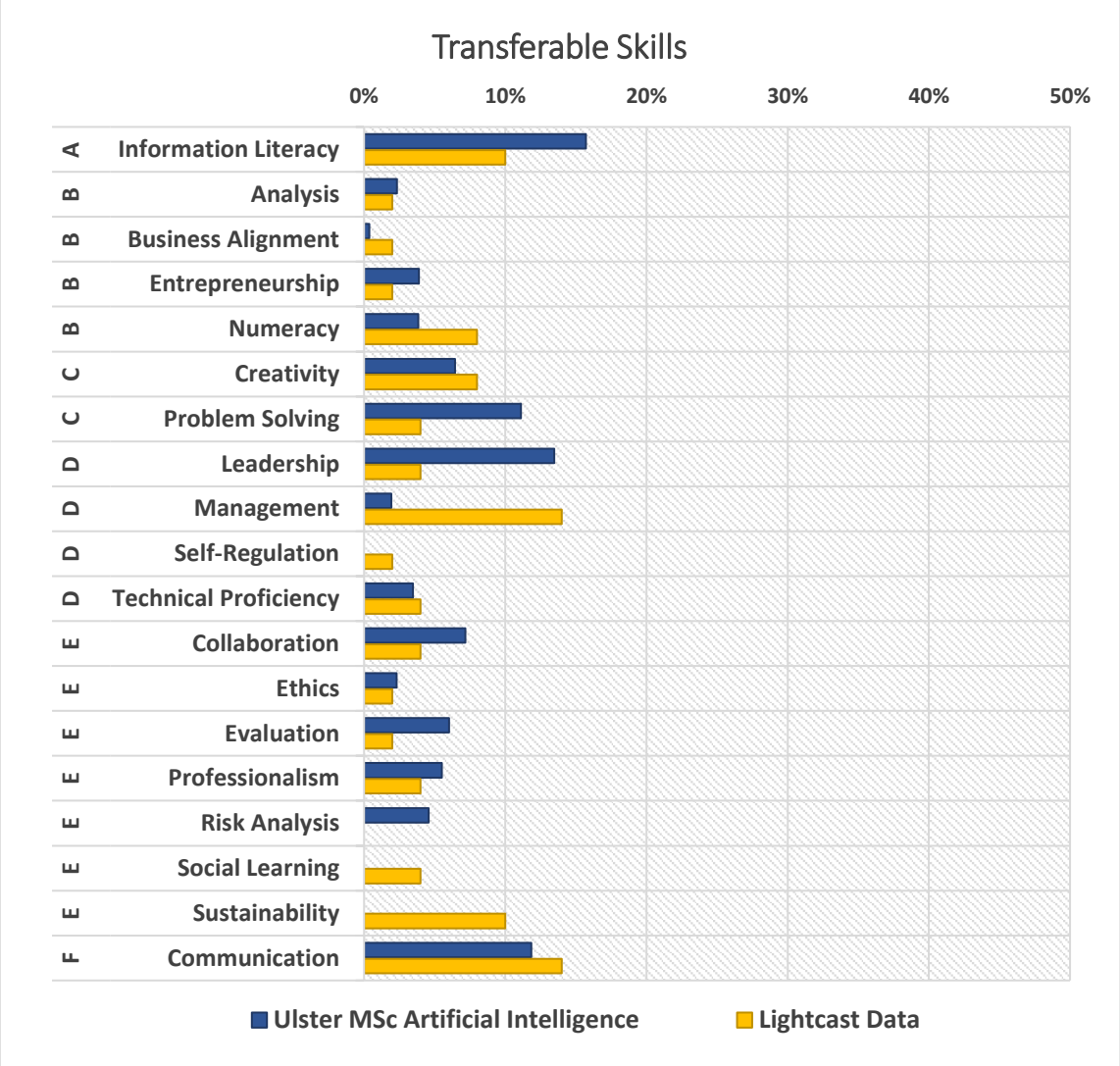


*Figure 49 - Transferable Skills*

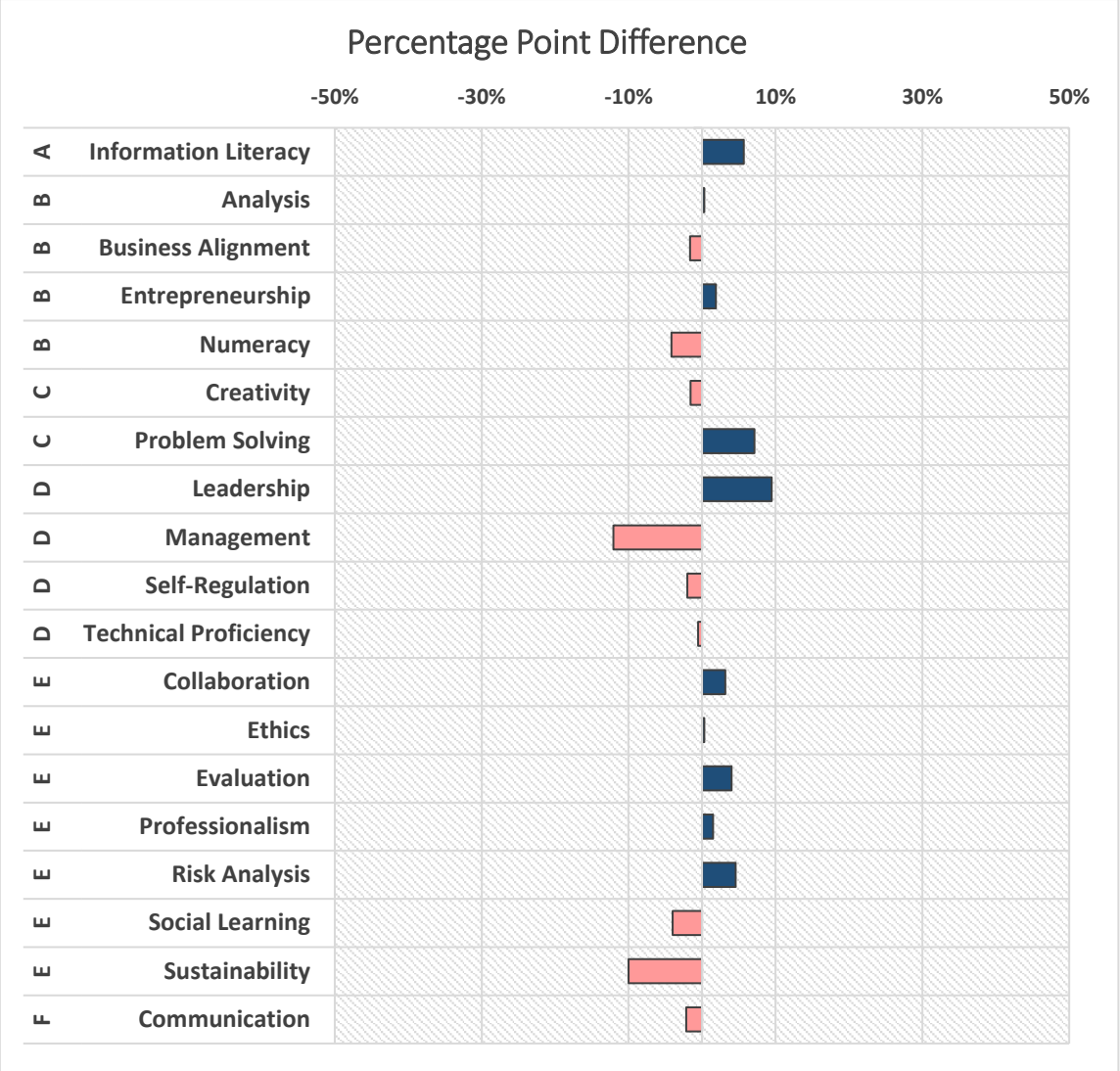


*Figure 50 - Transferable Skills Difference*

## *Micro-credential approach*

Two examples of how Ulster has used the *EDGE Award* to support the recognition of micro-credentials are:

1. Encouraging students to undertake industry certifications such as Microsoft Certified Professional or CISCO Certification,
2. Providing students with access to professional training courses provided by industry.

### *Industry Certifications*

Industry certifications such as those provided by Microsoft and CISCO, typically have a greater focus on a "product", whereas University modules typically focus on underpinning theory and principles. Whilst contrasting, these approaches are complimentary and overlap. At Ulster the curriculum of some modules was aligned to specific industry certifications, but the delivery retained the more "academic" focus. However, this gave students the necessary theory and underpinning to facilitate self-study towards gaining industry certification.

The academics therefore proposed a new *EDGE* activity which was to complete the industry certification. The required 30 hours of activity that was split between learning how the module content was practically applied within the relevant "product", alongside preparing for and undertaking the certification test itself. In this case, the certificate confirming the students had passed the test was used as the evidence required for the activity to be recognised, rather than the more typical reflective log. To encourage engagement, the University also paid for the test and up to one resit for each student and became a validated centre enabling the tests to be undertaken on University premises.

### *Professional Training Courses*

Most universities will have student prizes that are sponsored by local employers. Typically, these take the form of a financial reward and possibly a small trophy or similar. However, rather than offer a financial prize, Ulster worked with a local training provider who offered a place on any one of their International Software Testing Qualifications Board (ISTQB) Certified programmes. This significantly increased the face value of the prize to the student when compared with the more traditional financial reward, whilst also being a relatively "cheap" way for the company to provide such a high-valued prize.

Given a prize typically goes to one student, the training company also worked with the University to agree that any of our students on their year out on placement could attend the training at a significant discount. We then promoted the opportunity to all our placement employers and encouraged them to pay for students to participate if software testing was part of their job role.

The training programmes typically lasted 3 full days and were then followed by an assessment for those wishing to be certified. The time to attend the training plus the assessment (and some preparation time) was sufficient to justify the 30 hours of activity and hence we were able to create an *EDGE* activity for both the prize winner and those whose placement company were willing to pay the significantly reduced fee for the programme (or students who were prepared to self-fund, given the reduction in cost).

### *Benefits and limitations*

The primary benefits to students from the approach adopted are:

- The direct benefits acquired from engaging with the activities themselves.
- The flexibility of what can be included and hence the range of activities that can be incorporated within the *EDGE Award*.
- The *EDGE Award* makes dedicated students stand out from the crowd, particularly those who get the "higher" level award that requires engagement with a greater number of activities throughout their programme.
- The requirement to get three (or five) activities to complete the award, can encourage ongoing engagement in additional activity, promoting a culture of continuous development, particularly for those students who need "just one more activity" to complete an award.
- The award demonstrates to an employer, a student's dedication and commitment to continuous development.

The primary limitation of the approach adopted in this case is that the *EDGE Award* is optional rather than something all students are "forced" to do. Hence while there may be good intentions, other pressures, such as work commitments and credit bearing study, can often take over. The fact that there are two levels of the award helps mitigate against this as the lower award only requires one activity per year of study, so the commitment is not too onerous, but worthwhile.

### *Possible uses*

The skills profiles indicate the overall balance of skills within a programme. For example, in both the Ulster mappings, coverage of the transferable skill of *Leadership* was limited. Having identified this through this skills profile, students could select *EDGE* activities that develop this skill. For example, they could take on leadership roles in their local sports club, take on a leadership role in a student society, become a student representative and lead on providing student feedback to the department or similar activity.

Whilst there was more of a balance across the subject-specific skills delivered by the programmes, there are specific skills which have less coverage than others and hence, similarly, could be the focus for selecting appropriate *EDGE* activities. For example, on the BSc Hons Computing Science, specific learning outcomes directly linked to *Sustainability* had a relatively low number of hours allocated. Hence students may wish to seek, for example, an online micro-credential that would enhance their knowledge of this and use that as an *EDGE* activity.

# E. Embedded (stackable credit):

## E.1. Case Study 6 University of Huddersfield example model

The course BSc (Hons) Software Engineering was utilized to demonstrate how micro-credentials can be embedded into a course without compromising the core learning outcomes or negatively impacting students' assessment workload.

The primary focus of this course is for students to gain the skills necessary to thrive in the computing industry and offers a plethora of career pathways including IT consultant, software engineer, cyber security analyst, app developer and web developer. Along with this course's strong emphasis on providing students with the theoretical and practical knowledge they need to succeed; they have the opportunity to develop their employability through an optional placement in their third year. This course has been accredited by the British Computer Society (BCS), meaning graduates will have achieved the academic requirements for registration as a Chartered IT Professional, along with partially qualifying for Chartered Engineer.

### *Skills profiling*

Mapping of the learning outcomes to subject-specific and transferable skills helped identify how skills were accounted for in the total study time. Considering the highly technical nature of the course, it wasn't surprising to discover that 32% of the study hours were dedicated to the development of a single subject-specific skill, *Process and Production*. Two other subject-specific skills also compromised a large number of skills hours, *Technical Writing* (26%) and *Theory* (23%), most likely as a result of the prevalence of assessment components and associate learning outcomes focused on report-writing and logbook entries. The subject-specific skills with the least number of skills hours allocated to them were *Innovation*, *Business Requirements and Applications* and *Self-Reflection*. These skills accounted for 9%, 4.6% and 4.6% of the total study time respectively. Skills accounting for a lower percentage of study hours indicate that students may wish to increase their employability by developing themselves further in those areas through micro-credentials.

In terms of mapping learning outcomes for the course to transferable skills, as expected from a technical oriented course there is a major emphasis on developing *Technical Proficiency*. This is followed by *Information Literacy*, *Analysis* and *Problem Solving*. Each of these skills is crucial for students to develop to not only become a Software Engineer, but more broadly to succeed in an ever-changing industry that necessitates creative thinking. Less prominent skills were *Risk Analysis*, *Management*, *Evaluation* and *Ethics*, with all of them falling below 4% of total study hours. These skills are more likely to be developed in optional modules, for example the optional module Cyber Security would be expected to aid students in developing *Risk Analysis* and *Ethics*. This could imply that depending on what optional modules students choose, they may or may not develop those skills. This is something that could be resolved with micro-credentials targeted at the development of specific transferable skills resulting in more well-rounded graduates. *Sustainability* and *Entrepreneurship* made up a negligible percentage of study hours, which was surprising given the current importance of these skills both societally and within the computing industry.

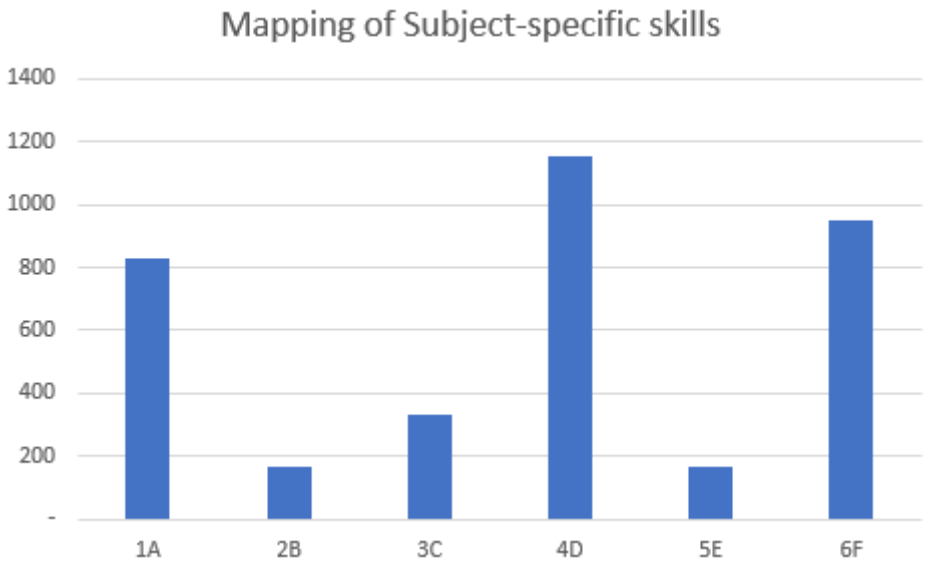


*Figure 51 - Subject-specific skills hours*

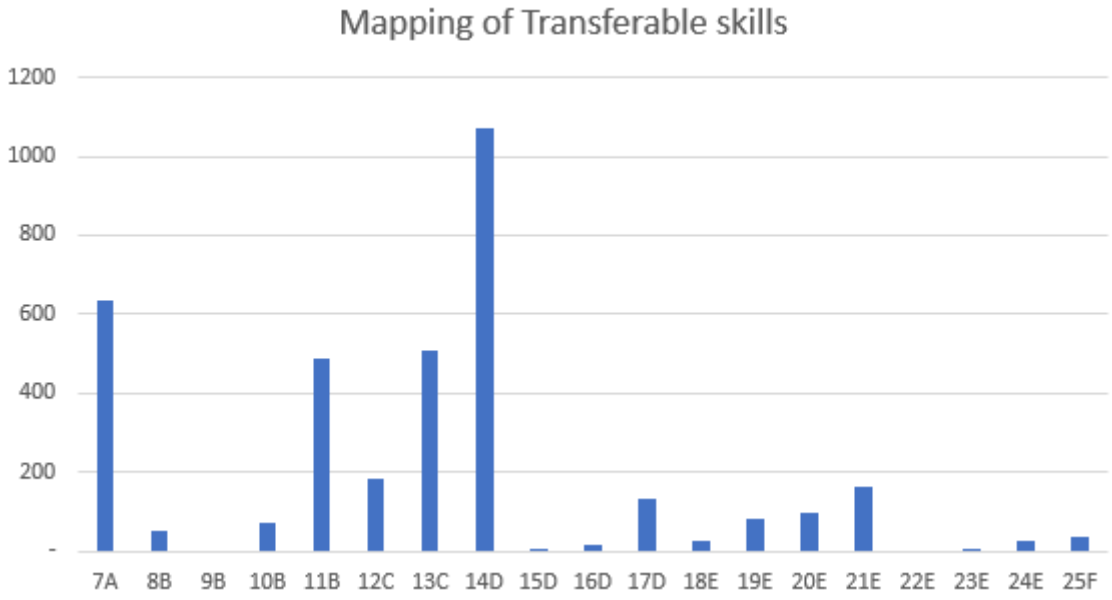


*Figure 52 - Transferable skills hours*

*Comparison with Lightcast*

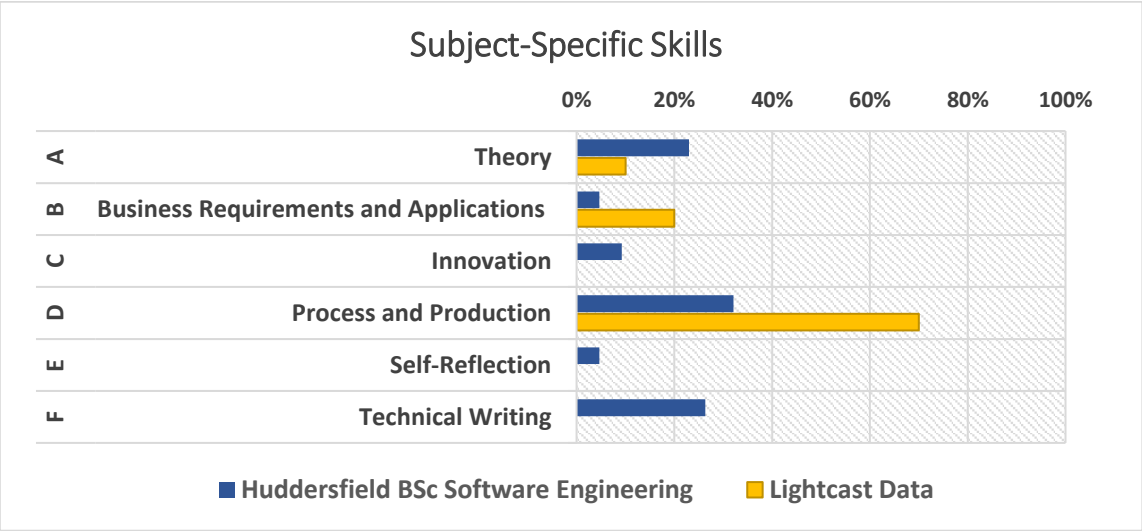


*Figure 53 - Subject-Specific Skills*

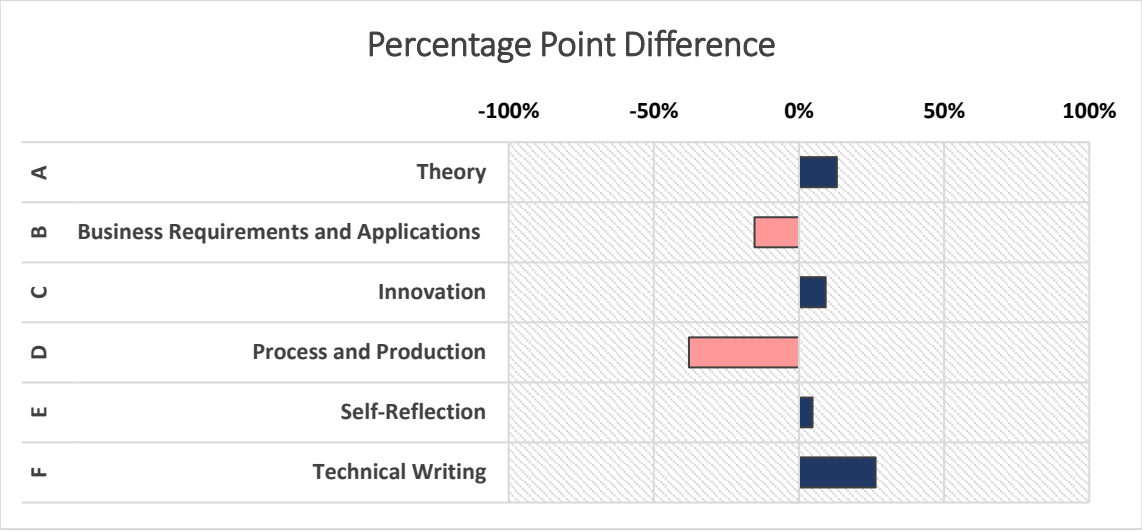


*Figure 54 - Subject-Specific Skills Difference*

For subject-specific skills, the Huddersfield course aligns well in *Theory* and *Business Requirements and Applications*. *Process and Production* alignment is reasonable but job roles focus strongly on this and do not specifically require *Innovation*, *Self-Reflection* or *Technical Writing*, which all contribute towards developing a rounded graduate. Given this the course as a whole seems well-aligned to industry requirements.

For transferable skills, the Huddersfield course is stronger in *Leadership* and weaker in *Management* than job roles require, and combining these together the course is still stronger. *Information Literacy*, *Numeracy* and *Problem Solving* are also stronger. The main gaps from the course in terms of transferable skills are in *Social Learning*, *Sustainability* and *Communication*. *Sustainability* is an area for development within the course, whilst *Social Learning* and *Communication* are present but

not recognised within the learning outcomes and assessments. Reviewing both learning outcomes and assessments should provide opportunities to revise these areas, perhaps through some reduction in *Information Literacy* and *Leadership*.

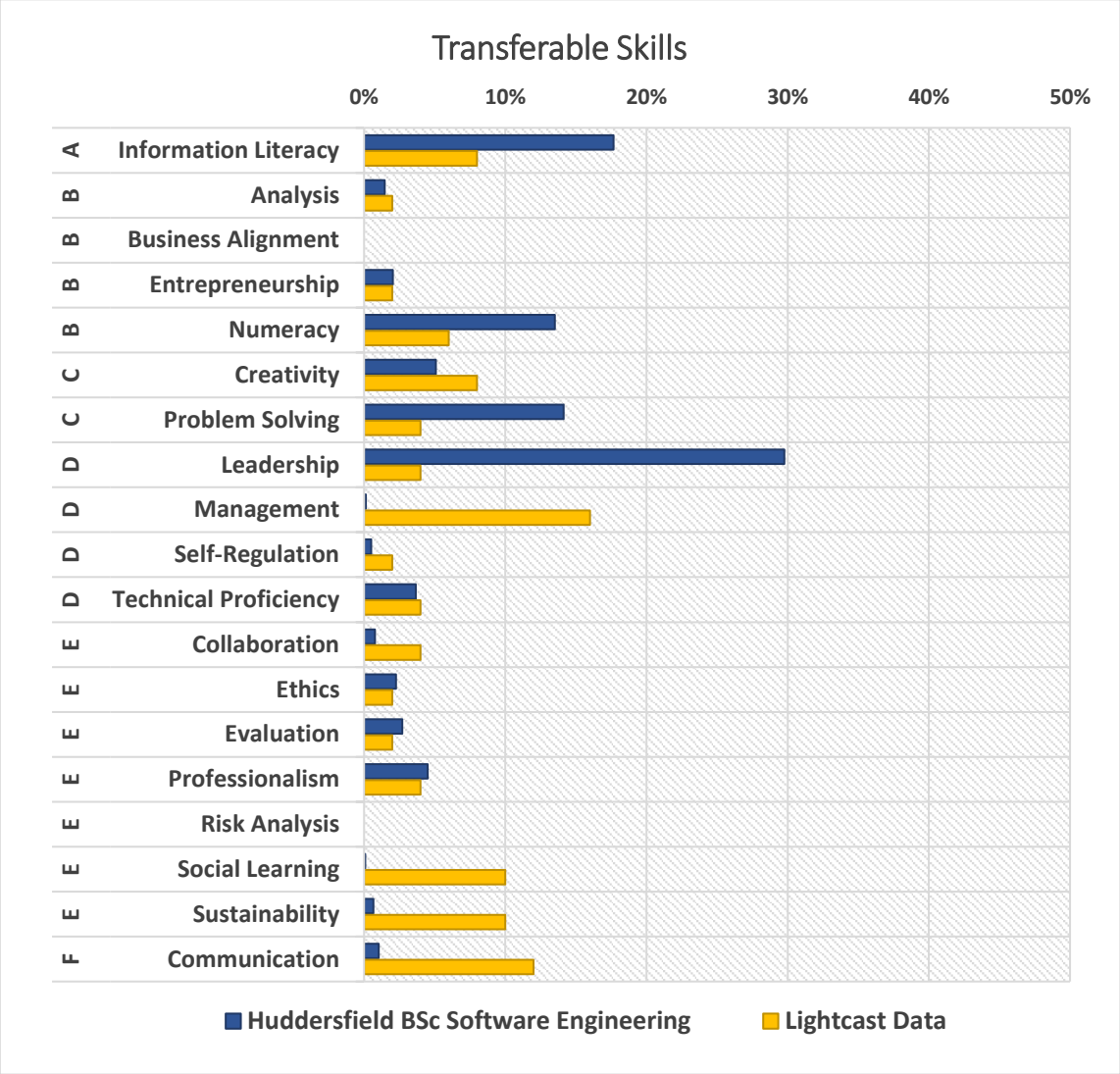


*Figure 55 - Transferable Skills*

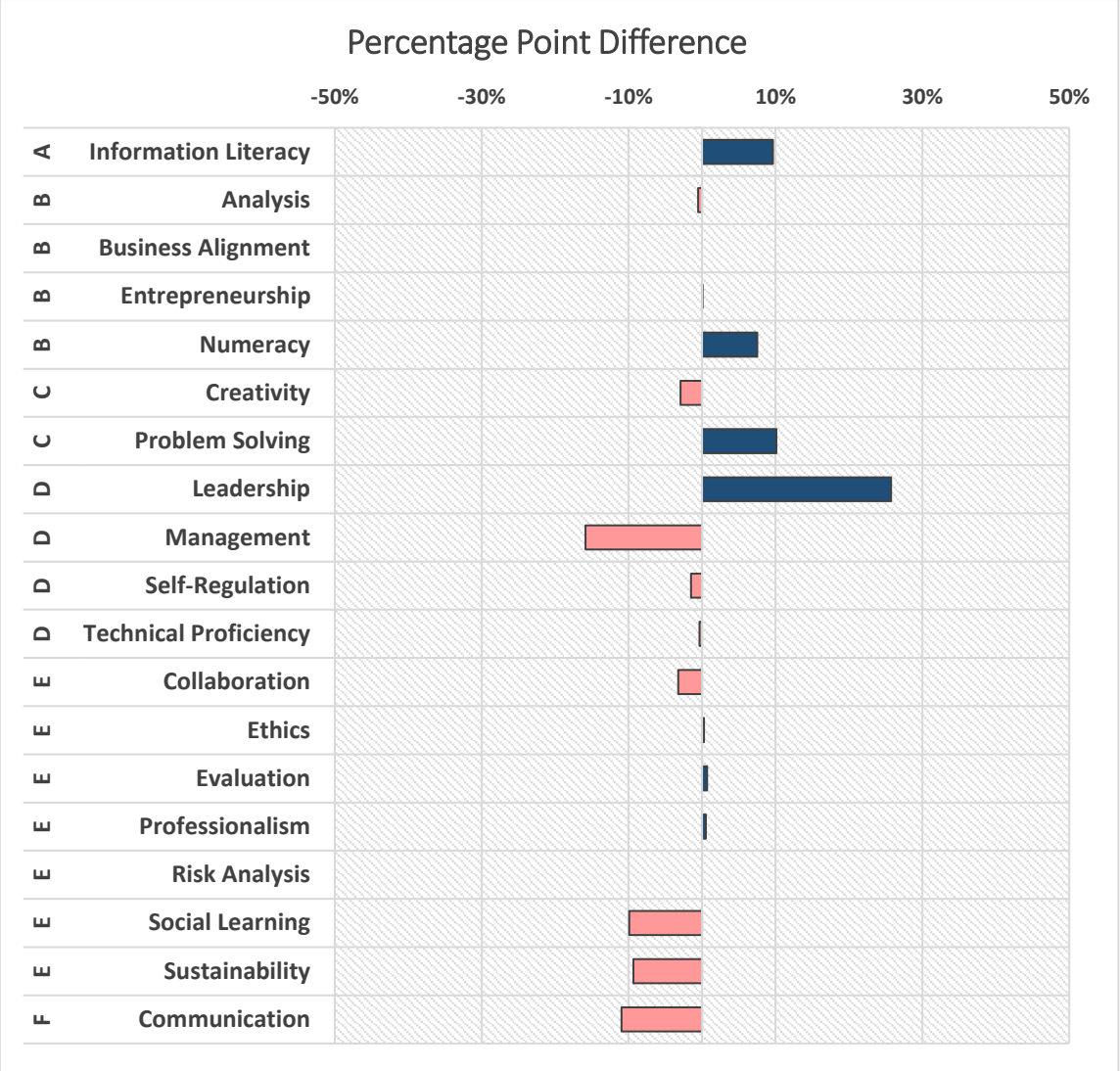


*Figure 56 - Transferable Skills Difference*

### *Micro-credential approach*

There are multiple ways of incorporating micro-credentials into the current course structure as stackable elements using informal learning platforms such as Inspiring Digital Enterprise Award (iDEA) and LinkedIn Learning.

iDEA uses a series of online challenges that reinforce the new ideas and concepts being learnt. Upon successful completion of a course, students get awarded with points and a digital badge reflecting this achievement. Based on the skills profiling of BSc (Hons) Software Engineering, it is evident that students may benefit from development in skills that would otherwise be underdeveloped following the traditional course structure. These are shown in Table 5.

| **Badges/Category** | **Subject-specific Skills** | **General Skills** |
|---|---|---|
| Social Media Ethics, Cyber Security, Digital Ethics, Global Goals, GDPR | Information Literacy, Business Requirement and Applications… | Problem Solving, Ethics, Risk Analysis, Sustainability… |
| Entrepreneur category | Innovation, Self-Reflection… | Entrepreneurship, Management, Leadership… |

*Table 5 - iDEA badges supporting skills development for Software Engineering*

LinkedIn Learning also aims to provide personalised content that reflects learners' skill gaps, personal and professional goals. It also has an interactive community to help students with social learning. Each course is led by an expert knowledgeable in the related field and the content is divided into sections and sub-sections with the option of making notes while watching course content or bookmarking relevant videos for future reference. In terms of using LinkedIn Learning content as micro-credentials, similar skills profiling can be done for each learning path/course to determine how they could reinforce current Software Engineering course content or even replace it.

Taking a look at the Software Engineering modules, each module can be broken down into blocks that build on each other to add up to the total learning hours of the module.

For example, a module can be divided into the following blocks:

- Lectures, practical classes, demonstrations and guided independent study
- Assessments (of which we assume 3 for the purpose of this example)

These blocks can be visualized using learning hours (empty blocks below that we can potentially replace, remove, or restructure (see Table 6).

| Lectures, practical classes, demonstration + independent study | assessments (3) |
|---|---|
| | |
| | |
| | |
| | |

*Table 6 - Skills profile components template*

One example of how to visualise these potential changes can be seen in Table 7, where content can be replaced in the left-hand column with badges and external learning resources, and micro-credentials can be used in the right-hand column to replace assessments.

| | |
|---|---|
| lectures + practical classes + independent study | assessments (1) + 1 |
| replaced with external learning resources | Replacing multiple assessments with one |
| replaced with external learning resources | |
| replaced with external learning resources | Restructuring the format of an assessment |
| | |

*Table 7 - Example of component changes enabled through skills profiling*

**Illustrative examples of a stackable model**

**1. Replacing multiple assessments with a single assessment**

The Cyber Security (CS) module represents 200 learning hours. It has 2 assessments, each weighted at 50%. These can be mapped to 3 subject-specific skills, as shown in Table 8.

| CIS2201 Cyber Security | | | Module Learning Hours | | | 200 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Asst | 1A | 2B | 3C | 4D | 5E | 6F |
| 1 | 67 | | | | | 33 |
| 2 | | | | 67 | | 33 |
| **Total** | **67** | | | **67** | | **67** |

*Table 8 - Subject-specific skills*

External Learning Resources (ELRs), that cover similar subject-specific skills, can be skills profiled and used within the module. An example of a set of suitable ELRs is shown in Table 9. The external learning hours from these ELRs is 120.

| ELR | 1A | 2B | 3C | 4D | 5E | 6F |
|---|---|---|---|---|---|---|
| 1 | 5 | | 10 | 5 | | |
| 2 | 10 | 5 | | 10 | | 10 |
| 3 | 5 | | | 10 | | 5 |
| 4 | 10 | | | 5 | | 5 |
| 5 | 5 | | | 10 | | 10 |
| **Total** | **35** | **5** | **10** | **40** | | **30** |
| **Remainder** | **32** | **-5** | **-10** | **27** | | **37** |

*Table 9 - Subject-specific skills for External Learning Resources (ELRs)*

The internal learning hours can then be reduced from 200 to 80 and, with it, the number of assessments. The ratio of the subject-specific skills in the remaining single assessment reflects the remainder values once the ELRs are subtracted i.e. 32:27:37. This is applied to 80 learning hours and is shown in a summary of the new stackable version of the module in Table 10.

| CIS2201E Cyber Security (ELR) | | | Internal Learning Hours | | | 80 |
|---|---|---|---|---|---|---|
| | | | External Learning Hours | | | 120 |
| | | | | | | |
| Asst | 1A | 2B | 3C | 4D | 5E | 6F |
| 1 | 28 | | | 22 | | 30 |
| ELRs | | | | | | |
| 1 | 5 | | 10 | 5 | | |
| 2 | 10 | 5 | | 10 | | 10 |
| 3 | 5 | | | 10 | | 5 |
| 4 | 10 | | | 5 | | 5 |
| 5 | 5 | | | 10 | | 10 |
| **Total** | **63** | **5** | **10** | **62** | **0** | **60** |

*Table 10 - A stackable version of the Cyber Security module*

A similar approach can be taken when considering transferable skills. Clearly one of the impacts of such an approach is that learning hours become more distributed across both subject-specific and transferable skills, as the ELRs are unlikely to exactly match the distribution of skills in the original modules. However, this is very much a positive change as it means that a broader range of skills are likely to be able to be evidenced with a more granular approach to where and how these are gained. Two further opportunities are gained through such an approach. Firstly, as well as assessment components being removed as ELRs are introduced, whole modules may also be removed as the skills can already be evidenced through existing assessments and as ELRs are introduced assessment in one module could be modified to accommodate remaining assessment requirements from another module. This approach therefore accommodates moves towards programme level learning outcomes and assessment, not just reductions within individual modules. Secondly, as well as adding flexibility in reducing and removing assessment and modules, this approach also enables programmes of study to develop into personalised learning pathways where individual learners can differentiate themselves and evidence their specific combinations of skills through increased variability in what is studied.

2. **Reducing core provision to support personalised learning and differentiation of skills gained**

Considering the example above, with a Cyber Security module and 5 ELRs, the internal learning hours for the module could be reduced from 200 to 140 hours with a pro-rata reduction in assessment, as shown in Table 11.

| CIS2201P Cyber Security (PL) | | | Module Learning Hours | | | 140 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Asst | 1A | 2B | 3C | 4D | 5E | 6F |
| 1 | 47 | | | | | 23 |
| 2 | | | | 47 | | 23 |
| Total | 47 | | | 47 | | 46 |

*Table 11 - A reduced learning hours version of the Cyber Security module*

The remaining learning hours could then be gained through different combinations of ELRs, with two examples shown in Table 12, representing ELRs 2 and 5 or ELRs 1, 3 and 4.

| ELR | 1A | 2B | 3C | 4D | 5E | 6F | |
|---|---|---|---|---|---|---|---|
| 2 | 10 | 5 | | 10 | | 10 | 35 |
| 5 | 5 | | | 10 | | 10 | 25 |
| **Total** | **15** | **5** | | **20** | | **20** | **60** |
| | | | | | | | |
| ELR | 1A | 2B | 3C | 4D | 5E | 6F | |
| 1 | 5 | | 10 | 5 | | | 20 |
| 3 | 5 | | | 10 | | 5 | 20 |
| 4 | 10 | | | 5 | | 5 | 20 |
| **Total** | **20** | | **10** | **20** | | **10** | **60** |

*Table 12 - Two examples of ELR combinations*

This would result in different skills profiles for the module as a whole, as shown in Tables 13 and 14.

| CIS2201PL Cyber Security (PL) | | | Internal Learning Hours | | | 140 |
|---|---|---|---|---|---|---|
| | | | External Learning Hours | | | 60 |
| Asst | 1A | 2B | 3C | 4D | 5E | 6F |
| 1 | 47 | | | | | 23 |
| 2 | | | | 47 | | 23 |
| ELRs | | | | | | |
| 2 | 10 | 5 | | 10 | | 10 |
| 5 | 5 | | | 10 | | 10 |
| **Total** | **62** | **5** | **0** | **67** | **0** | **66** |

*Table 13 - An example of a personalised learning approach to a module*

| CIS2201PL Cyber Security (PL) | | | Internal Learning Hours | | | 140 |
|---|---|---|---|---|---|---|
| | | | External Learning Hours | | | 60 |
| Asst | 1A | 2B | 3C | 4D | 5E | 6F |
| 1 | 47 | | | | | 23 |
| 2 | | | | 47 | | 23 |
| ELRs | | | | | | |
| 1 | 5 | | 10 | 5 | | |
| 3 | 5 | | | 10 | | 5 |
| 4 | 10 | | | 5 | | 5 |
| **Total** | **67** | **0** | **10** | **67** | **0** | **56** |

*Table 14 - A second example of a personalised learning approach to a module*

By providing choice to learners over a set of modules, significant variations in skills gained can be evidenced, with very little variation required within any single module. Again, this approach can be replicated for transferable skills profiles.

### *Benefits and limitations*

Benefits

- Enhanced employability, by producing more well-rounded students with a diverse skill set
- The opportunity to diversify their skill set, by personalising it to their professional goals and interests sets them apart from other graduates
- Reduced assessment workload, by removing or combining assessments
- Assessment flexibility, by giving students an alternative path to evidencing development of the skills they are being assessed on
- Encouraging learner agency, by providing opportunities to personalise their learning journey

Limitations

- Limited by student motivation
- Courses that students may be sign-posted must be of a comparable technical and academic level to that of an average university module

### *Possible uses*

Whilst initial skills profiling is required to enable this approach to be used, some of this could be built into module and assessment requirements. For example, learners could be asked to evidence the learning gained if they wish to replace some of the module learning and this could easily be incorporated into the assessment marking. Learners would need to choose suitable badges and micro-credentials, with clearly defined learning hours and learning outcomes, as per the example shown in Figure 57. A standard pro-forma, including a skills profiling template, could be completed to support the calculations and the evidence of completion provided to demonstrate the learning hours. Indeed, this approach is potentially more robust as a measure of evidencing learning hours than a traditional end assessment model.

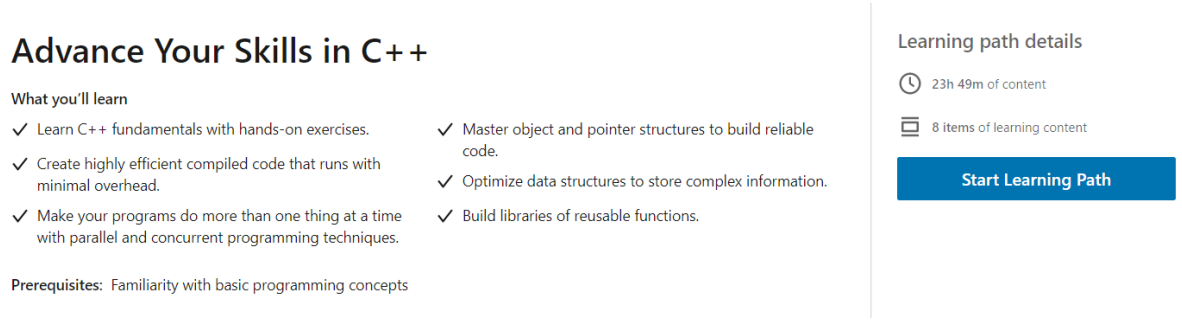


*Figure 57 - Example learning summary for use when using an external learning resource within a programme of study*

# 4. Recommendations

## 4.1. For Higher Education Institutions (HEIs)

### Recommended vocabulary set

A fundamental issue when seeking to understand the skills developed within any of the degree programmes considered within this report is the lack of a standardised approach within learning outcome descriptors. Sometimes the learning outcomes appear focused on what is taught, other times they appear to focus on what is to be learnt. Rarely are they focused on how they will be subsequently applied. It is little wonder therefore that employers struggle to understand the skills gained within a degree course, even when benchmark statements and professional body requirements are mapped to learning outcomes. The problems lie both with how learning outcomes are described (often academically and generically) and in the constraints these descriptions place on individual learner skills development.

Some institutions restrict the number of learning outcomes within a module, which can lead to multi-faceted learning outcomes including several skills within them. Where learning outcomes are not constrained in number, other skills translation challenges remain. The language and terms used often are provided to align with things that are easy to assess and thus the learning actually developed within the studies may be missed as it is more awkward to evidence through assessment. Evidencing skills from the existing learning outcome model is difficult enough when all learning is defined but becomes very problematic when learning is missed out of learning outcomes, or when we start with what will be assessed rather than what we would like to be learnt.

These findings point to a fundamental issue with a learning outcomes-based approach to defining programmes of study. A simple solution to this is to develop a set of tags that can be added to learning outcomes in a similar way that subject benchmark statements are mapped to. Ideally though, with a simple and limited set of skills, such as those used in this report, it should be straightforward for learning outcomes to incorporate such terms into the learning outcomes themselves making it much easier to translate and use skills profiling without the need for human translation each time.

Care should be taken, therefore, to ensure the knowledge, skills and dispositions implied by 21st century skills are fully embedded in the learning outcomes. For example, being an effective collaborator is probably the desired outcome related to 25F rather than solely in-depth knowledge related to theories of collaboration. This implies some *know-of* (knowledge / theory), some *know-how* (practice of collaboration) and some *dispositions* (individual behaviour patterns – willingness to work with others, respectful, etc.). Linking computing courses to skills frameworks, such as SFIA and the ACM CC2020 Project, for example, may be a good starting point to addressing this.

In terms of the constraints arising from a learning outcome descriptor approach, the most significant of these is the standardised nature of both the learning expectations and the evidence of achievement. It is challenging for teachers, learners and employers to both communicate the skills developed and differentiate learners in terms of the skills they have gained. Mapping work done by students on industrial placement to learning outcomes can be problematic, and most placement learning outcomes are therefore often generic. Formally identifying skills that are developed during placements and the way in which they are appraised could be a useful mechanism to enable such mappings. Reflective logs, for example, provide a way both to evidence skills gained and for a learner to better communicate these to employers. Whilst on placement micro-credentials could be used to

focus on specific skills development, and more broadly having learners reflecting on their skills development throughout their learning journey has long been an aspiration within higher education, but one that is rarely fully developed.

A skills profiling approach not only provides learners with an overall indication of their skills coverage, it also serves to highlight their current areas of strength as well as areas of potential development and extension. In so doing, it enables them to make more informed choices about both their learning and their subsequent employment, with access to more choice in where, when and how to develop if their course structures provide such flexibility via any of the approaches discussed in this report.

### Further studies

A number of further studies could be conducted related to the approach outlined in this report, working with HEIs, learner-earners and employers. For example, third party qualifications could be analysed to provide a set of credentials that could be incorporated into higher education courses; a qualitative study could be conducted to further evaluate interpretations of skills profiling, outsider perspectives, as gleamed from university website information, for example, could be compared with insider profiles to review whether what institutions think they are conveying to stakeholders reflects their interpretations of the courses; curriculum reviews could include skills profiling as either a reflection exercise to inform course developments or as a broad brush course evaluation tool, and this could also possibly be extended to course design as part of developing more personalised courses that better meet stakeholder needs. Course delivery could also be analysed, with learning outcomes and skills linked to specific sessions, for example, and thus providing a much more direct connection between what is being designed and what is being delivered.

## 4.2. For education and employment policies

There are significant skills gaps in the economy, and historically decades of underdevelopment of skills within the UK workforce. There are many reasons for this, however one clear issue that arises early in formal education, and persists through to employment, is a lack of clarity for learners on the links between learning and earning. Learning outcomes focus on capabilities that need to be developed, without any explanation regarding the potential applications of these capabilities as competencies in the workplace. Providing clarity on the skills required for particular job roles is straightforward through the use of labour market information, however currently the skills within formal education are much less visible and, as has been seen in this report, even when skills are translated from learning outcomes what is defined as being learnt against what is supposed to be learnt are not the same. This points to a more fundamental need to consider skills profiling within different levels of formal education, not only to better manage transitions between levels, but also to enable reskilling, re-engagement with education and reduce barriers to development. Badges and micro-credentials provide mechanisms to reduce such barriers, but they will only realise their potential if educational and employment structures understand and accommodate their value.

In terms of the broader use of skills profiling, one example application can be in supporting accreditation and reassuring stakeholders that courses provide both employable graduates and courses with a suitable skills profile. Considering, for example, Ulster's BSc (Hons) Computing Science and Manchester Metropolitan's BSc (Hons) Computer Science, as one would hope, there is

not much variation in skills profiles, as shown in Figures 58 and 59. The largest variations (around 10%) are seen in just three transferable skills *Problem Solving*, *Leadership* and *Technical Proficiency*. This shows a potential role in exploring variation between and within courses, as well as where courses are strongly and weekly aligned to industry needs. For example, of the three MSc courses considered, Northumbria's MSc Data Science shows the closest industry alignment, with Bath's generalist MSc Computer Science, somewhat understandably showing the greatest variance.

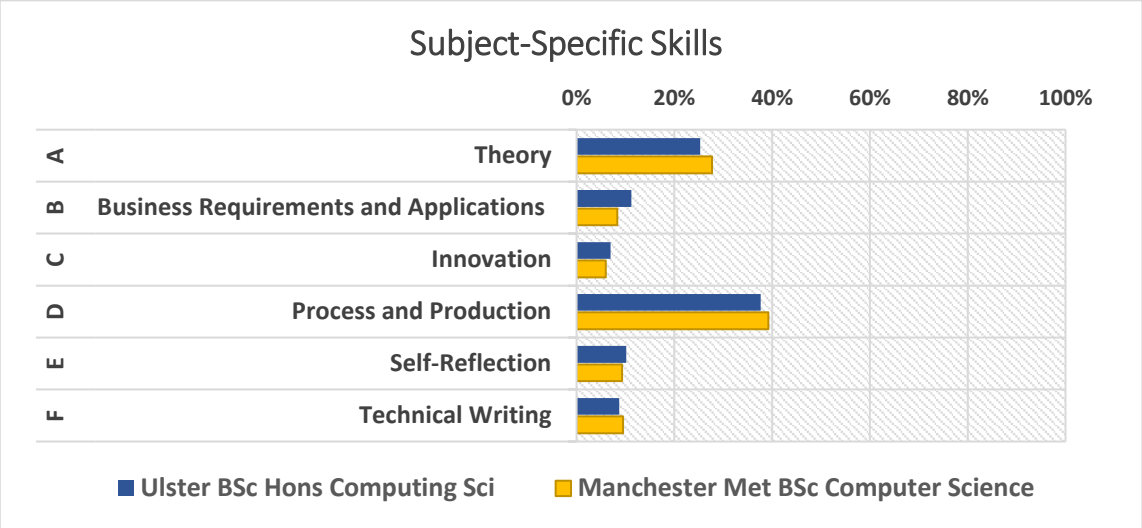


*Figure 58 - Comparison of subject-specific skills on undergraduate "comp sci" courses*

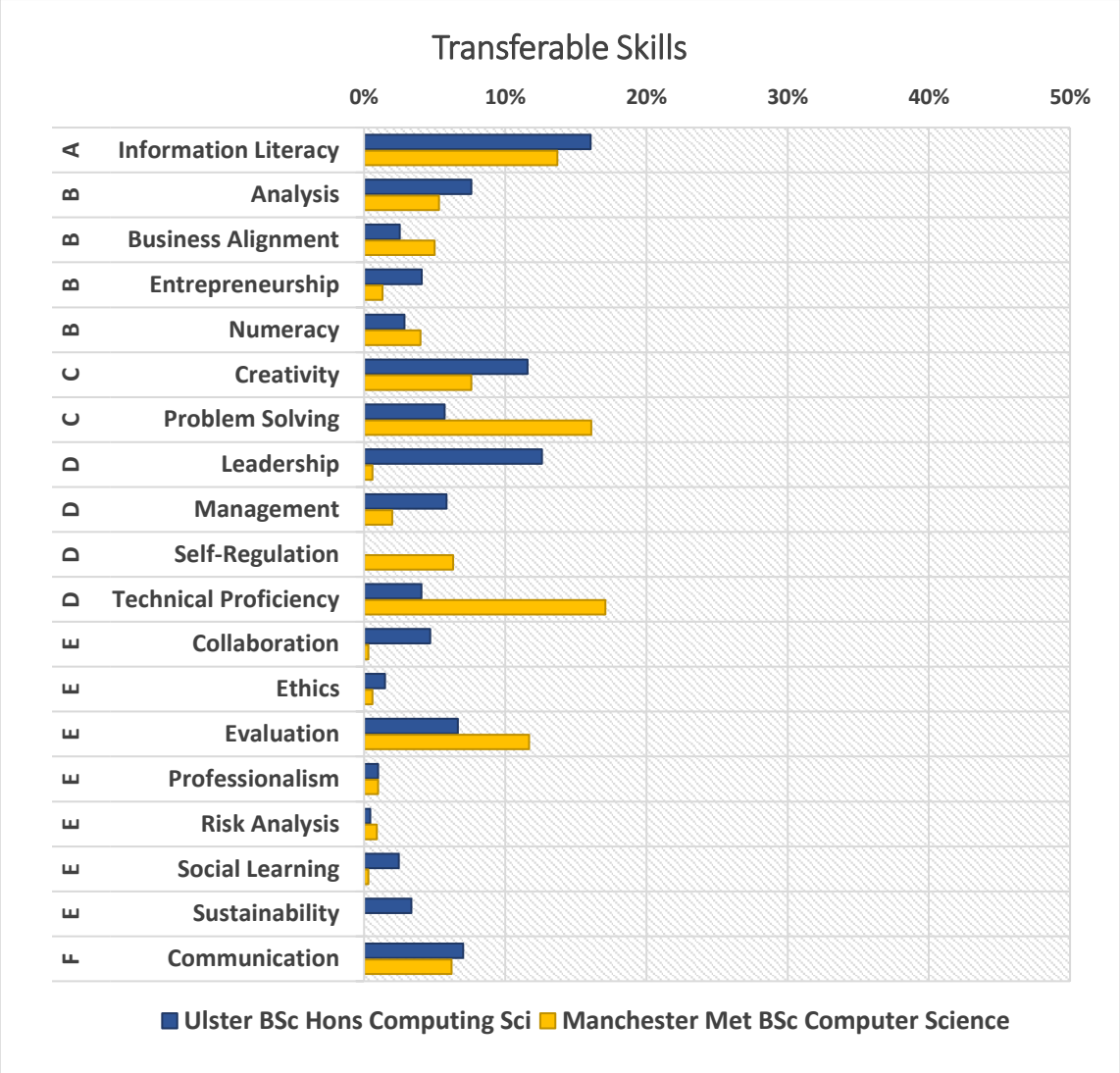


*Figure 59 - Comparison of transferable skills on undergraduate "comp sci" courses*

The comparison with Lightcast data highlights some general points regarding learning outcomes and job postings. In particular, for subject-specific skills *Innovation*, *Self-Reflection* and *Technical Writing* are specified in learning outcomes but not in job postings, however this difference is not necessarily a problem as degree programmes seek to provide broader preparation as a graduate than simply an aligned job role. For transferable skills, *Leadership* and *Management* could perhaps be combined without a significant loss of granularity. *Social Learning* and *Communication* should be recognised within degree programmes already and perhaps this points to a learning outcomes description issue. More broadly, *Professionalism*, *Ethics*, *Risk Analysis* and *Sustainability* are all areas that are prioritised as important by professional bodies, higher education institutions and employers, but their contribution towards the skills profiles of the courses considered within this report remains limited.

There is also then a philosophical point to consider with respect to the intent of higher education degree programmes and, more specifically, there remains a difference between education and training programmes. For example, it could be argued that in the United Kingdom higher education

programmes are a form of liberal education. When such liberal education was first established in the UK it was noted to have three central discourses:[1]

- Knowledge for its own end
- Knowledge viewed in relation to learning
- Knowledge used in relation to professional skill

Does such a model of liberal education still hold value? Or should the focus on professional skills be extended? Resolving this is beyond the scope of this report, however, the approach adopted does illuminate how knowledge in relation to professional skill is addressed within programmes.

## 4.3. For quality assurance

Quality assurance requires clear and robust ways to check for quality. In this case, the quality to be assured is that which enables learner-earners to best develop and for teachers and employers to best understand that development. Current approaches in relation to learning outcomes, as highlighted in this report, tend to focus on things that can be easily assessed rather than things that should be developed. If we are seeking quality enhancement opportunities within higher education, we, therefore, need to better understand how varied capabilities can be developed and how learner-earners can be best supported to develop the workplace competencies that employers seek. Programme documentation guidance, where available, tends to focus on how best to develop learning outcome descriptors but rarely considers clear definitions of skills, capabilities and competencies. It also tends to focus on individual modules at the expense of programme-level outcomes. If badges and micro-credentials are to be better accommodated within higher education, there needs to be much greater clarity on how this can be done. This report hopefully represents a useful initial step in achieving this.

Another benefit of this approach is that skills gaps can be more easily identified and reflected upon. Providing choice could lead to a lack of coherent learning and impact negatively on performance. However, by granularizing the curriculum, the component parts can be better understood and combined, with more opportunities to address gaps as they become more visible. By comparing with future job roles, for example, skills mismatches can be identified and addressed and skills development opportunities can be provided whilst still studying.

## 4.4. For assessment

Many skills are challenging to assess by traditional assessment mechanisms such as examinations or essays and instead would tend to require authentic assessments that would enable learners to evidence the expected knowledge, skills and dispositions. Again, this suggests a move to more formally considering skills, capabilities and competencies within higher education studies. By freeing up programme designers and learners to include a wide variety of learning evidence and activities within assessment, and learning more generally, and by moving away from focusing only on learning

[1] Collini, S., (2012). What are universities for?. Penguin UK.
Newman JH (1886) The idea of a university: defined and illustrated, Longmans Green

that is easy to assess, greater alignment can occur between learner interests and abilities and employer needs. It also provides teachers with a much clearer understanding of the types of learners and learning that occur within their courses and how these relate to future career opportunities for these learners. Rather than increasing assessment burden, such an approach can, as shown in this report, reduce the number of assessments whilst simultaneously repurposing and expanding the types and authenticity of assessments.

## 4.5. For personalised learning

Perhaps the most important benefit of the approach outlined in this report is that it facilitates more lifelong and lifewide learning. Learner-earners can understand their own development better and make more informed learner-earner choices. Clearly opening up higher education to more personalised learning pathways is not without its challenges, but like badges and micro-credentials, it presents huge opportunities to improve the learner-earner experience and through this improve both education and employment outcomes.

One challenge with such an approach is subject content. If skills profiling opens up different programming language options, for example, course coherence could be lost and additional support might be required for those undertaking options which make studies at their next learning level more challenging. Broader and deeper experience of programming would have been gained if they are successful, but they may find it harder to be successful. Providing extra choice and flexibility for learners should therefore be introduced gradually. This challenge also provides opportunities though. Greater awareness of learning and skills development, together with broader assessment and learning options, can enhance both performance and motivation. Currently learners are often repeatedly rewarded or punished for certain types of learning and assessment and providing different routes to achievement can help address this issue. Where key subject content is required, these constraints can still remain within programmes of study whilst opening up opportunities across the remainder of the course.

Finally, there are significant challenges within current higher education in both developing and measuring competencies. Competency requires learning to be applied within a context. Often in higher education this occurs within placement provision, but as we have already seen a learning outcome approach (based on development of capabilities) doesn't tend to work well with recognising competencies. One significant employment benefit from the skills profiling approach described in this report is that learner-earners can better understand their competencies whilst still learning and apply this understanding to deepen or broaden their competencies ahead of graduation. This approach means they understand themselves better as a learner-earner and can communicate this better to employers, but it also means they are better able to manage their future learner-earner journey where they can develop and adapt their competencies to meet their current and future aspirations. Badges and micro-credentials, alongside MOOCs, professional training, non-formal and informal learning and workplace development can all be better aligned through a skills profiling approach and ultimately this means that in learning and in earning, individuals can match what is asked of them and better prepare themselves for what is needed from them. The result is a more effective, productive and rewarding learner-earner journey for all of us.

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