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Exploring graduate and employer perceptions and expectations of the support provided for the learner-earner journey and mechanisms to bridge the digital skills gap

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Executive Summary

This report examines recent graduate and employer perceptions regarding support for the learner-earner journey, with a particular focus on skills gaps. It was a collaborative project between the computing departments in seven UK universities. It reports on workshops with students, graduates, and employers to gather insights. The document details the methodologies employed, including a "Futurespective" approach to visualising an idealised version of the learner-earner journey and a skills gap analysis based on SFIA (Skills Framework for the Information Age) behavioural factors and skills profiles. Furthermore, it presents case studies of successful university practices designed to enhance graduate employability. The report concludes by offering six recommendations regarding potential next steps to bridge the identified skill gaps and better prepare students for the professional world.

Introduction

The topic of how universities can support graduates in obtaining professional employment is of global interest, and numerous attempts have been made to measure and evaluate approaches across multiple disciplines. Many factors can influence the success of graduates in obtaining employment (Clarke, 2018), including:

- Human capital, which includes skills (technical and professional), work experience and work-integrated learning
- Social capital includes social class, social networks, status of university, etc
- Individual attributes and behaviours, which include career-building skills and career self-management. Career building can be viewed as a process of securing employment and then advancing within it. In contrast, self-management is understood as recognising the abilities, attitudes, and values desired by a specific employer and employers more generally.
- Adaptability/flexibility/resilience, including handling uncertainty and setbacks, ambiguity and being adaptable to change
- Labour market factors that will vary by geographic location and may be supply side (lots of competing graduates of some disciplines) or demand side (some skills are in higher demand than others)

In recent years, reports have emerged of skill gaps between the expectations of employers and the skills demonstrated by graduates globally (Winberg *et al.*, 2020; Raj *et al.*, 2022). In the computing discipline and STEM disciplines, more broadly, considerable work has been undertaken to address this issue, in part in response to related government reports (Shadbolt, 2016; Wakeham, 2016). These skill gaps are evidenced by higher-than-ideal graduate unemployment, graduate underemployment (i.e., graduates completing roles that non-graduates can typically access), and graduates lacking work readiness. These issues are presented in disciplines more broadly, as reported in the Institute of Student Employers' 2025 survey (Moss, 2025), which raises perceived issues related to work readiness, human skill development, and some technical skills. The Pearson Skills Outlook: Power Skills (Pearson plc, 2025)), which is derived from an analysis of a large set of online job advertisements, highlights that while technical skills remain in high demand, the most sought-after skills are human skills.

The 2023 UK Teaching Excellence Framework (TEF) exercise highlighted the importance of professional skills in their destination and progression metrics. Employment has been much disrupted in recent years, firstly by the COVID-19 pandemic, which has led to a growth in virtual and hybrid working in many employment sectors, including digital. Secondly, the release of ChatGPT and other generative AI and AI technologies is predicted to have a significant impact on employment for many. AI is transforming the computing profession at a rapid pace(Kelly, 2025) and may have a similar profound impact on other fields (e.g. Law (Muscavage, 2025)).

Regarding the skills and abilities that graduates can evidence, there is a push towards competency. The QAA Computing subject benchmark statement (QAA, 2022) cross-references the ACM/IEEE curricula guidance (CC2020 Task Force, 2020), which recommends adopting a competency-based approach. In this work, we will utilise the Skills for the Information Age (SFIA) framework. The international standard, ISO24773, defines Competency as:
”Competence involves the ability to apply knowledge and skills [...] to achieve a successful result on an ongoing basis [...] apply[ing] sound judgement, mak[ing] correct decisions, apply[ing] the appropriate skills and knowledge and mak[ing] use of relevant professional

attributes." (ISO, 2019). The SFIA model adopts the IS024773 definition (The SFIA Foundation, 2025). Demonstrating competence in the SFIA model requires the repeated application of professional skills and attributes in a real-world context. Competency is increasingly expected as part of various accreditation regimes. For example, with effect from the 2024/5 accreditation cycle, the Royal Society of Chemistry changed from, "Students must develop a range of practical skills" to, "Students must be competent in a range of practical skills" (Royal Society of Chemistry, 2025), and are specifically looking at how universities can show that students are actually competent in the key practical skills. The embedding of competency in accreditation for the computing discipline has been debated (Raj et al., 2022), and the Institute of Coding proposed one potential approach for the UK, based around the SFIA framework (Bowers *et al.*, 2023).

Four guiding questions steer this project:

1. How do employers, students, and graduates envision an idealised learner-earner journey? (See - A Futurespective Approach to Identifying How to Support Students Transition into Employment)
2. What (if any) are the perceived gaps between the digital skills possessed by recent computing graduates and the skills needed in the workplace, from student, graduate and employer perspectives? (See - Behavioural Factors
3. What (if any) are the perceived gaps between the behavioural attributes possessed by recent computing graduates and the skills needed in the workplace, from student, graduate and employer perspectives? (See - Technical Skills Gaps)
4. What teaching, learning, and assessment practices support the pursuit of professional employment or are applicable thereafter? (See -Case Studies)

This project reports on the outcomes of workshops with employers, graduates, and students at six UK universities, exploring perceptions of learner-earner journeys and digital skills gaps. It also documents and critically reviews case studies that provide institutional and sectoral insights into the mechanisms that support the learner-earner journey and evaluates the effectiveness of the teaching and assessment mechanisms designed to develop digital skills. The focus is on factors that universities can influence rather than those over which they have no control. The key discipline focus is computer science; however, where possible, this report endeavours to focus on discipline-independent outcomes, with the intention that it will be helpful to a wider audience.

The structure of this report is as follows:

1. Firstly, we will explain the approach adopted to explore stakeholder perceptions (See Method)
2. We will then explore the outcomes of the workshops, considering each significant component in turn, starting with a Futurespective (see A Futurespective Approach to Identifying How to Support Students Transition into Employment), then the human skills (or Behavioural Factors) (see Behavioural Factors) and finishing with the technical skills (see Technical Skills Gaps),
3. We will then present case studies which illustrate how the learner-earner journey will be supported (see Case Studies),
4. We will briefly explore some opportunities for further enhancement that the project has surfaced (see Other issues emerging from the workshops),
5. The report concludes with some high-level recommendations (see Recommendations).

Method

The project addresses the skills gap by exploring the perceptions of students, graduates, and employers. Firstly, the project explores how graduates obtain professional employment. The project then examines the alignment between the competencies acquired through degree study and those required in employment, with a focus on digital skills.

The workshops were delivered online using the Miro platform (Miro, 2025c) and Microsoft Teams (Miro, 2025b). Miro provides a dynamic, collaborative presentation and whiteboarding platform that integrates well with other collaboration tools, such as Microsoft Teams or Zoom (Miro, 2025a). Separate workshops for employers and recent graduates / final year students were held online by each participating institution, but an identical Miro Board was used across institutions. There were only minor differences between the Miro Boards used for the employer and recent graduate/final year student workshops. For example, recent graduates and final-year students were asked questions about what the University had done to help them find a job, but this was not part of the employer workshop. However, overall, the workshops were extremely similar. This approach enabled local analysis of the comments by each participating institution in relation to their own provision and comparison between employer and recent graduate/final-year student perspectives, while allowing the collation of insights gained into a more general set of sectoral outcomes.

The workshops were structured into five essential sections:

1. We introduce the project and what we are trying to achieve, pause for questions, and seek aural consent to participate in the research.
2. We capture *pen sketches* regarding attendees so we can refer to them anonymously in future outputs. In this case, the *pen sketch* includes first name, job title, type of organisation, career specialism, and organisation size.
3. The first part of the workshop is a foresight activity in the sense that it is a systematic attempt to look into the long term. In this, we visualise the ideal transition from studying at University to professional employment. We achieve this by running workshops of experts, namely students, graduates and employers. Exploring foresight by expert workshops is a standard foresight approach. The activity design is the *Catapult Futurespective* (Caroli and Coimbra, 2020). In the *Catapult Futurespective* workshop, participants are asked to visualise the transition from University to professional employment as a giant human catapult (the University) that shoots graduates over mountains (risks/challenges) into Nirvana(employment). The Workshop also addresses the desired *in-air support* to overcome the difficulties and employers' mechanisms to support the transition into the workplace. This playful approach is employed to promote unconstrained thinking. This can be seen in Figure 1
4. We then explore skills gaps regarding professional/soft skills. We use SFIA behavioural factors ((The SFIA Foundation, 2021)) as a model here.
5. We then explore skills gaps in terms of technical skills, using SFIA role families as a basis (The SFIA Foundation, 2023). We focus on the skill families most appropriate for our graduates, i.e., Software Engineering, Information and Cybersecurity, Business Analysis, Technology Infrastructure Platform Support (e.g., classical IT Tech work), Application Support (e.g., support and maintenance for civil service applications or manufacturing systems), Data Science, and Artificial Intelligence.

Figure 1: Human Catapult Futurespective (generated with the help of Microsoft Copilot)

The project has ethical approval from the partner universities. Participants were fully informed about the nature, purpose, and procedures of the study before their involvement. A Participant information sheet provided clear information regarding any potential risks and benefits. Participants were given the opportunity to ask questions. The workshops were recorded, so appropriate consent was obtained for that as well. Informed consent was obtained voluntarily from all participants, with the understanding that their participation was entirely optional. The right to withdraw from the study was clearly communicated, without requiring a reason and without facing any negative consequences.

Workshop Outcomes

The number of participants from which feedback was obtained is summarised in Table 1. Note that it was not possible to run a workshop for recent graduates or final-year students at Abertay. Overall feedback was obtained from 67 participants across a wide range of the UK's higher education sector.

University	Employers	Recent Graduates / Final Year Students
Abertay	3	-
Bath	1	4
London Met	7	17
Northumbria	6	6
Ulster	9	4
Warwick	5	5
Total	**31**	**36**

Table 1: Summary of Workshops

In the following sections, we will consider the outcomes of the three main sections of the workshops in turn

- A Futurespective Approach to Identifying How to Support Students Transition into Employment
- Behavioural Factors
- Technical Skills Gaps

A Futurespective Approach to Identifying How to Support Students Transition into Employment

As part of the Futurespective workshop, participants were asked to consider four questions:

- What can Universities do to support graduates moving from university to the workplace?
- What risks and challenges do graduates face in moving from university to employment?
- What can help graduates overcome the risks and challenges of moving from university to the workplace?
- What can employers do to support the graduates moving from university to the workplace?

The responses to each of these questions are discussed below.

What can Universities do to support graduates moving from university to the workplace?

The range of feedback to this question was diverse, covering the following broad themes:

1. Develop non-technical skills
2. Provide opportunities for real work experience

3. Provide students with a deeper understanding of job roles/specialisms
4. Support for career planning
5. Provide the educators opportunities to gain industry experience
6. Technical skills

Notably, the volume of comments by employers linked to the development of technical skills theme was very limited, with only a few general comments being made, such as ensuring students were exposed to open-source approaches. However, recent graduates / final year students made proportionately more comments on this theme than employers (23.7% vs 12.2%). The employer focus was much more on the general work environment, as reflected by the proportion of responses related to the first 3 of the above (65.6% versus 35.6% for recent graduates / final year students).

This feedback could suggest that existing programmes are largely delivering the required technical skills (given the limited employer comments relating to this aspect), but that a greater focus is needed on developing a much deeper knowledge and understanding of the work environment and context.

It is also worthy of note that several of the participating institutions, recent graduates / final year students provided many comments relating to the need to support career planning. However, for institutions that had a focus on placement, which incorporates an intentional element of placement preparations as part of the curriculum, the number of similar comments was greatly reduced, indicating they perhaps felt better prepared in this regard.

A summary of the dispersion of comments is shown in Table 2.

Theme		Abertay	Bath	London Met	Northumbria	Ulster	Warwick
1	Develop non-technical skills	15.4%	13.6%	17.2%	24.2%	17.9%	33.3%
2	Provide opportunities for real work experience	23.1%	22.7%	13.8%	21.2%	25.0%	4.2%
3	Provide students with a deeper understanding of job roles/specialisms	15.4%	13.6%	17.2%	15.2%	14.3%	12.5%
4	Support for career planning	23.1%	9.1%	37.9%	24.2%	10.7%	29.2%
5	Provide the educators opportunities to gain industry experience	7.7%	0.0%	10.3%	0.0%	21.4%	0.0%
6	Technical skills	15.4%	40.9%	3.4%	15.2%	10.7%	20.8%

Table 2: Dispersal of all comments against themes - What can Universities do to support graduates moving from university to the workplace?

What risks and challenges do graduates face in moving from university to employment?

Whilst expressed differently, the feedback around risks and challenges did reflect and align with the comments in the previous section. Risks and challenges identified included:

1. Moving from theoretical to practical application
2. Lack of understanding of the workplace culture
3. Moving from individual learning to adopting a teamwork approach

4. Working to tight timescales and budgets
5. Understanding business terminology
6. Support for career planning
7. Better onboarding planning

The majority of these reflect the lack of actual real work experience with which many students progress into employment following graduation. It could therefore be argued that the feedback reflects the importance of incorporating an extended period of real work experience as part of a student's overall educational journey. Short-term placements of a few days or even a couple of weeks, whilst helpful, are unlikely to give students time to develop the required level of understanding of the workplace context.

Themes 1, 2 and 6 were the predominant areas of focus for both employers (67.5%) and recent graduates / final year students (83.3%). Teamworking and working to timescales and budgets (themes 3 and 4) were less prevalent (20.5% for employers, 13.0% for recent graduates / final year students) within the responses, suggesting that widely adopted approaches of embedding groupwork within degree programmes and having submission deadlines for assessments may be effective at helping students prepare for employment.

Table 3 shows the dispersion of the comments against the themes for this stage of the Futurespective.

	Theme	Abertay	Bath	London Met	Northumbria	Ulster	Warwick
1	Moving from theoretical to practical application	10.0%	20.0%	22.2%	23.3%	33.3%	34.8%
2	Lack of understanding of the workplace culture	10.0%	40.0%	22.2%	23.3%	42.4%	17.4%
3	Moving from individual learning to adopting a teamwork approach	20.0%	20.0%	0.0%	10.0%	9.1%	17.4%
4	Working to tight timescales and budgets	0.0%	20.0%	8.3%	3.3%	6.1%	17.4%
5	Understanding business terminology	0.0%	0.0%	5.6%	0.0%	6.1%	0.0%
6	Support for career planning	50.0%	0.0%	30.6%	36.7%	3.0%	4.3%
7	Better onboarding planning	10.0%	0.0%	11.1%	3.3%	0.0%	8.7%

Table 3: Dispersal of all comments against themes- What risks and challenges do graduates face in moving from university to employment?

What can help graduates overcome the risks and challenges of moving from university to the workplace?

Responses to this question typically fell under the need for:

1. Greater exposure to the industry whilst at university
2. Development of non-technical skills
3. Currency and relevance of technical skills
4. Support for career planning and personal development
5. Supportive workplace environment

In relation to the development of non-technical skills, the potential benefits of volunteering in this regard were also highlighted. This would suggest university approaches that recognise student contributions beyond the curriculum (and which encourage student participation in activities such as volunteering) are of benefit to the student and can support their learner-earner transition.

93.7% of employer comments were linked to themes 1, 2 and 4, with no employers commenting on the currency and relevance of technical skills. This again reflects the need for students to develop an understanding of the working environment. Recent graduate / final year student comments were more evenly distributed across all the themes for this section, reflecting their greater focus on the need to develop technical skills, but also a recognition that they need support to transition to the working context when entering that environment.

Table 4 shows the dispersion of the comments against the themes for this stage of the Futurespective.

Theme		Abertay	Bath	London Met	Northumbria	Ulster	Warwick
1	Greater exposure to the industry whilst at university	0.0%	6.7%	29.6%	28.6%	35.5%	17.4%
2	Development of non-technical skills	0.0%	26.7%	37.0%	32.1%	22.6%	39.1%
3	Currency and relevance of technical skills	0.0%	6.7%	0.0%	0.0%	6.5%	8.7%
4	Support for career planning and personal development	100%	46.7%	33.3%	21.4%	35.5%	8.7%
5	Supportive workplace environment	0.0%	6.7%	0.0%	17.9%	0.0%	26.1%

Table 4: Dispersal of all comments against themes - What can help graduates overcome the risks and challenges of moving from university to the workplace?

What can employers do to support the graduates moving from university to the workplace?

Comments on this question fell into the following themes:

1. Offer a higher level of interaction with students throughout their programme
2. Provide more placement opportunities and mentors
3. Better onboarding planning
4. Enhancing employer induction to provide greater knowledge of the company and its context
5. Establish a “Grad Community” within the workplace to support those just starting their career

Elements of this feedback reflect similar themes from the earlier questions, focussing on what can be done while students are at university (1 and 2), while other suggestions (4 and 5) emphasised the additional support that employers need to provide within the company. It could be argued that such repetition reflects the importance of these aspects.

Given post-Covid working practices, one particularly interesting comment suggested that it was especially important that the team a graduate was joining were working "in the office" (rather than working from home) when the graduate commenced to enable team dynamics to be built.

Table 5 shows the dispersion of the comments against the themes for this stage of the Futurespective.

Theme		Abertay	Bath	London Met	Northumbria	Ulster	Warwick
1	Offer a higher level of interaction with students throughout their programme	0.0%	40.0%	30.6%	27.8%	33.3%	7.4%
2	Provide more placement opportunities and mentors	30.8%	10.0%	19.4%	19.4%	15.6%	14.8%
3	Better onboarding planning	61.5%	40.0%	22.2%	38.9%	26.7%	44.4%
4	Enhancing employer induction to provide greater knowledge of the company and its context	7.7%	10.0%	27.8%	13.9%	11.1%	14.8%
5	Establish a "Grad Community" within the workplace to support those just starting their career	0.0%	0.0%	0.0%	0.0%	13.3%	18.5%

Table 5: Dispersal of all comments against themes - What can employers do to support the graduates moving from university to the workplace?

Overall Reflections on the Futurespective

The feedback across the various workshops held by each participating university shared common themes. Hence, while the numbers participating in each workshop were small, the feedback in totality reflects the sector given the geographical spread across the whole of the UK and the consistency of feedback.

When answering all the Futurespective questions, participants were able to provide multiple answers to each question, so there were sometimes more responses provided to some questions than to others. It is therefore interesting to note that the largest number of responses (29.2%) among employers were linked to the question, "What can employers do to support graduates moving from university to the workplace?" Whilst not hugely above the "expected value" of 25% (given there were 4 questions), the higher rate of responses could reflect an acknowledgment from the industry that they too have a significant role to play in developing their employees of the future. Similarly, 28.4% of recent graduate / final year student comments were aligned to this question, again marginally the largest number.

Across all the questions, the importance of industry engagement (specifically work experience) is clear, but there is also value in students engaging with other "real world" experiences, such as volunteering. The need for employers, universities and the students themselves to all engage in the support of the learner-earner journey is also notable, each with a different role to play. However, those roles need to collaborate and align rather than operate in isolation and hence the concept of "partnership" based on deep and meaningful relationships is key.

The focus on non-technical skills (rather than technical skills) in the feedback stands out and hence it is important that curriculum designers reflect on the overall "balance" of technical and non-technical skills in the programmes they design. Incorporating a greater focus on the development and demonstration of non-technical skills is likely to require different pedagogical approaches to both the delivery and assessment of such programmes and hence presents a significant challenge for the higher education sector.

One question which arises from the data is whether the focus on non-technical skills in the comments received reflects a dilution in the technical skills that students now require to get a job (due to getting specific technical skills training once employed), or that educational establishments have become better at ensuring technical skills are adequately developed and remain current and relevant to the needs of the sector. The latter can be achieved to some extent by much stronger and deeper links with industry where meaningful change is brought about in the curriculum through regular and ongoing dialogue and engagement rather than "random encounters" at the point of institutional revalidation exercises to "tick a box". However, the timescales for developing the curriculum (and the subsequent approval processes) remain problematic in a field which is changing as rapidly as the IT sector.

Whilst there was significant overlap in the content of the comments received for each question, of the four Futurespective questions, the greatest number of comments received from employers related to the question "What can employers do?" This indicates that there is a strong desire on the part of employers to engage and support the sector, not least because without such support, companies may fail to employ the graduates they need in the future, or at best will have to invest heavily in the training of their employees immediately on recruitment. This willingness to support the higher education sector needs to be harnessed through deeper partnerships and co-delivery of the skills needed.

Examples of comments against each of themes discussed above are included in Table 6. Please note that no comments were made by recent graduates / final year students under the theme of "Understanding business terminology" when asked about risks and challenges. Similarly, no comments were made by employers under the theme of "Currency and relevance of technical skills" when asked about what can help graduates.

Themes	Employer Comments	Recent Graduate / Final Year Student Comments
Things universities can do to help students transition to employment		
Develop non-technical skills	Soft Skills e.g. resilience, speaking to people in person (not online), focus	Perhaps some teaching on broader skills that are useful in a corporate environment (a bit boring, but hey, it's useful!)
Provide opportunities for real work experience	Experiential workplace sessions	Provide placement opportunities within the university
Provide students with a deeper understanding of job roles/specialisms	Understand different role/job families	Outline the different parts and roles in tech for students to get involved in and offer pathways based off that as opposed to just coding
Support for career planning	Support career mapping	Information on job opportunities in the tech sector, careers support
Provide the educators opportunities to gain industry experience.	Educators gain more experience of industry	Speak with employers to focus on technologies used in industry
Technical skills	Tech skills - sharing code (projects) with others, deploying technology to production environments, collaborative source control	Learn programming languages that are currently being used within the industry and are popular
Risks and Challenges		
Moving from theoretical to practical application	Struggle to apply learning to real life	Academic skills vs practical skills + industry skills
Lack of understanding of the workplace culture	Understanding the different dynamics of the workplace compared to the study place	No knowledge of workplace culture - how to build relationships within the organisation
Moving from individual learning to adopting a teamwork approach	Learning to cooperate with colleagues and other teams	Agile ceremonies were at first frustrating, as I found them to 'get in the way' of me completing my work. However, after getting used to them I began to appreciate their usefulness. Albeit my thoughts on this matter are still nuanced
Working to tight timescales and budgets	Stronger consequences of not delivering to deadlines	Managing multiple projects / priorities at one time
Understanding business terminology	Navigating business terms	-
Support for career planning	Understanding how the skillset they have applies to the roles they are applying to	Was not always advised on the best modules to take for specific career paths
Better onboarding planning	Pressure to be already prepared for the job. Companies provide	Financial concerns

	technical training, no one is ready from the beginning!	
What can help Graduates?		
Greater exposure to the industry whilst at university	Maybe projects/dissertations that require co-operation with an employer (e.g. as a co-supervisor)	Doing internships helped getting used to corporate culture
Development of non-technical skills	Provide for greater experience in time management and planning across academic-year-long projects	Developing soft skills and appreciating non-technical strengths that I had
Currency and relevance of technical skills	-	Class on use of the command-line/terminal. A highly useful skill that is underrated
Support for career planning and personal development	Mentors and coaches available	Help them to understand that they may not walk into their 'dream role' and that they will have some career hoops to jump through
Supportive workplace environment	Structured organisation inductions	My Line Manager is supportive and nice - does not expect me to be a pro straight away;
What can Employers do?		
Offer a higher level of interaction with students throughout their programme	Align with Universities on soft skills improvement	Meet with final year students in relevant modules to relay the working experience
Provide more placement opportunities and mentors	Offer project or work ex opportunities	Perhaps offer a short one-week placement-like activity at an earlier stage to 'dip your toe in'
Better onboarding planning	Documented, detailed team onboarding	Placement offered 8 week training course, which helped learn new languages/tech stacks that wouldn't be offered in university
Enhancing employer induction to provide greater knowledge of the company and its context	Team being in the office, especially at the start of graduate employment	Employer provided: enough time to get familiar with systems, knowledge transfer sessions, extensive training and shadowing sessions, set realistic deadlines and provided support during probation period and even after
Establish a "Grad Community" within the workplace to support those just starting their career	Build communities around new intake	Kickstart initiative - give grads first year a grad group project to complete - encourages networking and looking outside career stream

Table 6: Example Employer and Recent Graduate / Final Year Student Comments for each Theme

Behavioural Factors

Background and approach

In the second part of the Workshop, we explored skills gaps in terms of SFIA Behavioural Factors (The SFIA Foundation, 2021) with employers, graduates, and students who had completed a year-long industrial placement. Behavioural factors are the expected attitudes and actions that contribute to a person's overall effectiveness in a role. They are not separate skills but rather factors that are necessary when applying professional skills and knowledge. For example, if you are developing software, you will require professional skills and knowledge related to programming. Your effectiveness in exercising that skill is mediated by behavioural factors related to problem-solving, communication (with other members of the development team and potential user groups, etc.), collaboration (with your team), and other factors. These attitudes and actions, in SFIA terms, are behavioural factors. In the literature, they are alternatively described as personal competencies (Prickett *et al.*, 2024), human skills (Rose, Putnam and MacDonald, 2020), personal skills (Fernandez-Sanz, 2009), soft skills (Groeneveld, Becker and Vennekens, 2020), non-technical skills (Groeneveld, Becker and Vennekens, 2020), professional skills (Groeneveld, Becker and Vennekens, 2020), elaborations of dispositions (CC2020 Task Force, 2020) or transversal competencies (Cruz, Saunders-Smits and Groen, 2020). In this project, SFIA version 8 was used (The SFIA Foundation, 2021), as it was the current version at the time the project began.

SFIA version 8 defines five generic attributes (Autonomy, Influence, Complexity, Business Skill and Knowledge). In turn, these generic attributes are composed of eleven behavioural factors (Collaboration, Communication Skills, Creativity, Decision Making, Delegation, Execution Performance, Influence, Leadership, Learning and Professional Development, Planning, Problem Solving). SFIA defines seven levels for the behavioural factors. Not all the behavioural factors are represented at all levels. Level one is entry-level. Level 7 is for experienced and senior professionals. Level 5 is typical for a graduate professional with 3-5 years of work experience. Within this project, we considered level 4 and below as relevant to recent graduates in employment. Each factor and level have a corresponding statement indicating the expectations for someone operating at that level within a given factor. Some of the behavioural factors start at a higher responsibility level than level 1. In this report, we will focus on the behavioural factors that have statements defining responsibility levels 1 through 4.

For example, communication is represented within the Business Skills generic attribute. The related SFIA statements are in Table 7 .

SFIA Responsibility Level	Statement
1	Has sufficient oral and written communication skills for effective engagement with immediate colleagues.
2	Has sufficient oral and written communication skills for effective engagement with colleagues and internal users/customers.
3	Demonstrates effective oral and written communication skills when engaging on issues with colleagues, users/customers, suppliers and partners.
4	Communicates fluently, orally and in writing, and can present complex information to both technical and nontechnical audiences when engaging with colleagues, users/customers, suppliers and partners.

Table 7: Communication represented in Business skills in SFIA (derived from (The SFIA Foundation, 2021, p5.))

Using the SFIA rubrics for behavioural factors, we asked workshop participants to indicate:

1. At which level do employers want recent graduates to be? We termed this the *expected* level.
2. At which level do graduates currently evidence? We termed this the *actual* level.

On the occasions when a participant felt that there was a borderline case between two SFIA responsibility levels, we requested that this is indicated. This was recorded as a ½ value, i.e., if a participant indicated between levels 3 and 4, the recorded level would be 3.5. Additionally, some of the Behavioural Factors are not expressed at lower levels (e.g., there is no statement for levels 1 or 2, etc.). See the example provided in Figure 2.

It then follows that if the actual level is higher than the expected level, then graduates are exceeding expectations; conversely, if the expected level is higher than the actual level, then graduates are falling short of expectations. If graduates are, on average, falling short of expectations, then arguably, there is a skills gap. We can create a measure for this gap by subtracting the *actual* level from the *expected* level.

Gap = expected level – actual level

If the measurement is positive, then a gap is suggested; if it is negative, then graduates are exceeding employers' expectations. One comment from employers on this approach is that there is considerable variety among graduates, as you might anticipate. Various factors contribute to a graduate's human and social capital, so this observation from employers is consistent with the model discussed by Clarke (2018) in the Introduction section. We requested that employers indicate, as accurately as possible, the general case. We asked graduates and students to indicate their responses from a more personal viewpoint (e.g., themselves and their peers).

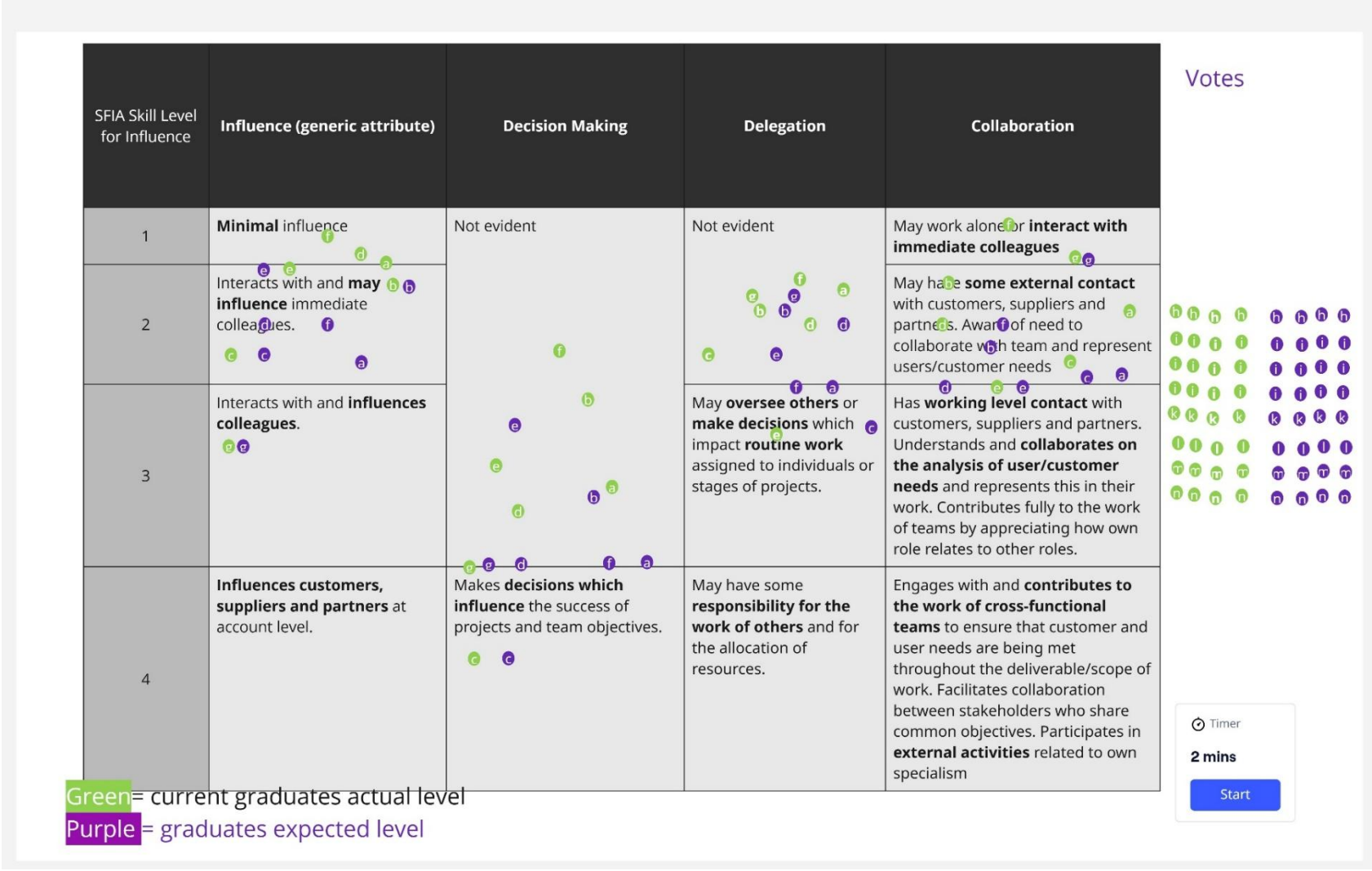

Figure 2: Example board for voting on behavioural factors

Analysis Approach

This section provides a graphical and statistical analysis of the responses. The analysis work was completed using R-Studio (2025.05.1 Build 513) (Posit, 2025). The description of this analysis is structured as follows:

1. A table of the means for actual and expected behavioural factors from the perspective of employers and graduates/students with significant industry experience is provided. This serves to provide an initial high-level summary.
2. Histograms from the employer's perspective. Histograms are provided for the behavioural factors that have responsibilities defined for levels 1-4. We also provide the outcomes for a corresponding t-test, where H0 is that the mean gap is 0. We state the t-value, degrees of freedom, and p-value for completeness. Suppose the t-test produces a statistically significant t-value. In that case, this provides evidence that any trends we observe (e.g., the existence of skills gaps) are also present in the sample (i.e., the universities involved in the study). Furthermore, these skill gaps may also be present in more general cases and may be worth further exploration in different contexts (i.e., other universities).
3. Consideration of the outcomes from the workshops with graduates and students with industrial experience. The outcomes in this case were less conclusive. For brevity, we provide a table related to a set of t-tests where H0 is that the mean skills gap is 0. We then provide the histograms for any statistically significant outcomes.

We are conducting several tests on the sample here. As such, there is a risk of multiple comparison errors. We use the Bonferroni correction (Armstrong, 2014) as a statistical adjustment to address these multiple comparison issues. We are using the 1% significance level. Overall, there are 24 tests. Hence, we use 0.01/24 to obtain the p-value we regard as significant (e.g., 0.000357 or 3.57E-04). Any p-values smaller than 0.000357 we regard as statistically significant at the 1% significance level. Whilst the sample is small, we are reasonably confident that there is evidence of a skills gap on aggregate for these cases. Any p-values larger than 0.000357 we regard as insignificant and could have occurred by chance. There is some variability in all cases, so we are not claiming that all graduates exhibit a skills gap. We are, however, claiming that the outcomes suggest that a significant proportion are quite likely to, and this warrants further investigation. There are more sophisticated approaches to approach this analysis; however, given the size of the data sample, there are potential issues with generalising the outcomes. Nevertheless, the use of these simple statistics provides some confidence that some areas are worthy of further consideration.

Results

Generic Attribute		Behavioural Factor	Range of possible values	Employer	Graduate or Student
Autonomy	Actual	Generic Attribute	1-4	1.935	2.443
	Expected	Generic Attribute	1-4	2.613	2.986
	Actual	Delegation	3-4	2.980	3.033
	Expected	Delegation	3-4	3.148	3.333
	Actual	Decision Making	1-4	2.000	2.800
	Expected	Decision Making	1-4	2.450	2.357
	Actual	Planning	3-4	3.500	3.250
	Expected	Planning	3-4	3.125	3.382
Influence	Actual	Generic Attribute	1-4	1.656	2.529
	Expected	Generic Attribute	1-4	2.516	3.057
	Actual	Decision Making	3.5-4	3.643	4.000
	Expected	Decision Making	3.5-4	3.813	4.000
	Actual	Delegation	2.5-4	3.000	3.211
	Expected	Delegation	2.5-4	3.179	3.682
	Actual	Collaboration	1-4	1.516	2.029
	Expected	Collaboration	1-4	2.306	2.586
Complexity	Actual	Execution Performance	1-4	1.547	2.714
	Expected	Execution Performance	1-4	2.422	2.671
	Actual	Problem Solving	1-4	1.613	2.586
	Expected	Problem Solving	1-4	2.403	2.857
	Actual	Creativity	1-4	1.656	2.271
	Expected	Creativity	1-4	2.547	2.800
Business Skills	Actual	Communication	1-4	1.281	2.357
	Expected	Communication	1-4	2.281	3.129
	Actual	Leadership	3.5-4	4.000	3.929
	Expected	Leadership	3.5-4	3.833	3.846
	Actual	Execution Performance	1-4	1.875	2.271
	Expected	Execution Performance	1-4	2.594	2.743
	Actual	Planning	1-4	1.688	2.557
	Expected	Planning	1-4	2.625	3.171
	Actual	Learning and Professional Development	1-4	1.419	2.586
	Expected	Learning and Professional Development	1-4	2.516	3.014
	Actual	Security, Privacy and Ethics	1-4	1.625	2.457

Generic Attribute		**Behavioural Factor**	**Range of possible values**	**Employer**	**Graduate or Student**
	Expected	Security, Privacy and Ethics	1-4	2.422	2.529
Learning and Development	Actual	Knowledge	1-4	1.532	2.443
	Expected	Knowledge	1-4	2.355	2.771
	Actual	Attribute	1-4	1.597	2.486
	Expected	Attribute	1-4	2.194	2.629

Table 8: Averages for Actual and Expected Behavioural Factors

Note: The provided averages represent the averages of the indicated SFIA levels. For example, in the case of Leadership, which is not expected at SFIA responsibility levels 3 or below, the average rating of the participants who indicated it was at either 3.5 (borderline) or 4 (statement met) is 3.5. In the analysis that follows, we will focus on the behavioural factors that have a range from 1 to 4 and provide a histogram for them.

The means in Table 8 suggest that, on average, for most behavioural factors, there appears to be a gap between the actual level evidenced by graduates and that desired by employers. As you might anticipate, this will vary from graduate to graduate and employer to employer; however, on aggregate, there appears to be a gap, with more expected from graduates than is sometimes evidenced. It is also notable that the values indicated by employers tend to be lower than those suggested by graduates or students with significant industry experience. The report explores these issues in more detail next.

***Note**: for each SFIA behavioural factor under consideration in the following sections, please refer to (The SFIA Foundation, 2021) for a formal definition and the related rubric which defines achievement at each of the different responsibility levels.*

Graphs for Employer Viewpoints

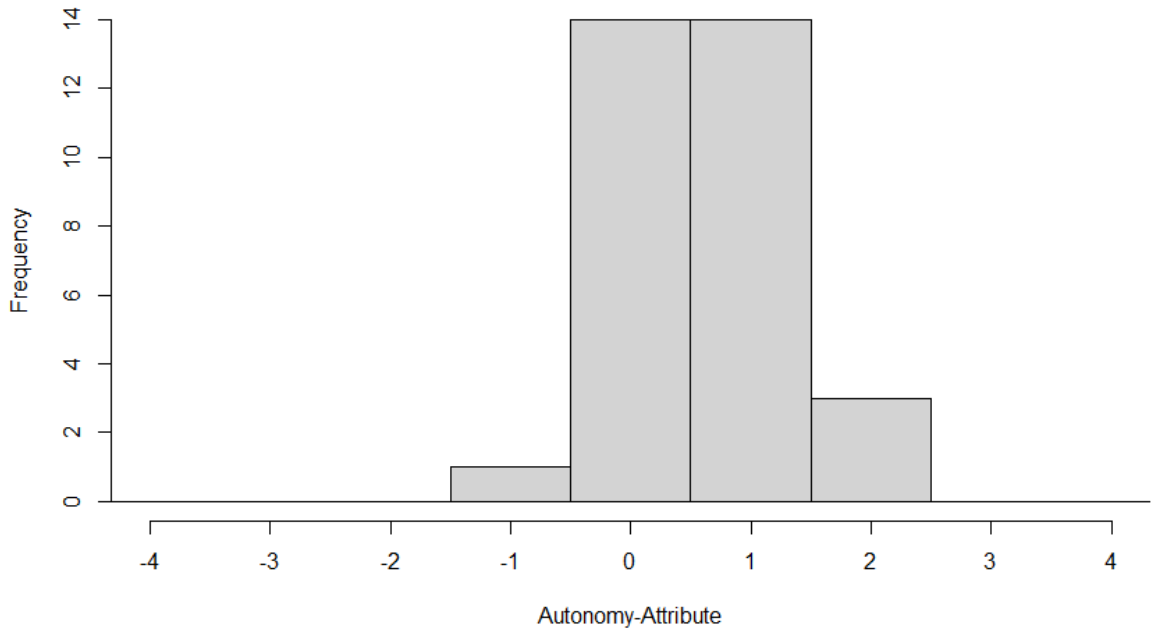

Figure 3: Gap between what employers expect and what graduates/placement students evidence for the attribute Autonomy

The histogram Figure 3 illustrates some variability from the perspective of employers; however, it appears that more employers feel there is a gap than not. Considering the t-test, we have (H0: Mean of gap =0) - mean = 0.65625, t = 5.2983, df = 31, p-value = 9.13e-06. This is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This result again supports the idea that there is a skills gap in terms of autonomy for some graduates.

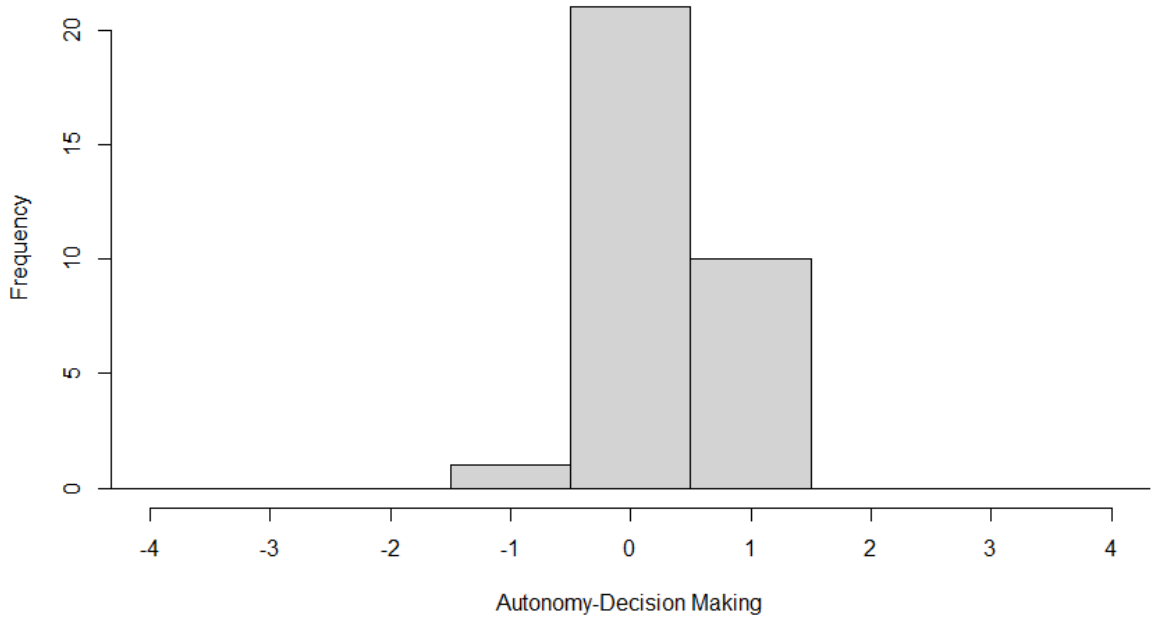

Figure 4: Gap between what employers expect and what graduates/placement students evidence for Autonomy-> Decision-Making

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0)- mean = 0.421875, t = 4.2986, df = 31, p-value = 0.0001583. This is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This suggests that there may be a skills gap related to autonomy->decision making for some graduates.

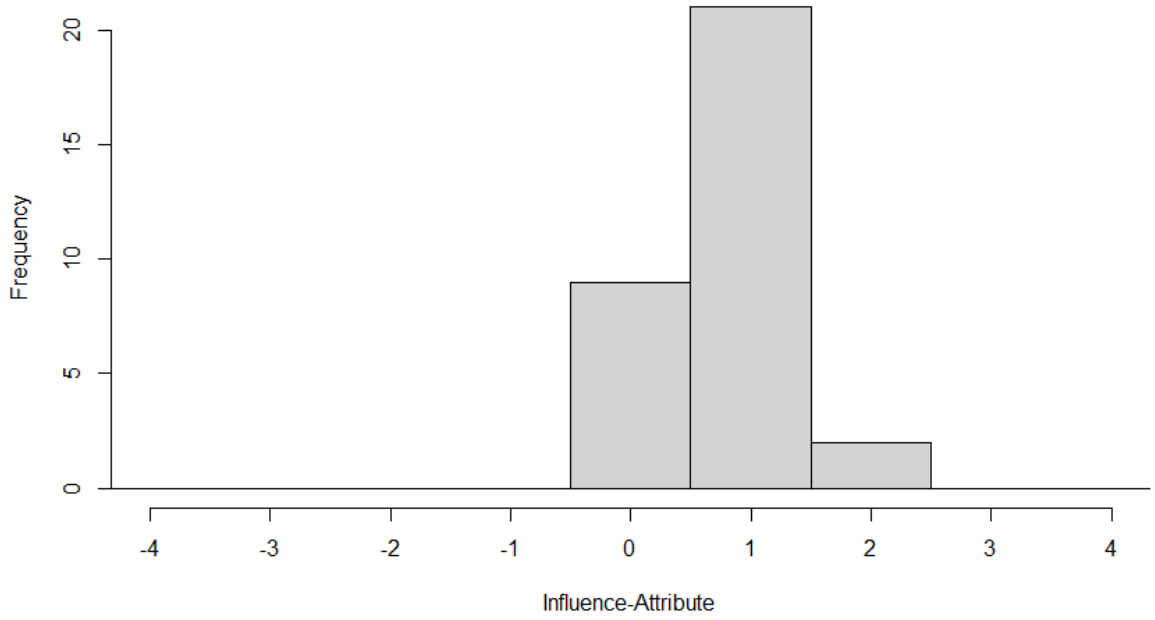

Figure 5: Gap between what employers expect and what graduates/placement students evidence for Influence-Attribute

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) - mean = 0.859375 , t = 9.2205, df = 31, p-value = 2.146e-10. This is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This suggests that there may be a skills gap related to influence-> generic attribute for some graduates.

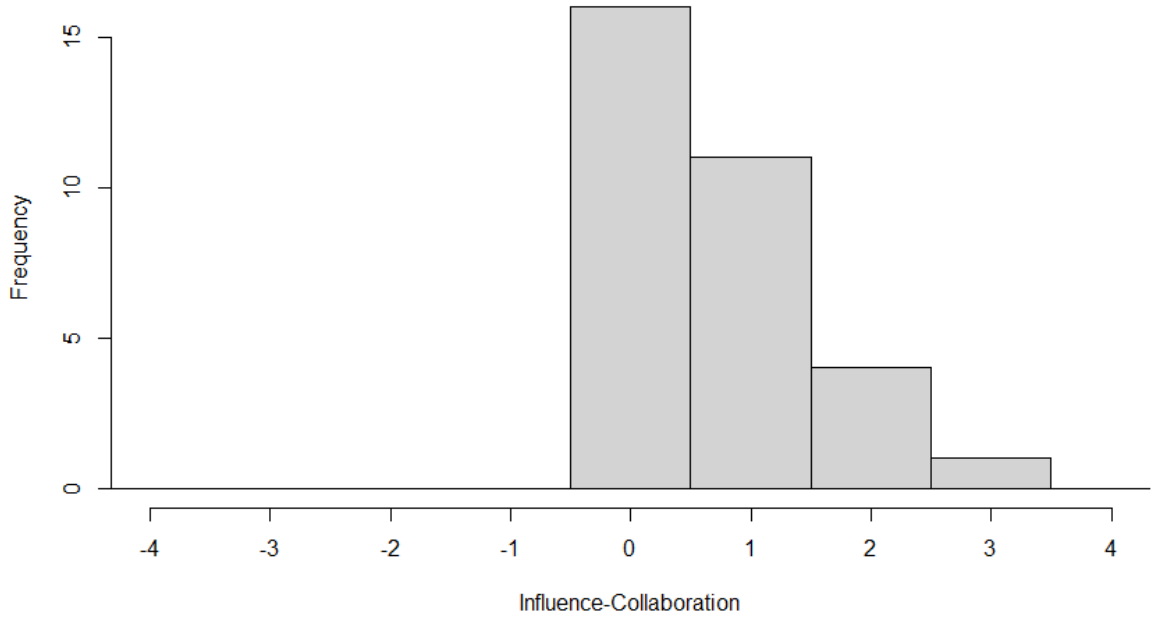

Figure 6: Gap between what employers expect and what graduates/placement students evidence for Influence->Collaboration

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) - mean = 0.765625, t = 5.6076, df = 31, p-value = 3.762e-06. This result is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This suggests that there may be a skills gap related to influence->collaboration for some graduates.

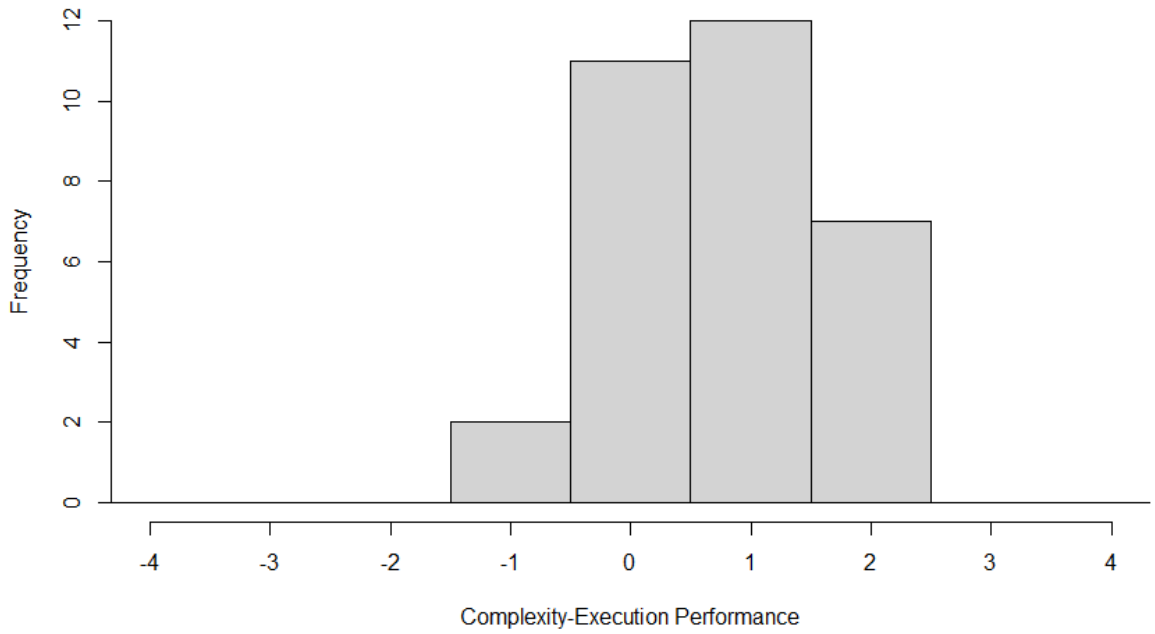

Figure 7: Gap between what employers expect and what graduates/placement students evidence for Complexity->Execution Performance

Execution performance is the SFIA term for the ability to deliver work to the required standards of quality, timeliness, and efficiency, thereby meeting organisational objectives. There are different expectations for this at differing SFIA responsibility levels.

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) - mean = 0.875, t = 5.81, df = 31, p-value = 2.109e-06. This result is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This result suggests that there may be a skills gap related to complexity->execution performance for some graduates.

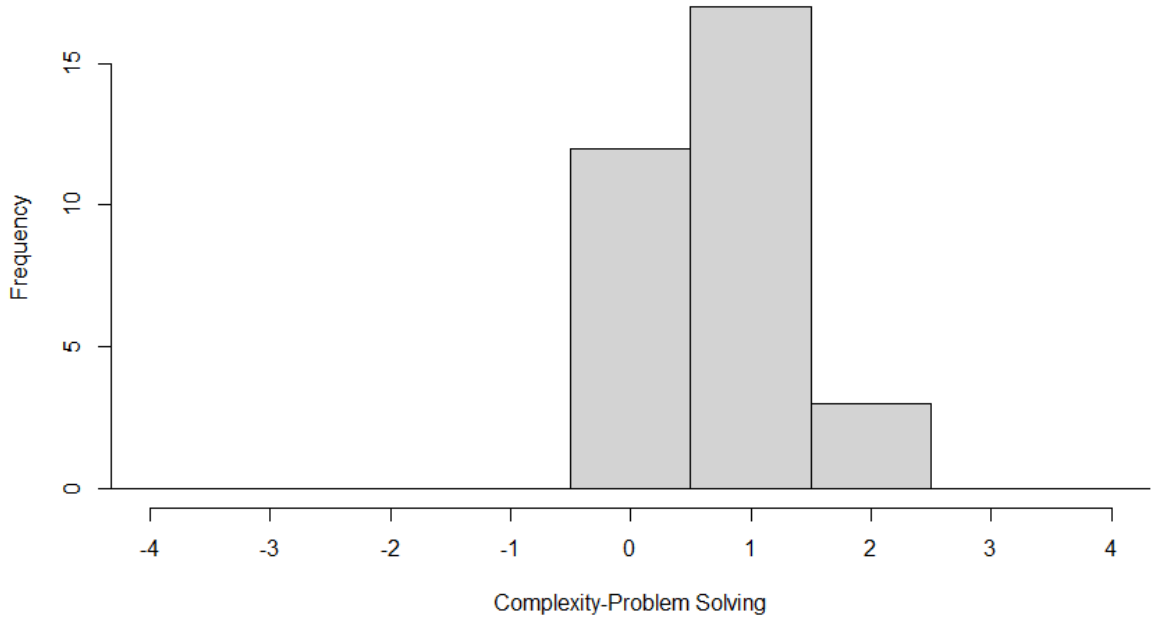

Figure 8: Gap between what employers expect and what graduates/placement students evidence for Complexity->Problem-solving

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) - mean = 0.765625, t = 6.9634, df = 31, p-value = 8.191e-08. This result is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This outcome suggests that there may be a skills gap related to complexity->problem solving for some graduates.

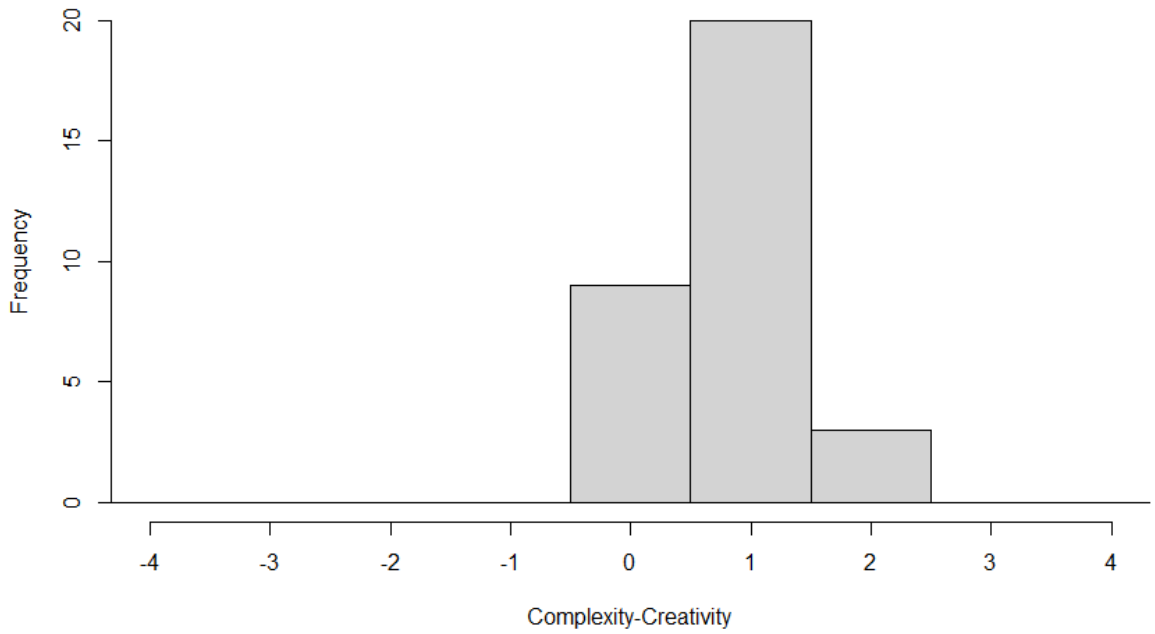

Figure 9: Gap between what employers expect and what graduates/placement students evidence for Complexity->Creativity

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) - mean = 0.890625 , t = 8.9301, df = 31, p-value = 4.447e-10. This result is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This outcome suggests that there may be a skills gap related to complexity->creativity for some graduates.

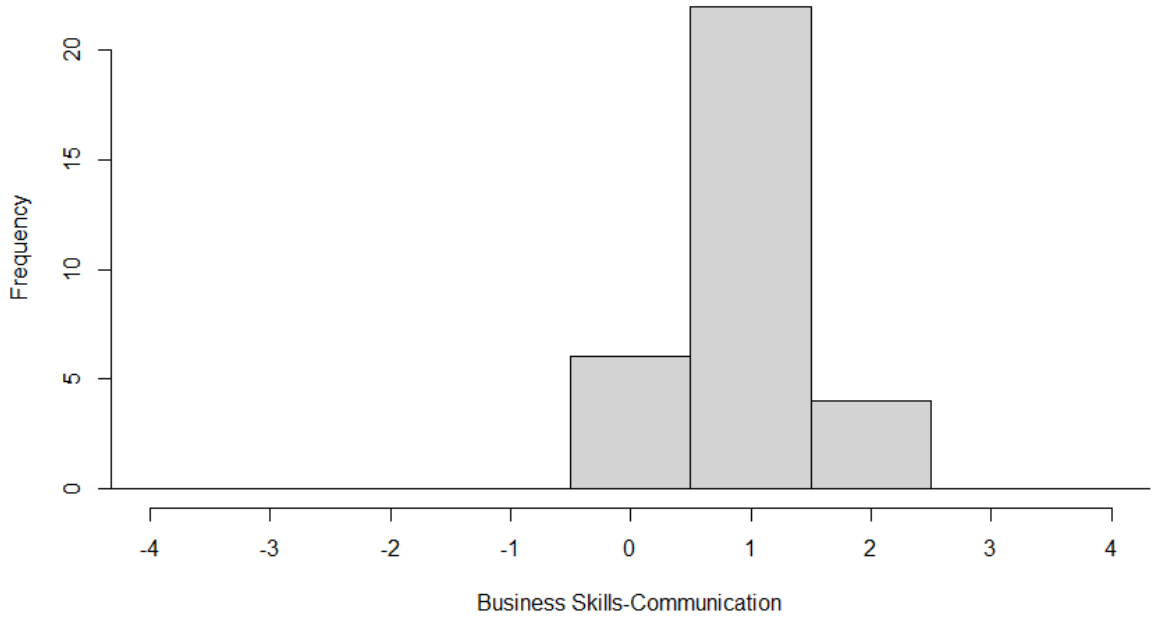

Figure 10: Gap between what employers expect and what graduates/placement students evidence for Business Skills- Communication

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) mean =1, t = 9.0921, df = 31, p-value = 2.957e-10. This result is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This outcome suggests that there may be a skills gap related to business skill->communication for some graduates.

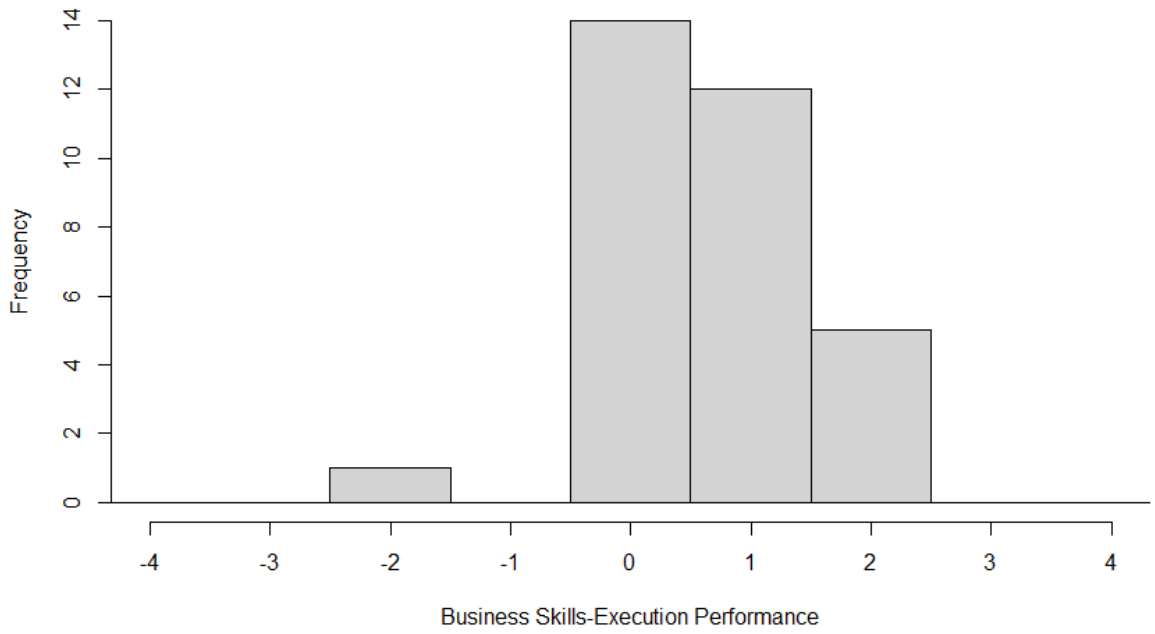

Figure 11: Gap between what employers expect and what graduates/placement students evidence for Business Skills -> Execution Performance

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) mean =0.71875, t = 4.9436, df = 31, p-value = 2.524e-05. This result is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This outcome suggests that there may be a skills gap related to business skill->execution performance for some graduates.

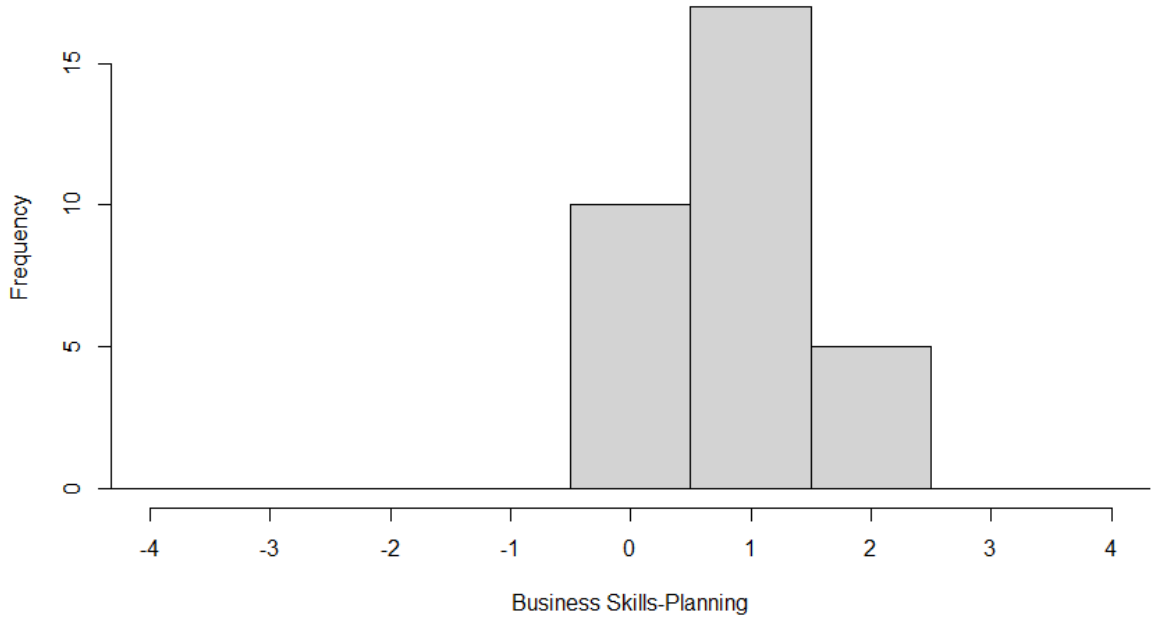

Figure 12: Gap between what employers expect and what graduates/placement students evidence for Business Skills -> Planning

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) mean =0.9375, t = 7.788, df = 31, p-value = 8.686e-09. This is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This outcome suggests that there may be a skills gap related to business skill->planning for some graduates.

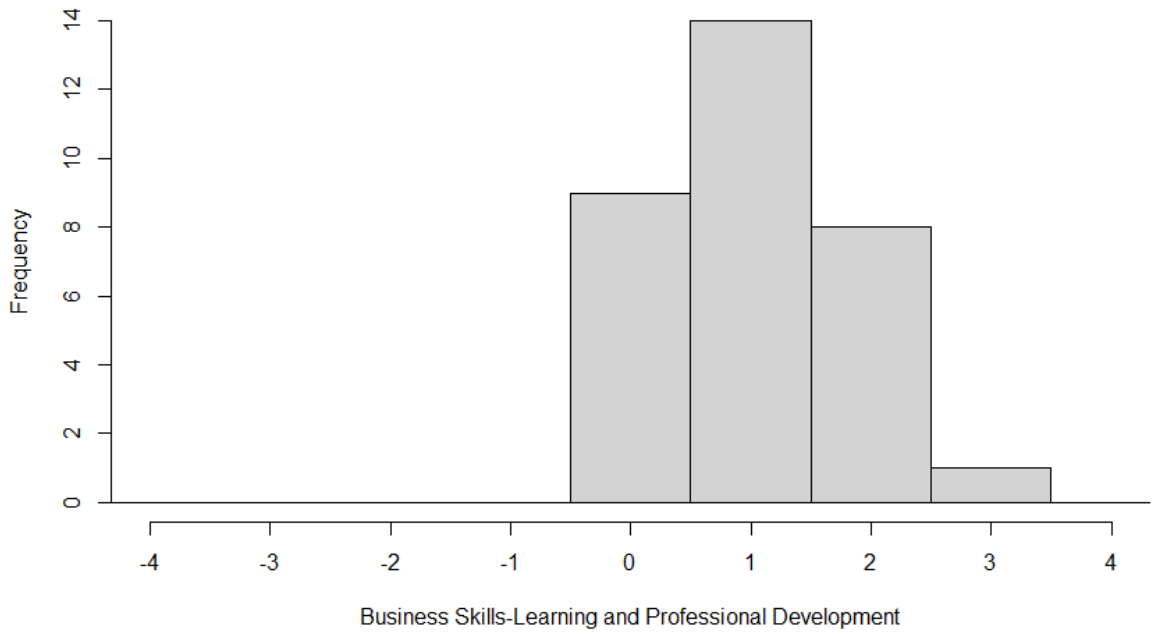

Figure 13: Gap between what employers expect and what graduates/placement students evidence for Business Skills -> Learning and Professional Development

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) mean =1.0625 , t = 7.6026, df = 31, p-value = 1.429e-08. This result is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This outcome suggests that there may be a skills gap related to business skill->planning for some graduates.

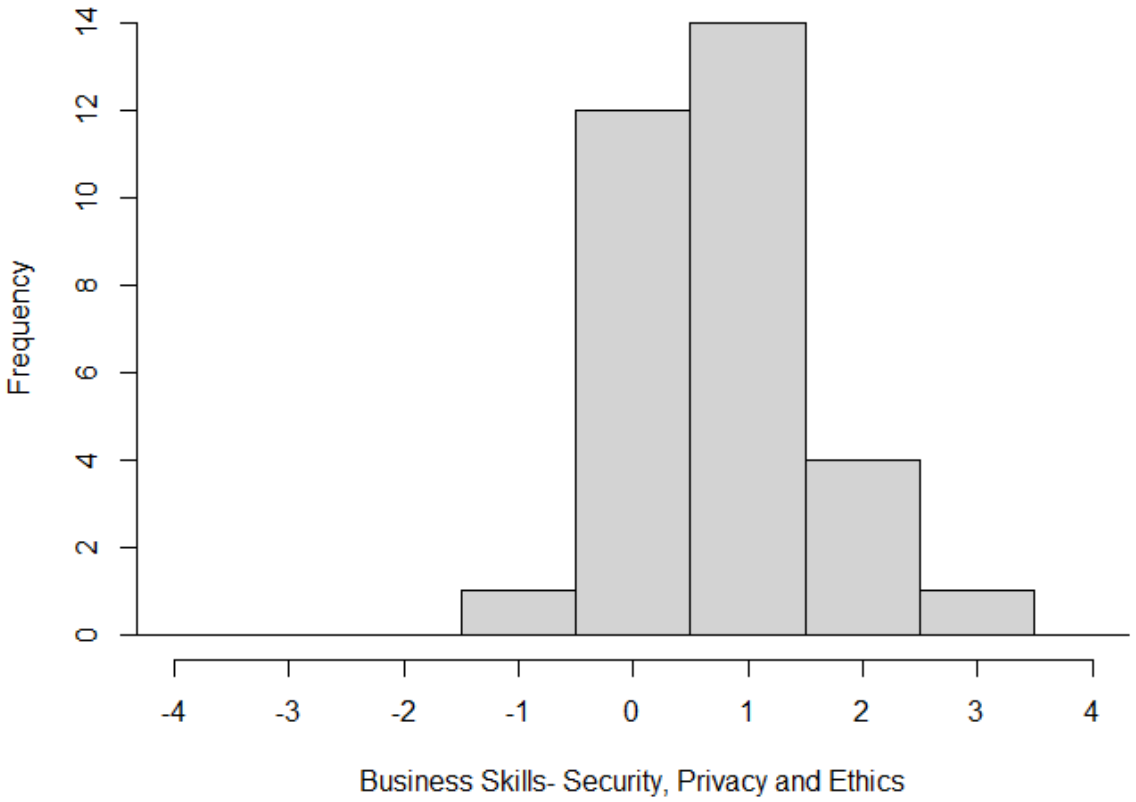

Figure 14: Gap between what employers expect and what graduates/placement students evidence for Business Skills -> Security, Privacy and Ethics

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) mean =0.796875 , t = 5.1852, df = 31, p-value = 1.263e-05. This result is statistically significant against the p value threshold we are considering (0.000357 or 3.57E-04)). This outcome suggests that there may be a skills gap related to business skills->security, privacy and ethics for some graduates.

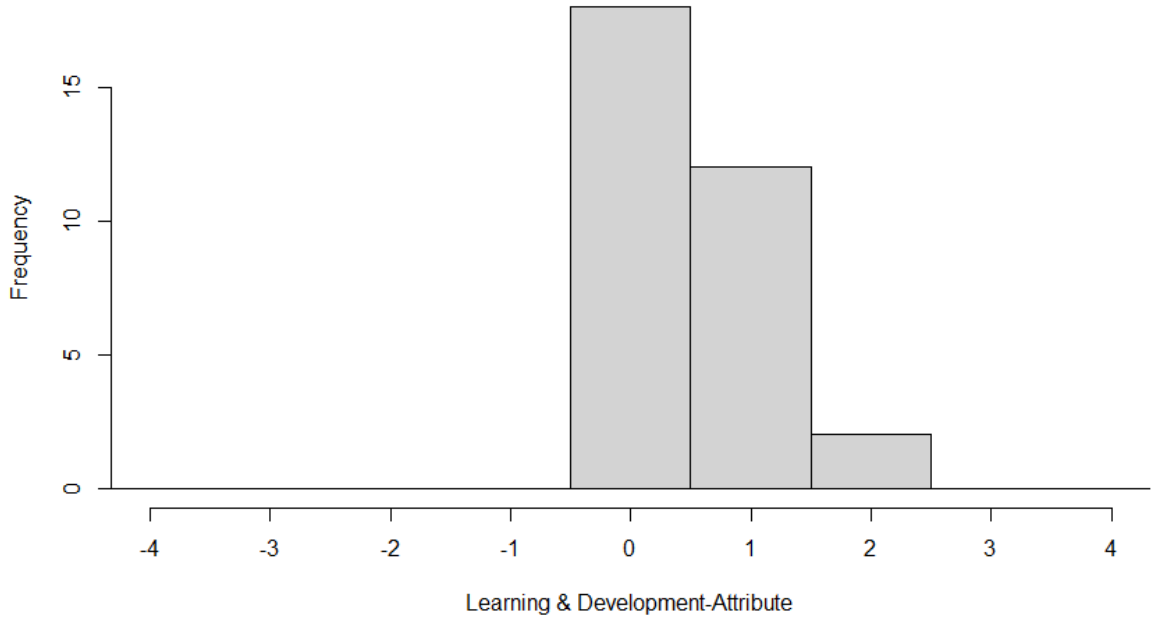

Figure 15: Gap between what employers expect and what graduates/placement students evidence for Learning and Development->Knowledge

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) mean 0.578125, t = 6.9799, df = 31, p-value = 7.825e-08. This result is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This outcome suggests that there may be a skills gap related to learning and development -> knowledge for some graduates.

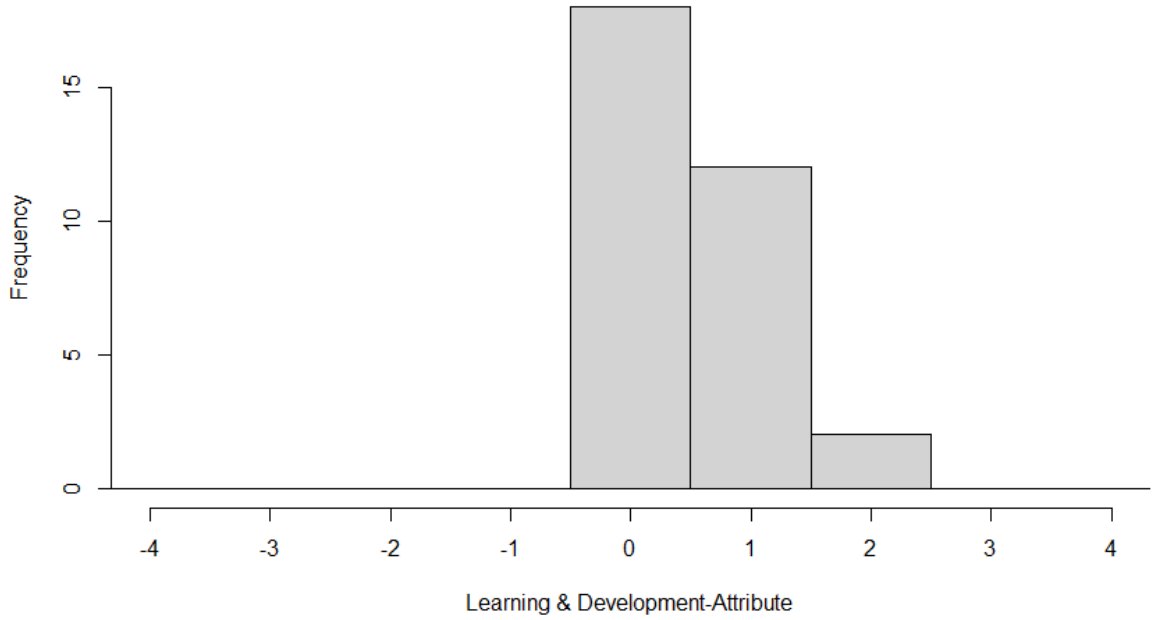

Figure 16: Gap between what employers expect and what graduates/placement students evidence for Learning and Development->Attribute

Again, there appear to be slightly more employers indicating a gap than those who indicate there is not. Considering the t-test, we have (H0: Mean of gap =0) mean=0.578125, t = t = 5.6047, df = 31, p-value = 3.793e-06. This result is statistically significant against the p-value threshold we are considering (0.000357 or 3.57E-04)). This outcome suggests that there may be a skills gap related to learning and development -> attribute for some graduates.

Outcomes from graduate and student viewpoints workshops

Table 9 provides a summary of some of the outcomes from the workshops with (a) graduates and (b) students who have completed a placement. For each behavioural factor, the table indicates the mean and a t-test outcome (H0: mean = 0). The gaps identified in these workshops tended to be smaller than those identified in workshops with employers. Only one of the behavioural factors (i.e., Business Skills-Communication) presented evidence at the 1% level that the mean was not equal to zero, indicating a skills gap from the viewpoint of graduates and students who have completed a placement.

Behavioural Factor	Mean	t-test outcome
Autonomy-Attribute	0.5428571	t = 2.3018, df = 34, p-value = 0.0276
Autonomy-Decision Making	-0.4428571	t = -2.2193, df = 34, p-value = 0.03324
Influence-Attribute	0.5285714	t = 2.704, df = 34, p-value = 0.01062
Influence-Collaboration	0.5571429	t = 3.6074, df = 34, p-value = 0.0009817
Complexity-Execution Performance	-0.04285714	t = -0.21637, df = 34, p-value = 0.83
Complexity-Problem Solving	0.2714286	t = 1.3561, df = 34, p-value = 0.184
Complexity-Creativity	0.5285714	t = 2.7979, df = 34, p-value = 0.00841
Business Skills-Communication	0.7714286	t = 4.5524, df = 34, p-value = 6.486e-05 *
Business Skills-Execution Performance	0.4714286	t = 2.4251, df = 34, p-value = 0.02077
Business Skills-Planning	0.6142857	t = 3.8661, df = 34, p-value = 0.0004745
Business Skills-Learning and Professional Development	0.4285714	t = 2.5708, df = 34, p-value = 0.0147
Business Skills -Security, Privacy and Ethics	0.07142857	t = 0.33203, df = 34, p-value = 0.7419
Learning & Development-Knowledge	0.3285714	t = 1.5287, df = 34, p-value = 0.1356
Learning & Development-Attribute	0.1428571	t = 0.8741, df = 34, p-value = 0.3882

Table 9: The outcomes of T-tests (H0: mean of skills gap =0) for behavioural factors of graduates as expressed at graduate and student viewpoint workshops

For brevity, not all histograms are provided here. However, a histogram is provided for Business Skills->Communication. This behavioural factor appears to be statistically significant (using the Bonferroni correction p value using the 1% significance level (e.g., p of 0.000357 or 3.57E-04 or less)).

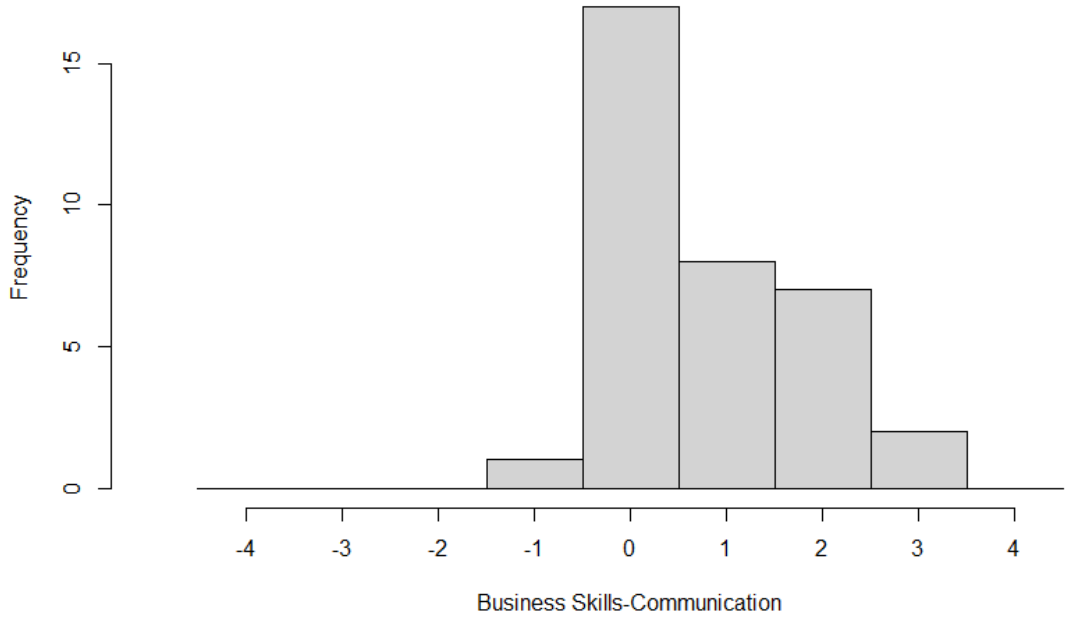

Figure 17: Gap between what employers expect and what graduates/placement students evidence for Business Skills -> Communication (student/graduate viewpoint)

There is some variation here, with some believing they are exceeding their employers' expectations; however, it appears to be an area of development for many.

The lack of gaps perceived by participants at these workshops may be partly explained by the sample involved. The participants are self-selecting, so those with stronger behavioural factors may be more likely to engage in the workshops than those with weaker behavioural factors. The research team's perception was that many high-achieving participants attended the workshops. Equally, some participants may be overrating their abilities, and there is a difference between their self-perception of the behavioural factors and the view of their managers. Alternatively, a larger sample may have provided evidence of statistically significant gaps. It is noteworthy that the perception of the existence of gaps appears to be lower among graduates and students who have completed a placement than it was in discussions with employers.

Discussion of outcomes from the behavioural factors skills gaps analysis

From the perspective of employers

1. There is a variety of views on the skills gaps that exist in terms of behavioural factors. There is also variation from graduate to graduate,
2. However, employers reported there appear to be skills gaps in the following behavioural factors:
    a. Autonomy
        i. The attribute itself
        ii. Decision making
    b. Influence
        i. The attribute itself
        ii. Collaboration
    c. Complexity – in terms of creativity
    d. Business skills
        i. Communication
        ii. Execution performance
        iii. Planning
        iv. Learning and professional development
        v. Security, privacy and ethics
    e. Learning and Development
        i. Knowledge
        ii. Attribute
3. The workshops with graduates and students who had completed a placement also suggested that there might be gaps in business skills -> communication. Hence, that behavioural factor could present a good starting point for further exploration and enhancement.

Employer criticism of graduates' behavioural factors is not new (Clarke, 2018), so this outcome may not be too surprising. However, considering this issue in terms of those expressed in an industrial skills framework (The SFIA Foundation, 2021) presents a more novel perspective. Additionally, this approach may provide scaffolding for identifying which behavioural factors might benefit from promotion within degree programmes and for articulating desirable graduate capabilities.

These potential skills gaps suggest that:

1. Similar outcomes might be replicated at other universities. As such, it is recommended to consider repeating the study at different universities (and potentially other departments) as a mechanism for exploring how well employer expectations for behavioural factors are addressed. This could be achieved through a survey or via a workshop-style activity within employer advisor boards or similar settings.
2. It may be worthwhile considering the practices in the Case Studies section as possible candidates for adoption. Alternatively, other mechanisms that promote the growth of behavioural factors could be developed. Such approaches might include further consideration of work-based learning (QAA, 2018), competency-based assessment (Prickett *et al.*, 2024) or authentic assessment (Prickett *et al.*, 2025).

3. The rubrics provided by (The SFIA Foundation, 2021) present a useful resource that could be used within programme, module, curriculum and assessment design.
4. Exploring whether and how these factors are taught and assessed within programmes may be a productive follow-up to help identify and address any skills gaps.
5. The perceptions of employers concerning the behavioural factors which graduates exhibit, and those employers would like graduates to demonstrate, are worthy of exploration.

Qualitative questions related to Behavioural Factors

To supplement this quantitative work, the workshops also asked the participants several qualitative questions related to behavioural factors. In the workshops for graduates or students with significant experience in industry, we asked the following questions, organised in three sets:

Set 1

- Looking back at your course at university, what personal or professional or soft skills did we help you develop that helped you *find* a job?
- Was there any support you wished for that was not provided?

Set 2

- Looking back at your course at university, what personal or professional or soft skills did we help you develop that helped *in your* job?
- Looking back at your course at university, what support did we provide to help you achieve the skill that was useful within your job?

Set 3

- In terms of professional skills / soft skills / behavioural factors, what do you believe you do well?
- … and what do you believe you could do better?

For employers, we asked the following questions

- What do graduates do well?
- What could graduates do better?

The research team has conducted an open-coding analysis of the responses to these questions as a mechanism to identify the main themes within the responses. The process adopted was:

1. One team member coded the data for a set of workshops they ran.
2. A second team member from a different university coded their responses.
3. The two team members met to consolidate the two coding schemes.
4. Other team members then coded the responses at the other workshops using the established coding schemes. They recorded any items that did not fit with the established coding scheme.
5. The whole team met to discuss the uncoded items. These items were then either coded or the coding scheme was extended by adding a new code. The entire team then revisited the data using the new coding scheme to confirm that all items were coded correctly.

The key themes identified were:

- Communication and presentation skills
- Career development
- Project management and agile practices
- Software and technical skills
- Research and critical analysis
- General support and miscellaneous skills
- Personal development.

In the following subsections, we will consider each of the guiding questions in turn. First, we will consider the results from workshops with graduates or students who have significant industrial experience. We will then consider the results from the employer workshops.

Workshops with graduates or students who have significant industrial experience

Set 1

Looking back at your course at university, what personal or professional or soft skills did we help you develop that helped you find a job?

Responses to this question varied considerably across the different universities. At Northumbria, career development (e.g. “personal workshops with CVs), software and technical skills (e.g. “range of tech skills”) and general support and miscellaneous (e.g. “range of business skills”) were seen as helpful. At Bath, the focus was upon communication and presentation skills (e.g. “network with humans!”). London Metropolitan shared the same themes as Northumbria and Bath. Ulster responses focused on career development and general support (including the “ASD mentor” and “Handshake” initiatives, which are specific to Ulster). At Warwick, communication and personal skills (e.g. “presentations and team work”), project management and agile practices (e.g. “managing a team/project”).

Was there any support you wished for that was not provided?

For this guiding question, again, there was some variation around the key themes. At Northumbria, there was a desire for further specific career development (e.g., “help for exploring different career paths”) and additional curriculum coverage of particular topics (e.g., “more resources for DevOps”). At London Metropolitan there was a desire for further support for communication and presentations skills (e.g. “prepare for the interview”), career development (e.g. “more work placements”), software and technical skills (e.g. “more hands-on experience in some cybersecurity modules”) and personal development (e.g. “looking at what tools are used in the market so that you can self-learn”). At Ulster, communication and presentation skills (e.g. “public speaking skills”), career development (e.g. “breakdown of common business methodologies”), project management and agile practices (e.g. “a mini final year project in the second year”), software and technical skills (e.g. “support for understanding the hardware knowledge needed to settle in the industry”) and personal development (e.g. “perhaps a short 10 credit module on the less flashy parts of being at work (VCS, Terminal, MS Teams, Email Management etc)”. At Warwick, career development (e.g. “mock Interviews”) and software and technical Skills (e.g. “collaboration on GitHub - taught foundations but not how to collaborate on it”) were suggested.

Set 2

Looking back at your course at university, what personal or professional or soft skills did we help you develop that helped in your job?

For this guiding question, again, there was some variation around the key themes. At Northumbria, activities which helped were communication and presentation skills (e.g. “public speaking”), project management and agile practices (e.g. “a group project where we followed through a project end-to-end”), software and technical skills (e.g. “software development”), research and critical analysis (e.g. “critical thinking”) and general support and miscellaneous (e.g. “contact with supervisors”). At London Metropolitan, communication and presentation skills (“team work in group projects”), career development (e.g. “access to various certifications”), software and technical skills (e.g. “up to date software”), general and miscellaneous support (e.g. “teachers with good knowledge”) and personal development (e.g. ”guidance on how to approach this challenge”), were welcomed. At Ulster, this was more targeted, focusing on project management and agile practices (e.g. “use of agile-scrum”) and software and technical skills (e.g. “knowledge acquisition”). Students and graduates at Warwick welcomed communication and presentation skills (e.g. “being able to talk about group work experiences”) and technical skills (e.g., “coding skills helped get through technical interviews”).

Looking back at your course at university, what support did we provide to help you achieve the skill that was useful within your job?

For this guiding question, there were again differences between the universities. At Northumbria, London Metropolitan and Warwick, communication and presentation skills (e.g., “few of the projects had presentations that were delivered to the whole class”) were highlighted. At London Metropolitan, the workshops also highlighted career development (e.g., “access to various certifications”), software and technical skills (e.g., “software tools”) and general support and miscellaneous (e.g., “supportive teachers”). At Ulster, the workshops highlighted project management and agile practices (e.g. “software quality and engineering management module”) and software and technical skills (e.g. “modules that require you to explore a topic or domain that you may not be familiar with.”).

Set 3

In terms of professional skills / soft skills / behavioural factors, what do you believe you do well?

At workshops at Northumbria the participants indicated they felt graduates were good at communication and presentation skills (e.g. “report writing”), project management and agile development (e.g. “team work”), technical skills (e.g. “software development”) and research and critical analysis (e.g. “critical thinking”). Communication and presentation skills were noted at Bath (e.g. “communicate openly”). At London Metropolitan, communication and presentation skills were highlighted again, together with career development (e.g. ”networking skills”), project management and agile practices (e.g. “team work and professionalism”), software and technical skills (several security tasks e.g. “writing scripts for specific forensic analysis tasks”, “ethical Hacking activities and use of the tools”, “forensic analysis with different tools”) and research and critical analysis (e.g. “researching topics and gathering information”). At Ulster, the workshops focused on project management and agile practices (e.g., “working as part of a team on a project”) and software and technical skills (e.g. “being able to pick up multiple coding languages”). At the Warwick workshops, the following issues were highlighted: communication and presentation skills (e.g. “communication and working in a team”) and software and technical skills (e.g. “great level of foundational level knowledge / skills”).

… and what do you believe you could do better?

At workshops at Northumbria the participants indicated they felt graduates could be better at communication and presentation skills (e.g. “interpersonal communication”), project management and agile development (e.g. “leadership”) and technical skills (DevOps broadly, e.g. “DevOps-CICD”, “Git”, “Docker/Kubernetes”, “Containerisation”). At Bath, communication and presentation skills were again identified as areas for development (e.g., “reaching out to others” or “giving constructive criticism”). At London Metropolitan, workshop attendees highlighted communication and presentation skills (e.g. “communication Skills in group projects”), project management and agile practices (e.g. ”team work skills” and “project manager skills”), software and technical skills (e.g. “understand the programming language used by their employer”) and general support and miscellaneous (e.g. “doing a lot of research”). At Ulster, the workshops highlighted communication and presentation skills (e.g. “doing a presentation, not many modules require one in front of people”), project management and agile practices (e.g. “leading a project”, “The importance of testing”, “The importance of documentation”), and general support and miscellaneous (e.g. “problem solving”). At the Warwick workshops, the following issues were highlighted: communication and presentation skills (e.g. “dealing with external clients”) and software and technical skills (e.g. “some knowledge more traditional – e.g. DB vs cloud computing /infra, PRINCE2 vs agile/Jira”, “Unfamiliar with HDL (System Verilog)”, or “Expect to use GPT / gen AI in my role”).

Summary

It is interesting to note that, in terms of what graduates think they can do well and could do better, these areas are often thematically similar; however, there appears to be a desire for further development. For example, they recognise that they have developed their communication and presentation skills but feel the need to enhance those further. The support offered appears to be well-received by the graduates and students involved in the study, but there is a desire for further opportunities. This is encouraging; however, it again highlights that further enhancements are possible. Some of the differences in the commentary highlight the distinctions between using technology in a classroom environment and applying it in a real-world setting. That trend may help highlight further use of work-based learning (QAA, 2018) and/or authentic assessment (Prickett *et al.*, 2025) and competency-related assessment (Prickett *et al.*, 2024) as a productive way forward.

One of the challenges here is that much of the additional support desired is already available at the universities in the study. However, it is understandable that graduates may not have the availability to engage in co-curricular activities due to work and other commitments. Maybe, embedding support within the curriculum is a potentially productive approach.

Workshops with Employers

What do graduates do well?

At the Northumbria workshop, attendees indicated that graduates tended to do well with technical skills (e.g. “open to learning more technical job-related skills and learn quickly”, “tend to be open to learning opportunities”) and personal development (e.g. “positive and energetic attitude", “learn quickly”, or “hungry to develop new skills”). At Bath, the workshop highlighted communication and presentation skills (e.g. “active listening”) and personal development (e.g. “enthusiastic”, “willing to learn”). At London Metropolitan, the attendees highlighted communication and presentation skills (e.g. “seek social connection with team”), software and technical skills (e.g. “tech skills that were acquired in academia” and “eager to learn new skills") and personal development (e.g. “enthusiasm and Inquisitiveness”). At Ulster, things graduates were seen to do well included communication and presentation skills (e.g. “ask questions and seek clarity”), project management and agile practices (e.g. “agility”), software and technical skills (e.g. “digital literacy”) and personal development (e.g. “enthusiasm and motivation” and “fresh perspective”). At the Warwick workshops, the following themes were highlighted: communication and presentation skills (e.g. “communication”), software and technical skills (e.g. “generally very technically good”) and personal development (e.g. “enthusiasm” and “keen to learn”).

What could graduates do better?

At the Northumbria workshop, attendees indicated that graduates could do better with communication and presentation skills (e.g. “defaulting to verbal communication rather than keyboard wars”, or “communicating – thinking about their audience”), career development (e.g. “have better problem solving skills”), project management and agile development (e.g. “adapt to work in a team”) and personal development (e.g. “behaviour can sometimes be a problem such as not paying attention, being late”). At Bath, the workshop highlighted communication and presentation skills (e.g. “ask more questions”) and personal development (e.g. “take more initiative”). At London Metropolitan, the attendees highlighted communication and presentation skills (e.g. “communication of work progress with others that are depending on that task being completed”, “communicate with staff that 'outrank' them” and “report frequently and speak up early in front of difficulties/problems”), career development (e.g. “be more patient to understand problems and learn new skills”), project management and agile practices (e.g. “collaboration”), software and technical skills (e.g. “automation” or “documentation") and personal development (e.g. “adapt to work culture” and “understand that things can take long time to change”). At Ulster things that could be better include communication and presentation skills (e.g. “ask more questions”, “presentation skills”, “communication” and “listening”), project management and agile practices (e.g. “working as a team”, “managing their time”, and “prioritising”) and personal development (e.g. “understand how real life works”). At the Warwick workshops, personal development was the core theme highlighted (e.g. “compromise”, “self-reliance”, and “it’s not all about me- it's about the team”).

Summary

Firstly, it is notable that the employer's viewpoint is not as positive as that of the graduates or students with industry experience. This echoes the outcomes we discussed earlier related to the quantitative view of behavioural factors. Secondly, apparent gaps are being expressed, with employers welcoming some aspects of the graduates' skill base but seeking further development of some of their other skills.

On the positive side, it's great to see enthusiasm and a willingness to learn being welcomed. However, less positively, there again appears to be some aspects related to behavioural factors or the experience and expectations of the world of work more broadly that could benefit from being considered more completely within degree programmes. It may be worthwhile considering the practices in the Case Studies section as possible candidates for adoption. Alternatively, other mechanisms that promote the growth of behavioural factors could be developed. Such approaches might include further consideration of work-based learning (QAA, 2018), competency-based assessment (Prickett *et al.*, 2024) or authentic assessment (Prickett *et al.*, 2025).

Technical Skills Gaps

Introduction

At the workshops, participants were first asked to assess their graduate capability in terms of technical skills, followed by a more specific evaluation of the technical skills defined by SFIA skill profiles (The SFIA Foundation, 2023). The skill profiles were selected to reflect the common graduate destinations of the universities participating in the study.

For employers, the question was framed as: “In terms of skill X, could you tell us one thing that graduates tend to do well and one thing they could do better?” For graduates, the question was: “In terms of skill X, when you first started your job, could you tell us one thing you could do well and one thing you needed to learn?”

The objective was to analyse perceptions of strengths and weaknesses in the current capabilities of emerging professionals across the different skill profiles, thereby identifying areas for improvement in education and training programmes. By understanding these insights, institutions and industry partners can better align their curricula with evolving industry needs, ensuring that graduates are well-prepared for the practical realities of the workplace.

The participants at the workshops were either employers of graduates, graduates, or students who had significant industry experience (e.g., having completed a year-long industrial placement). In the sections that follow, we will consider their input from two viewpoints: the view of employers and the view of graduates (in which we will also consider the opinions of students who have had significant industry experience). In each section, we will consider what has currently been achieved (i.e., what graduates do well) and identify opportunities for enhancement (i.e., what graduates could do better). The narative will provide a sense of progress and illustrate skills gaps.

The following sections provide a qualitative summary of the responses.

Technical skills

Technical skills in computer science are fundamental across a wide range of roles and sectors. As digital systems become more complex and central to business operations, the need for professionals who can design, develop, use and maintain software, systems, and data infrastructure continues to grow.

Do well…

Employers' observations about graduates' technical skills cluster into three areas. First, agility with new tools - employers say graduates "pick up new tools quickly" and are "una-fraid to adopt new technology" and show an "agility/eagerness to learn new tech". They "get excited by new learning". Second, they bring a sound technical foundation - solid core programming knowledge, efficient code-writing habits and practical familiarity with generic office and software tools gained from academic projects. Employers commented that graduates "have the latest techniques grounded in theory", "are more digitally capable" and are "knowledgeable about the latest tech innovation". One commented that they are "often up with [the] latest tech skills - sometimes in advance of current employees". Thirdly, employers feel that graduates are looking for creative improvement - they "come up with new ideas for improvement of existing practices" and show "thinking outside of the box/ creatively".

Graduates tell a similar story, grouping their strengths into three overlapping areas. First, firm software-engineering foundations - they feel confident in fundamental software engineering skills - "OOP, WebDev", "general object-oriented theory", and "decomposition - breaking down a complex problem into manageable tasks". They show a grasp of object-oriented theory, data structures, decomposition, clean-code habits and the ability to read, debug and structure large codebases and architectures. They can "implement good code design principles" and "understand design architectures (MVC / MVVM)". Second, they celebrate their language and stack breadth, commenting that they have an "understanding of multiple coding languages" and can decide on an "appropriate application of different languages for specific tasks/ requirements". The third theme is around professional workflow and resourcefulness, with graduates "knowing where to find information" and commenting that "research was a significant part of the role - Stack Overflow, GitHub, YouTube." Many say that problem-solving is an everyday strength.

Could do better…

Employers point to four key areas where new graduates could develop further. The first is delivery discipline. Graduates are encouraged to adopt practices that ensure quality and maintainability, such as "good governance – testing, peer reviews, commenting code." There is also an emphasis on recognising the value of established processes, understanding that these often support long-term success. As one employer notes, graduates should "appreciate standards/policies that may appear to slow progress". The second area is operational fluency with modern infrastructure. Employers note that while graduates may be comfortable writing code, they often lack confidence with the environments in which their systems run. Skills like CI/CD, secure DevOps, cloud infrastructure, and Linux/Unix fluency are frequently mentioned as areas to develop, helping graduates better deploy, troubleshoot, and run what they build.

Third, collaboration and communication are seen as areas where graduates could improve. This includes working effectively with tools like Git, sharing calendars and documents, listening to user needs, and clearly articulating technical decisions. As one employer puts it, it's important to "explain the why, not just the how" and to "understand the importance of communicating technical intent". Finally, employers want to see more contextual and pragmatic thinking, for example, the ability to see the bigger business picture and understand how their work fits into organisational goals and constraints. This includes "understanding [the] business environment" and the "legalities around processes and understanding why/why not".

Graduates largely agree, identifying four main areas where they want to grow. First, they aim to stretch into production-grade DevOps. Many list "Software Testing, Git, Automation (Ansible etc.), Containerisation (Kubernetes, OpenShift)" as priorities, along with "understanding cloud architecture like AWS". Second, they want to develop stronger quality assurance, including building debugging pipelines and validating their code with systematic unit tests, rather than "just clicking run once". Third, they seek broader technical breadth, mastering additional paradigms, frameworks, stacks, or new languages. These include languages like Rust, Go, C++, and Typescript, libraries such as React, as well as frameworks such as Spring. The goal is to choose the right tool for the job, rather than defaulting to the familiar one. Finally, they highlight the need to improve professional collaboration and workflow. A common reflection is the desire to "contribute to/understand a larger code base". Others recognise the importance of mastering tools like "Git (especially in a collaborative setting)" and "Jira", as well as using documented design patterns fluently and understanding how their code fits into the wider business, security, and networking context.

In short, graduates bring new ideas, modern skills and solid fundamentals, but both they and their employers see the next step being towards disciplined DevOps practice, cloud-native operations, rigorous testing and more practiced, business-aware collaboration.

Software Engineering

Software engineering involves the application of a systematic, disciplined, and quantifiable approach to the development, operation, and maintenance of software (the application of engineering to software). These skills are important for creating reliable and effective systems, and as organisations increasingly rely on software, the demand for people with these capabilities continues to grow. This classification is from SFIA (The SFIA Foundation, 2023).

Do well…

Employers' feedback on graduate strengths clustered into three main themes. Firstly, Technical foundations where employers comment on the solid core programming ability in Java, C#, Python describing graduates as having "good fundamental understanding" and "good core knowledge". The ability to learn tools for the job formed the second theme. Employers commented that graduates are "quick to learn new initiatives" and "persist with development tasks without being fussy about exactly what they're working on", taking unfamiliar tools in their stride. Finally, employers praised the graduates' technical skills and teamwork. Employers praise a "methodical approach to planning work", "pair programming" and "peer code review," plus clear-headed "problem solving" when extending or refactoring code.

Graduates described their strengths clustering into three areas. Software-engineering foundations came first, and they described feeling confident across multiple languages and concepts, citing "Python scripting", "C# and .NET programming" and a solid grasp of "fundamental concepts & understandings" such as algorithms, data structures and design patterns. Many emphasise code quality, "documenting my code and writing it in a way that's maintainable and understandable by others", often backed by UML or pseudocode, e.g. "using pseudocode to better understand a problem". Systems & security competence formed the second theme with many graduates reporting hands-on exposure to infrastructure and work with "network, OS, hardware", "cloud computing i.e. SaaS", and "high-level DB architecture", as well as security practices like "researching various threats to security", adding "encryption using AES", or writing "semi-secure code". Routine patching and basic SQL also feature. Finally, graduates feel that delivery and collaboration is another thing they do well. They say they adapt quickly in real projects, "getting up to speed with a large codebase", "coding and fulfilling the tasks". Skills such as "time management" and "team planning" are also mentioned.

Could do better…

Employers group graduates' growth needs into three themes. Production-readiness comes first with employers looking for graduates to master the delivery pipeline, including "end-to-end programming CI/CD understanding of tools", "CICD automation", robust "version control", and the ability to "run applications outside an IDE". They also comment that they should "understand deployment (CI/CD) and write pipelines", patch live systems and keep "audit trails" once software is in production. Built-in quality and maintainability follow. Employers want graduates to "appreciate the importance of producing testable and maintainable code", to prioritise "testing, [and] building testable code" so defects are fixed "without regression", and to improve "documentation and logging for when things go wrong". The final theme is contextual judgement with employers commenting that graduates must accept that "constraints are normal and tend to improve creativity", that they should seek to balance optimisation against "MVP / YAGNI" simplicity, and grasp "the commercial reason for some tools". Several note that "sometimes over-confidence leads to issues with taking advice and guidance", while others see an "inability to fly solo" when context is unclear. Employers therefore emphasise better "collaboration and communication", treating peer review as dialogue, not an exam.

Graduates identify similar gaps. DevOps and operational delivery is top priority and many want deeper experience with "hands-on CI/CD with Jenkins or GitHub Actions", "comfort in the terminal", stronger "Git branching", and clearer control of DORA metrics and the flow from "prod environments vs testing env – process to get from B to A". Testing, quality and documentation comes next. Graduates want to be better at "unit testing + integration testing", "TDD", and to develop a broader "software-testing mindset (NOT just unit tests)". They also acknowledge the need for clearer writing such as "how to write a report from an industrial point of view" and how to produce "proper documentation during hand-over". The third theme is process know-how and technical breadth. Graduates want to see "what Scrum looks like in practice", manage work in Jira/Confluence, and expand into "database management, API development, front-end frameworks, cloud infrastructure and even crypto/blockchain", turning classroom theory into lived professional routines.

In short, graduates arrive strong on fundamentals and eager to learn, but they and their managers recognise the need to deepen DevOps skills, embrace disciplined testing and documentation, and sharpen the contextual judgement that turns code into reliable software.

Information and Cyber Security

This technical area in SFIA is seen as the day-to-day execution of security policies and procedures. Using monitoring tools to identify threats and incidents (The SFIA Foundation, 2023).

Do well…

Employers overall appreciated the good motivation of taking cybersecurity tasks based on either interest or enthusiasm, and observed graduates "tend to have a big enthusiasm for the subject" and "bring an eagerness to help". Employers also felt graduates developed a certain level of understanding of cyber security related issues. Thirdly, employers observed graduates are able to use various cyber security tools in order to address cyber security challenges. A number of positive behavioral traits were also suggested by employers, such as "taking back to process all information before making decisions" and "be diligent in following security procedures". Interestingly, an employer additionally commended that graduates were "more informed on the security threats compared to some senior members". **Graduates** listed a number of cyber threats and relevant technologies, such as DoS, DDoS, SQL injection, phishing, malware scams, firewall, Linux etc. They also stressed the ethics and legal aspects, such as GDPR.

Could do better…

Employers provided a longer list of responses, which can be considered under two broad categories, more technical skills and better personal skills. They reported graduates could equip with more ethical hacking knowledge and skills, such as understanding common threat vectors, basic vulnerability testing, and the use of more tools to address these. Regarding personal skills, employers reported problem solving skills, SIEM skills, report writing, and other soft skills. **Graduates** mentioned overlapping areas to the employers, such as various technical knowledge and cyber security skills. They additionally reported IP compliance, code copywrite etc.

Business Analysis

Again, we employ the SFIA definition, with Business Analysis being seen as "investigating operational issues, problems, and new opportunities. Finding effective business solutions through improvements in aspects of business operations and business systems."(The SFIA Foundation, 2023)

Do well…

There are three aspects that **employers** felt graduates did well. First, graduates overall demonstrated a good understanding of business, commercial needs, problem identification processes, and the use of relevant tools to solve problems. In addition, employers stressed graduates usually bring new perspectives, latest theory and fresh knowledge into the business. The third aspect is about the good attitude of graduates such as they have interest to learn more, follow documentation, want to do things right and not cut corners, and keen on exploring new ideas and experiences. The responses from **graduates** are mainly about business understanding through effective communication and requirement gathering, and specific business analysis skills such as abstracting business processes, identifying business threats,

profiling customers, analysing strength and weakness, and visualising data. Graduates additionally reported soft skills, such as teamwork, meeting deadlines, and innovative thinking.

Could do better…

Employer responses can be categorised in three broad groups, better understanding of business needs, improved communication, and being more proactive. Employers emphasized the need to better understand the wider business context, the complexity of business needs and different business landscapes. They felt graduates could be better listeners to hear about business needs and customer requirements, and better communicator though effective vocal and written reporting and documenting. Graduates could be more proactive and more confident in proposing new ideas and thoughts for wider discussion in the team. Less responses were received from **graduates**, which covers a broad range of technical perspectives and business related skills. The technical perspectives include advanced data collection and analysis, actual technical prevention of identified threats, machine learning, pros and cons of generative AI for business, and data protection. The business skills graduates mentioned include costing/budgeting, KIP, negotiating with a client, project management, etc.

Technology Infrastructure Management (TIM)

Technology Infrastructure Management (TIM) In SFIA is seen as “a critical discipline that supports the design, deployment, and maintenance of organizational IT environments”(The SFIA Foundation, 2023). As digital transformation accelerates, the demand for skilled professionals who can manage complex infrastructure, particularly cloud and hybrid systems, continues to grow.

Do Well…

Employers consistently acknowledge that graduates entering the workforce possess a solid foundational knowledge of technical infrastructure. Many demonstrate competence with Microsoft 365 and broader infrastructure concepts, alongside familiarity with virtual environments and cloud-based tools. There is a general awareness of security risks and threats, which employers consider essential in today’s environment. Graduates are also noted for their adaptability, ability to learn emerging technologies swiftly, and skill in working within established guidelines while posing relevant questions when clarification is required. Their problem-solving abilities, thorough documentation practices, and capacity to implement solutions devised by senior team members contribute to their value within technical teams. Employers also appreciate graduates’ openness to new ideas and their general flexibility in adapting to evolving technologies.

From the graduates’ perspective, there is recognition of strong technical and analytical capabilities. Many of them report proficiency with automation tools such as Terraform and Ansible for server deployment and management. They display an ability to select cloud services that meet client restrictions and are increasingly capable of identifying and proposing security solutions for safeguarding infrastructure. Troubleshooting remains a prominent strength, supported by effective documentation and a willingness to suggest alternative analytical methods to improve operational workflows. Graduates’ broad skill set includes experience with Microsoft and Oracle cloud platforms, Python programming, and Cisco networking, highlighting their comprehensive technical preparation. Additionally, their use of project management software like Microsoft Project enables them to coordinate complex tasks efficiently.

Elsewhere, while still developing experience, particapants show clear enthusiasm and a commitment to learning. They actively engage with current industry tools such as Azure, GitHub, Linux, and WordPress. Some are involved in writing unit tests, network troubleshooting, and developing foundational knowledge in artificial intelligence. Their professionalism is demonstrated by a proactive approach to staying current with cybersecurity developments and utilizing project management tools such as Asana and Linear. The combination of eagerness to explore new technologies and steadily growing technical competencies signals promising potential for their future roles in TIM.

Could Do Better...

Despite these strengths, significant gaps are evident across all stakeholder groups. **Employers** emphasize that many graduates lack both foundational and advanced skills required to manage complex, large-scale infrastructure environments effectively. A common concern relates to insufficient prior learning and practical experience with core cloud platforms, especially Microsoft Azure and AWS. There is scepticism regarding whether university curricula adequately emphasize these critical technologies, third-party solutions, and associated DevOps practices. Employers also identify a need for a more profound understanding of the complexity inherent in large organizational platforms, including distinctions between on-premises and cloud-based infrastructures.

Moreover, financial literacy concerning infrastructure decisions is often underdeveloped, with many graduates demonstrating limited awareness of operational expenditure (OpEx) versus capital expenditure (CapEx) and how these factors influence infrastructure strategies. Practical competencies in Docker containerization, infrastructure as code (IaC), and automation of repetitive tasks are frequently lacking. Graduates also exhibit weaknesses in networking experience and Linux/Unix system proficiency. Security awareness is another critical area for improvement, particularly regarding least privilege access, zero trust security models, and security group management. Employers further highlight the importance of graduates' ability to perform root cause analyses (RCAs) and to appreciate the role of legacy systems alongside newer technologies. There is a clear understanding that newer technology is not always superior, and operational reliability often depends on maintaining legacy systems and achieving practical compromises.

Graduates themselves acknowledge these shortcomings, particularly regarding exposure to automation, containerization, and a broader cloud ecosystem beyond AWS and Azure, including Google Cloud Platform (GCP), IBM Cloud, and Oracle Cloud. They express the need for more hands-on experience managing cloud provisioning and virtualization technologies, as well as a deeper understanding of security tools such as network traffic analysis and data loss prevention systems. Graduates also emphasize the importance of adopting best operational practices, such as safeguarding API keys and implementing effective backup plans. Proficiency with developer tools like Jupyter Notebook and Visual Studio Code is also identified as an area requiring further development. Overall, graduates recognize the need to better balance theoretical knowledge with practical application.They stress the importance of understanding the differences between development (Dev) and live production environments. While familiar with continuous integration and deployment (CI/CD) pipelines, they seek deeper insight into the quality assurance processes that support these workflows. They identify several areas for enhancement, including understanding the advantages and operational trade-offs between public cloud services and on-premises infrastructure, efficient provisioning of computing resources, especially within AWS, and balancing cost and performance in infrastructure

planning. Skills related to cloud migration, AWS certifications, and collaborative platforms like GitHub and GitHub Actions are also highlighted as crucial for development.

Additionally, they recognise the value of testing changes locally before deployment and emphasise the importance of learning ethical frameworks for collaborative work environments. Practical experience with networking tools such as Wireshark and command-line utilities like StrongSwan, as well as adaptability to new tools and methodologies, and proficiency with project management software like MS Project, are further areas where students see room for growth. They suggest that earlier integration of these practical skills and frameworks within university programs would better prepare them for the challenges of professional infrastructure management.

Application Support Practitioner

The SFIA definition of Application Support Practitioner, meaning "managing the provision of reliable secure software applications which support business capabilities and are easily re-used, maintained and updated to meet current and future organisational needs" (The SFIA Foundation, 2023) is employed here.

Do well…

The skills which **employers** felt graduates did well fell into two broad categories. First, business and product analysis – examples included the ability to understand initial product requirements along with a good understanding of what a "good" application looks like, including its usability. The second category related to lower-level technical capabilities such as identifying opportunities for code reuse and good SQL skills. Positive behavioural traits were also mentioned by employers – for example, graduates were "calm & methodical when dealing with incidents". There were limited **graduate** responses but being able to identify defects and debugging existing code was highlighted.

Could do better …

Employer responses can again be considered under two broad categories, better technical skills and better professional skills. They felt graduates could be better at troubleshooting complex defects, have a better awareness of data storage types and schemas, and better understand software deployment pipelines. Handling the complexity of real-world computing environments was also mentioned – the "ability to navigate around applications - how to log onto remote servers, cloud services and identify issues". Professional skill deficiencies in this SFIA area included communication skills, the willingness to put in some "out of hours" effort, and limited understanding of the role of application support within the wider organisation. In terms of what they could do better, **graduates** tended to mention non-overlapping areas to the employers. These included navigating and comprehending very large systems and codebases, how to identify technical debt and how to refactor code.

Data Science

The SFIA definition of Data Science, meaning "using scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data"(The SFIA Foundation, 2023) is employed here.

Data Science is a relatively new term, which can mean different things to different people

Do well ....

One employer noted "Often the first person in the data team with a formal degree covering this subject", and there were related topics about skills. One employer was keen on the value and ubiquity of data. Graduates tended to focus on computer skills (Python, MySQL etc.), whereas employers and students mentioned these also, but as a minority of comments. Cloud skills came up from employers and students, but weren't remarked on as much by employees (presumably because they were already "cloud-native").

Could do better...

Not surprisingly, employers and graduates both commented on the lack of practice in dealing with large real-world (hence imperfect) datasets. Related to this was a lack of complex SQL skills (especially noted by employees). Advanced software skills (Docker, Kubernetes etc.) also came up from employees. All three groups commented on difficulties with choosing the right machine-learning algorithms, though this is such a fast-moving field that it's hard to imagine this not being an issue.

Employers commented on the lack of explanation skills, especially "could pitch the output of the analysis at the correct level for given audience". Data ethics were raised by one set of employers and one (but different) set of employees, probably relating to "real world" issues. There were other behavioural aspects, such as "attention to detail", but these were generic.

Usage of AI

AI, including generative AI, is now widely used across many organisations. As this adoption increases, so does the demand for professionals who can develop, integrate, and manage AI models for a range of applications.

Do well...

Employers' observations about graduates' engagement with AI clustered into two main themes. First, a curiosity about the technology itself - employers described graduate employees as "super enthusiastic about opportunities involving AI" and "comfortable asking questions of tools like ChatGPT." They like that they "love using it," and are keen to explore emerging AI agents and code-generation tools such as GitHub Copilot. Second, employers see graduates as having confidence in the practical application of AI – building on their experience at university where they were already using AI as part of their coursework, graduates use prompting to accelerate early project work, and show an informed "awareness of the current capability and limitations of AI". Underlying these themes are constructive behaviours - graduates are willing to experiment, proactive in seeking opportunities where AI can add value, and are willing to refine their approach as they learn.

Graduates tell much the same story, and their comments can be grouped into two complementary themes. First, a strong conceptual and technical command of AI/ML - many

describe having a good grasp of underlying algorithms, dataset-modelling and training, agent setup, prompt-writing and refactoring, which allows them to use tools such as ChatGPT, GitHub Copilot or Perplexity "effectively with work & uni" or to "speed up research and coursework". Second, a sense of caution - they recognise when, not just how, to deploy AI, with one graduate noting "I always verify information before I paste it anywhere".

Could do better…

Perhaps where the two groups diverge is depth and discipline. **Employers** want graduates to "understand that they're statistical models, not just ChatGPT" and to sharpen their understanding of the maths, modelling steps and business-case limits. They also want them to question outputs rather than copy-paste - one employer states "Remember that AI can produce garbage - understand the code before using it". Another area where employers think graduates could do better is around understanding the ethical, legal, customer perception, data, IP and security constraints. One employer comments that "often they don't appreciate the culture towards ethics in this area", and there were comments about only using AI "when AI-usage has been agreed within the organisation".

Graduates largely agree with the critique and suggest several skills required to close the gap. They want to move beyond basic usage - one graduate commented "I need better ways to query/prompt", while another would "like to learn programming AI models, combining different types of LLM and experimenting with reinforcement learning". Graduates also recognise gaps in their understanding of ethical guidelines, data privacy, provenance and proper referencing, and want a better understanding of where their data and generated content go. "Where my data goes in terms of privacy protection" and "How to use AI ethically" appear repeatedly.

In short, graduates already use today's tools with confidence, but both they and their employers see the next step as deeper technical fluency, sharper operational use and a firmer grasp of the legal and ethical issues.

Discussion of outcomes from the technical skills gaps analysis

The analysis of graduate and employer perceptions across SFIA-defined technical skill areas reveals both encouraging strengths and clear development needs. Graduates entering the workforce are generally well-prepared in foundational technical concepts, with strong enthusiasm, adaptability, and a proactive attitude towards learning new technologies. Their confidence in programming, cloud environments, and modern tools, such as AI platforms, reflects the value of recent academic curricula in preparing students for contemporary digital workplaces.

However, across nearly all areas—whether software engineering, cybersecurity, infrastructure management, data science, business analysis, or application support—employers highlight a need for deeper practical experience, stronger contextual understanding, and more consistent application of professional skills. Key themes include:

- Limited exposure to real-world scale and complexity in systems and data
- Insufficient hands-on experience with cloud infrastructure, automation, and DevOps tools
- Gaps in security practices, including ethical, legal, and operational considerations
- A need for better business communication, stakeholder awareness, and decision-making confidence
- Underdeveloped understanding of project pipelines, deployment workflows, and cost-efficiency

Graduates themselves are aware of these challenges and are keen to bridge the gaps, often calling for more applied learning opportunities, earlier exposure to industry tools, and clearer ethical frameworks.

Addressing these gaps requires a collaborative response from universities and industry. Curricula must evolve to better integrate theoretical learning with authentic, real-world application, supported by placements, project-based learning, and enhanced employer engagement. Embedding technical fluency, operational realism, and professional resilience will be essential in equipping future graduates to thrive - and lead - within an ever-changing digital economy.

As with the behavioural attributes analysis (Discussion of outcomes from the behavioural factors skills gaps analysis), it may be worthwhile considering the practices in the Case Studies section as possible candidates for adoption. Other mechanisms that address the technical skills gaps could also be developed. Such approaches might include further consideration of work-based learning (QAA, 2018), competency-based assessment (Prickett *et al.*, 2024) or authentic assessment (Prickett *et al.*, 2025).

Final Thoughts

Final Thoughts from Employers and Graduates

Each workshop concluded with a "final thoughts" section. Employers were invited to share anything graduates were doing particularly well that had not yet been discussed, as well as any major concerns they felt were important to raise. Graduates were similarly asked to reflect on additional strengths they felt they brought to the workplace and to identify any areas where they felt underprepared.

What Graduates Do Well

Employers consistently noted that graduates demonstrated strong preparation before joining the company, showing a genuine eagerness to learn and a proactive attitude toward taking advantage of opportunities. Overall, the graduates were described as enthusiastic and ready to contribute from day one. On their side, students highlighted their growing familiarity with generative AI as a productivity tool and expressed confidence in using such technologies in their daily work.

Areas for Improvement

Employers primarily pointed to a gap in students' understanding of the broader commercial and technical contexts in which they operate. On the business side, one employer noted that "*students lack the ability to see the wider context of what they are working with*." From a technical perspective, concerns were raised about students' awareness of how deeply integrated modern codebases can be. As one employer put it, "*There needs to be a better kind of consideration for interacting with a code base and then its ramifications, which I don't think you get with singular assignments in coursework*." Another added that students should "*understand the code and problem before using the tools*."

Interestingly, while employers generally had positive experiences with graduates' use of generative AI, students themselves felt less confident. They acknowledged that they lacked a full understanding of the broader benefits of large language models (LLMs), especially as tools for learning and development beyond code generation. Some also expressed concerns about becoming overly reliant on AI and emphasized the importance of using it effectively but responsibly.

Case Studies

This section of the report seeks to link emergent themes from the workshops and good practice within the partner universities which, we believe, supports positive outcomes in relation to the learner-earner journey. As previously noted, employer comments concerning graduate technical skills were relatively few in comparison to their observations regarding behavioural traits and workplace capabilities such as a deeper understanding of job roles and support for career planning. The following case studies have been selected to highlight a range of practices within the project universities which contribute to the development of behavioural and workplace skills.

Undertaking an industrial placement, in various forms, is a common feature of many undergraduate programmes; approaches to sandwich placements have been described elsewhere (Udell *et al.*, 2023; Prickett *et al.*, 2025). Here, the first three case studies describe other placement-related practices which enhance this key employability initiative. The Ulster case study describes a structured approach to placement preparation. The Bath case study highlights the importance of when placement is offered within the programme, how return from placement is supported. From London Metropolitan, we see a model for flexible placement provision. The remaining four case studies describe other practices for building employability skills. From Cardiff is the National Software Academy and its industry-focused curriculum. From Northumbria, we see the role of a computing consultancy module that focuses on graduate real-world readiness. Finally, the Warwick case study describes a group software engineering project module, which provides students with experience of a brief co-created project with an industrial partner that requires students to execute a project through the full project lifecycle.

Placements – Maximising Uptake (Ulster University)

Introduction

During the graduate workshops, where a programme of study offered an industrial placement, feedback highlighted the value students placed on explicit placement preparation activities in the year prior to placement, typically year 2 (Level 5) for undergraduate sandwich courses. At Ulster University, support of this nature is provided through a structured set of placement preparation activities which have evolved over a number of years, sometimes offered within a dedicated module, sometimes in the context of "extended year 2 induction" activities.

Description of Practice

In this case study, we illustrate the current approach taken in the full-time undergraduate computing programmes currently offered by the School of Computing. These programmes are BSc Hons Computing Science, BEng/MEng Hons Software Engineering, BSc Hons Computing Technologies and BSc Hons Interactive Computing. The bachelor programmes consist of four years of study, with year 3 as a full placement year. During year 3, students are enrolled on a 60 credit, assessed placement module.

For many years, the programmes have organised their placement and employability activity within the AWARE framework (Ayre, McChesney and Sterritt, 2016). As such, year 2 placement preparation (work preparation) is delivered in the wider context of an employability journey which the student begins in year 1.

A	Awareness	Level 4
W	Work preparation	Level 5
A	Acquire experience	Level 5 Placement
R	Reflect / refine / refocus	Level 6
E	Enhancement / employment	Level 7 / Graduation

Table 10: The AWARE Framework

In its present form, placement preparation consists of timetabled contact time with all year 2 students. During semester 1, this runs for 9 weeks and during semester 2 from weeks 2 to 5. The sessions are led by a School of Computing academic, supported by a member of staff from the university careers service (Employability & Graduate Futures). Semester 1 delivery is structured around a number of core activities. Weeks 1 and 2 introduce the overall process and encourage students to take a strategic approach to all learning opportunities in year 2 - modules, guest lectures, careers fairs and tailored 1:1 support.

From week 3 onwards, core employability activities covered include:

- CV preparation and evaluation, using support tools such as CV360 (The Access Group, 2025) and VMOCK (VMock, 2025).
- Focused employer presentations from placement partners with a history of employing Ulster students. These presentations introduce students to the "3 P's for interviews -

Prepare, Practice and Perform" and the STAR technique for structuring interview responses to questions.
- A detailed walkthrough of Handshake, the platform used by placement employers to advertise placement vacancies to students, and Interview360 (VMock, 2025), an online tool to help students review and optimise their interview performance

Use of these tools and techniques is further developed through timetabled, practical workshops and 1:1 support sessions.

In addition to these core placement preparation sessions, students are made aware of broader employability topics such as University policy for students using social media, health and safety in the workplace, codes of professional practice, the SFIA framework, and commercial awareness. Finally, students are introduced to the core competencies they will be expected to demonstrate in order to successfully complete their placement year, as assessed in their year 3 placement module. Because of the above placement preparation activities, these broader topics now have context, which enhances understanding.

Around week 3 or 4 of semester 1 each year, the university careers service hosts a dedicated IT careers fair. Students are briefed on the companies attending and how to engage in 1:1 Handshake sessions with them. Part of this includes availability of a "quiet hour" during the careers fair for students who are more comfortable engaging with employers in a quieter setting.

Semester 2 activity focuses on reinforcing the resources, skills and techniques from semester 1. The specific activities undertaken are determined by obtaining student feedback during week 1 via an online questionnaire. The areas typically requested by students are 1:1 support for CV review and interview technique.

Finally, to complement the placement preparation activities, the assessment in selected year 2 modules takes the form of time-constrained, in-lab programming tasks. These have been incorporated based on feedback from employers, to help students prepare for practical tasks which they may encounter during the application and selection process for placement vacancies.

Why we believe it is successful

Recent years have seen 80%-90% of graduating students completing a placement. Of course, student performance while on placement will vary, but the initiatives the school has been operating over a number of years, such as those described above, are key contributors to student success. The approach is effective because employability is prioritised and resourced by the School of Computing and by the University. The close cooperation between the academic department and the University careers staff is critical, one complementing the other.

A further reason for success is the positive relationship the school maintains with placement providers. Employers are encouraged (and are eager) to come onto campus to engage with students – a rich guest lecture programme further facilitates this.

There is scope for further work. Despite our best efforts, not all students appreciate the importance of the placement preparation process. At some sessions, attendance is poor,

especially when the sessions align with module assessment deadlines. Over the years, the School has experimented with delivering placement preparation outside of modules (as above) and within modules, and hence as an activity which is assessed.

Summary

Engaged students respond positively to and value the placement preparation support provided. Critical success factors include having a strong relationship with local employers, the academic department actively promoting placement vacancies and supporting the application process, working in partnership with the university careers service and the use of software tools to support students in CV preparation and interview technique.

The above is just one way in which enhanced placement preparation can be provided. Elsewhere, for example on programmes where placement is optional, the smaller number of students involved would allow for more tailored placement preparation and 1:1 support.

Return from Placement (University of Bath)

Introduction

The Department of Computer Science at the University of Bath offers all its undergraduate students the opportunity to undertake a professional placement year and approximately 64% undertake this opportunity. Placements last for one calendar year, and students receive a salary from the employer. The placement year attracts 120 CATS (60 ECTS) and is assessed. There is a Faculty-based dedicated placement team who maintain and grow our list of placement providers and provide developmental support for students to enable them to be successful in the placement application process (e.g. interview skills and CV writing). Students are visited by colleagues in the University whilst on placement.

Description of Practice

Pre-placement support for students is reasonably extensive and supportive with dedicated help and support from a dedicated Faculty-based team in addition to skills developed within the core curriculum. Despite this, feedback from placement students at Bath reported that the move to work was challenging. This has been articulated as the need to "find the motivation to do things after works" and challenges associated with "the need to take breaks when working in a 9-5 environment". It is an indicator that there is scope for more work to be done in developing the social capita skills needed to be successful in the workforce.

One thing we'd noted about our placement provision was that it was potentially having an adverse effect on the completion rate of our Integrated Masters provision (MComp).

Year	BSc	MComp
1	Taught level 4	Taught level 4
2	Taught level 5	Taught level 5
3	**Placement**	**Placement**
4	Taught level 6	Taught level 6
5	Completed	Taught level 7

Table 9: Original Placement Structure

The table above highlights our previous structure. It offers the advantage of allowing all students (regardless of whether they are pursuing a BSc or MComp) to undertake their placement simultaneously during their course. This meant that students from the same intake year collectively undertook their placement with their peers and, upon returning to university, were able to rekindle their peer networks. This was particularly important for those students whose peer network consisted of both MComp and BSc students. This was considered to be particularly beneficial, for example, when students needed to organise their living arrangements for when they returned from placement. The structure in the table above also meant that the organisation, allocation, and tracking of placement students were administratively easier, as all students from the same year intake were going on placement at the same time.

However, we noted that returning from placement was challenging for many of our students. Our students had become accustomed to the world of work, with set work and attendance patterns, and a reasonable graduate-level salary at their disposal. Returning to university to

become a final-year student required some reorientation to the reality of being a student in the final year(s) of studies. One consequence we had noticed was that some MComp students, after their placement, requested to transfer from their MComp to the BSc course. One of the reasons cited was that the two further years of study, post-placement, weren't particularly appealing as students were keen to re-enter the workforce. One driver for this was that students felt the placement providers were more likely to offer a position of permanent employment one year after the placement had completed rather than the two years that would have been required for the MComp students. The Department felt that students were missing out on the experience of a year of Master's-Level (level 7) study as a direct consequence of the structure of our provision.

Consequently, we modified the structure of our provision to that indicated in the table below. It offers the advantage that all of our placements, whether BSc or MComp, now have only one year to complete their course post placement. We have noticed a reduction in the number of transfer requests, and we are pleased that students who wish to study at level 7 for a year now feel more supported in doing so.

Year	BSc	MComp
1	Taught level 4	Taught level 4
2	Taught Level 5	Taught Level 5
3	**Placement**	Taught Level 6
4	Taught level 6	**Placement**
5	Completed	Taught Level 7

Table 10 Modified Placement Structure

We have looked at the assessment of the placement year through the lens of supporting our students in the transition from work (placement) to academia (final year). There is a formative and a summative element to the assessment of the placement.

Formatively, students are asked to prepare a poster reflecting their placement session. We hold a mini-conference session where all students display their posters. All students and staff are encouraged to attend and discuss the posters on display. The production of the poster and the poster session is two-fold. Firstly, encouraging students to reflect on what they have done, and more importantly, what they have learnt, is a gentle way of moving them away from the details of work and more towards the critical and evaluative skills they will need to harness for their final year. Secondly, it provides a forum whereby student peers can reorient their networks within the final-year student community.

Summatively, students are asked to submit a recording of a presentation on their learning experience. The students are given guidance on what their recording should include. this guidance includes reflection on:

- The Company Name
- Your Role
- Your Responsibilities
- What project were you working on
- What did the project try and do

- What is your reflection on the outcomes of the project
- What (and how) technologies did you use
- What (and how) project management techniques did you use

Why we believe it is successful

The poster presentation session, post placement, is helpful in enabling students to undergo the transition from being an employee to becoming a student again. It is a good means of re-orientation. Additionally, students take pride in the skills they acquired during their placement and relish the opportunity to share this with their peers. It also provides an opportunity for students to re-establish their peer networks as our students undertake placements that are based both nationally and internationally. Typically, each employer will only place one of our students, and this can be challenging for some students in terms of social activities outside of work. For our integrated master's students, completing their studies in one year is less daunting than completing them in two years. This is particularly true for those students who undertake well-paid placements with strong developmental support from their employer. We have mitigated this challenge somewhat by enabling our students to continue the work they undertake on placement as part of their final-year project. However, this can only take place with the full knowledge and approval of the employer. Moving the placement for integrated master's students to the penultimate year has also helped mitigate this, resulting in fewer students requesting a transfer to our bachelor's provision.

Summary

Returning from placement can be challenging for our students. Returning to academia after experiencing a year of well-paid employment is not particularly appealing to some students. We can help students to reorient back to study through the provision of both summative and formative assessment exercises. The formative poster session both facilitates re-orientation and enables peer networks to become re-established. Summatively, students are encouraged to reflect upon their placement experience against the backdrop of the computer science discipline. Innovations that we have implemented to aid students in re-transitioning include repositioning the placement year in our programmes and providing support, with employer approval, for students to focus their final year project on enhancing and extending the work they undertook on placement.

Placement Within a 3-year Degree (London Metropolitan University)

Introduction

This case study presents the transformation of the Work Related Learning (WRL) module into the Career Development Learning (CDL) module at London Metropolitan University's School of Computing and Digital Media (SCDM). The intervention responds to challenges identified following a longitudinal study, during which feedback highlighted WRL's limited scope, accessibility issues, and insufficient alignment with evolving expectations of employability. CDL was designed to offer a more inclusive, flexible, and skills-based framework for career development. This change supports institutional priorities, particularly the improvement of Graduate Outcomes (GOs), and exemplifies a commitment to embedding employability meaningfully into the curriculum.

Description of Practice

Feedback from alumni and employers highlighted several limitations of the Work-Related Learning (WRL) model. It was perceived as overly reliant on traditional placements, lacked sufficient scaffolding, and failed to effectively support students who were unable to secure relevant work opportunities. In response, a strategic decision was made to redesign the module to provide a more holistic and inclusive approach to employability. The result is the new Career Development and Learning (CDL) module, which aligns closely with London Met's Graduate Outcomes Plan (GOP) by offering a curriculum-integrated pathway to real-world readiness.

CDL is delivered alongside Level 6 modules across BSc programmes in computing, digital media, and mathematical sciences. It is offered in both the autumn and spring terms, replacing the previous WRL module. CDL is now fully implemented across the Computer Science and Applied Computing (CSA) and Creative Technologies and Digital Media (CTD) departments, with a phased rollout underway for Communications Technology and Mathematics (CTM).

The module includes a range of flexible, pre-approved activity options that students can complete as part of their learning. These include external and internal placements, professional certifications and training, entrepreneurial and business start-up initiatives, as well as research and volunteering opportunities.

Students complete approximately 70 hours of active engagement as part of a total 150 learning hours. Reflective logs, submitted every three weeks, support scaffolded learning and encourage continuous self-evaluation.

The module has been designed with an inclusive assessment strategy that offers students a choice of three submission formats: a written portfolio, a visual presentation, or a dialogic poster presentation. A reflective summary accompanies each option to support critical self-evaluation. Additionally, the module requires the completion of a Mandatory Learning Agreement and Health & Safety approval, ensuring appropriate accountability and effective risk management for all learning activities.

CDL is co-delivered by a multidisciplinary team comprising Academic Supervisors, the Careers and Employability Service, and the Employer Engagement Team. To enhance industry engagement and practical learning, the module integrates a range of innovative, industry-facing

tools. These include Riipen, a platform that connects students with real-world projects from global employers, enabling them to apply their academic knowledge to industry challenges in a structured and supported environment. Another tool, BodySwaps, which is currently being trialled, uses immersive virtual reality (VR) to simulate workplace scenarios, such as interviews, presentations, and teamwork, to help students build confidence and develop essential soft skills in a safe and reflective space.

Why we believe it is successful

Triangulated data from a range of sources including Power BI dashboards, EvaSys evaluations (the University's standardised student feedback system used to gather structured input on teaching and module delivery), WebLearn activity logs (digital records of student engagement within the University's virtual learning environment), tri-weekly student reflections, and final portfolio submissions, consistently indicate sustained high levels of student satisfaction across multiple cohorts. Students frequently highlight the flexibility of activity choices tailored to their individual career goals, the value of continuous feedback through tri-weekly reflections, and the supportive, accessible nature of both academic and employability staff as key strengths of the module.

Employers have expressed continued interest in collaborating with CDL, with several requesting repeat student placements and further engagement opportunities. One student commented: *"This module has pushed me out of my comfort zone and helped me gain real-world experience I never thought possible while still at university. The learning logs kept me on track, and the support from staff made me feel genuinely guided."*

Summary

CDL demonstrates that a flexible, scaffolded, and reflective approach to employability can significantly enhance student engagement and real-world readiness. Several key success factors have been identified. Early, structured communication with students is critical for effective onboarding and continued success. Embedding employability support early in the semester leads to improved outcomes. The scaffolded approach to self-reflection encourages students to take ownership of their development and helps foster a professional identity. Additional success factors include the wide range of authentic learning activities available to students and the clear alignment of these activities with employability outcomes such as the inclusive and multi-format assessment strategy and the collaborative model, in which academic and employer support is integrated throughout the student journey.

This case study provides a compelling example of how curriculum reform, driven by institutional strategy and sustained student–staff dialogue, can transform employability provision and foster inclusive, scalable models of career development learning. The CDL module is now fully operational across the CSA and CTD, with implementation planned for CTM. Its modular design, inclusive assessment framework, and emphasis on real-world readiness position it as a strong candidate for adaptation across other disciplines and higher education institutions.

National Software Academy (Cardiff University)

Introduction

The National Software Academy (NSA) was established in 2015 as a partnership between Welsh Government, tech industry leaders and Cardiff University. Designed in response to a recognised skills shortfall in the technology industry. One of the first projects was the development of a new undergraduate degree programme. The initial undergraduate degree programme was industry-led, rather than research-led, with a focus on the skills, knowledge and hands-on experience required to be an effective commercial software engineer. The key features include a focus on industry working practices in an environment that mimics a typical technology company.

The vibrant learning environment helps establish the difference between the NSA degree programmes and their research-led counterparts, which lack lecture theatres and traditional computer science labs. The learning spaces are designed with an open-plan office layout, featuring breakout areas, conference rooms, and meeting rooms. The degree programmes follow a project-based learning approach using real-world projects nominated by industry clients. Projects are aligned with academic modules, and students report via update meetings to their industry clients.

Description of Practice

The Autumn semester of each academic year sees the delivery of core modules aimed at preparing students for their industry projects, which take place during the Spring semester. These core modules have been developed in collaboration with industry partners to ensure their continued relevance.

Year 1 begins with building core analytical and coding skills that underpin future studies and future careers. With a focus on web technologies, students are taught HTML, JavaScript, Java, Python, and relational and NoSQL database systems to design, develop and deploy web applications according to the needs of their clients.

The Spring semester sees students working in teams on a client project, where they begin to develop professional skills such as communication, teamwork, project management, and principles of agile development to enable them to produce quality software solutions.

Year 2 focuses on building knowledge in areas such as performance and scalability, cybersecurity, DevOps, and cloud-based enterprise solutions. This year saw students take on larger, more complex and technically challenging projects. By the Spring semester of year 2, students are expected to lead project meetings with their clients and take responsibility for planning and managing the team's development work.

Year 3 focuses on user experience design and emerging technological trends, which are used to develop a product with an appreciation for the latest languages, frameworks, and tools. Though the environment of the NSA has been created to mimic that of a tech start-up, year 3 will see students appreciate larger organisational structures and how they manage change and adopt technology. The large team project is equivalent to a traditional final-year project, where students collaborate to develop a high-quality software solution that meets the needs of their clients.

At the end of each academic year, final-year students are expected to showcase their work to other students, clients, academics, and industry guests. The showcase also includes

networking opportunities, and students from first and second years are invited to either view projects or showcase their own.

Why we believe it is successful

The practical nature of the programme enables students to develop key employability skills alongside their academic and professional skills, such as teamworking, communication, collaboration, time management, and influence, as well as building confidence and resilience.

The final-year large team project gives students the opportunity to develop leadership skills while creating bespoke, high-quality software solutions with industry partners acting as clients and mentors.

A key element of the NSA's success is its close relationships with industry partners, where students work on real-world projects with actual clients, adding an extra layer of authenticity to the work they complete. Each project that a student works on adds to their CV and work portfolio, which can be shared with potential employers. Their experience with teamworking and diverse clients adds an interesting element to their interview talking points, providing comprehensive examples of core competencies.

Summary

The effectiveness of the National Software Academy lies in its ability to provide students with an opportunity to balance academic and professional practice through hands-on, project-based learning. The client projects are open enough to enable creativity and innovation in the solutions, but with a clear set of academic deliverables to ensure students deliver a meaningful piece of work.

The unique structure of NSA programmes fosters enterprise and entrepreneurship, which has seen several large team projects turned into student start-ups using a range of emerging technologies such as Virtual Reality and Artificial Intelligence.

The key measurement of success is the 100% employability rate of NSA undergraduate students. As alluded to in the Introduction, 100% employability may not mean there are no skills gaps. Hence, the NSA continues to work proactively with industry to ensure a continued understanding of industrial needs and, where possible, seeks to address these in the curriculum.

Consultancy Project (Northumbria University)

Introduction

A theme to emerge from the workshops was the need to enhance employability and real-world readiness in computing students. In this case study we describe how this is achieved through authentic, project-based learning with external clients. It involves embedding real consultancy projects within the curriculum that develop professional skills (client liaison, project management, teamworking) and mirror the graduate work environment.

Description of Practice

The Computing Consultancy module was designed in response to employer feedback highlighting the need for graduates to develop transferable skills alongside technical expertise. Its development aligns with Northumbria University's strategic priority of embedding experiential learning across all programmes, ensuring students gain applied knowledge through hands-on, real-world activity. The module is a Level 5, 20-credit core module delivered across all second-year undergraduate computing programmes.

The module has a number of key features. Students undertake authentic projects, working in teams to address live briefs from real or simulated external clients. Early in the module, workshops focus on consultancy skills development, looking at consultancy roles, client communication, and group dynamics. Through a group skills analysis and charter, teams complete skills audits and set out working agreements and expectations. Another key theme is project management in practice, with students producing project charters and progress reports while engaging with clients. Students maintain and submit a reflective log connecting their experience to academic and professional growth. Formal assessment consists of a 50% weighted group report and presentation, plus a 2,000-word individual reflection. Peer assessment adjusts individual marks based on contribution.

Why we believe it is successful

We believe the module is successful because it creates a meaningful bridge between academic study and industry expectations. Students are not only required to apply technical knowledge to real-world problems but also develop critical soft skills such as leadership, adaptability, and client communication. The authentic nature of the consultancy experience boosts student engagement and confidence. We see a really positive level of attendance each week in seminars. Industry partners have explicitly recognised the value of this module, and students cite it as their most impactful learning experience. Its design ensures deep experiential learning and high levels of personal responsibility, which align strongly with the learner-earner journey and Northumbria's strategic goals for graduate employability.

Summary

There are some important lessons we have learned through our delivery of the module.

Meaningful client engagement is essential - students benefit most when client engagement is strong and consistent. Structured milestones such as project charters and mid-point reviews are essential for project momentum. Students must be supported in the reflective practice mentioned above – it must be explicitly scaffolded to go beyond description and into learning.

Finally, by their nature, team dynamics need careful monitoring; peer assessment helps but doesn't solve all issues.

Other important success factors include:

- Early and clear explanation of the consultant role and module expectations.
- Regular, proactive tutor support with clear feedback.
- Authenticity of the client brief - whether real or simulated, it must feel "real" to students.
- Emphasis on both *product* (project output) and *process* (teamwork, professionalism, learning).

The Computing Consultancy module is an approach to enhancing employability which can be implemented elsewhere. It does require working with industry partners to source suitable live briefs. If a full module approach is not suitable, modules in earlier years could adapt the above principles to trial smaller consultancy-style tasks to build up student confidence.

Group Software Engineering Project (University of Warwick)

Introduction

The group software project, part of our software engineering module, offers students a real task as defined by a real industry partner. The goal is to familiarise students with the nature of practical software development and provide a reasonable simulation of a real-world environment. Students are assigned to groups randomly and are expected to demonstrate a good practical application of the theoretical grounding provided throughout the module. The environment aims to embed employability skills, both technical and non-technical, and provide students with an experience that helps demonstrate their value to employers. The University of Warwick version is described here; however, variations of this approach exist at other universities involved in this study (for example, at Northumbria, a similar module is also offered in addition to the consultancy practice described above).

Description of Practice

The mode is a second-year, Term 2 module. It is core for the majority of our degree programs: BSc/MEng Computer Science, BSc Computer Science with Business Studies, BEng/MEng Computer Systems Engineering, and BSc/MSci Data Science. The module has existed, in some form, for many years and has worked with industry partners for at least two decades.

Over a single term, students gain a theoretical foundation in various core elements of professional and industry software engineering, including case studies of good and less effective practices, key methodologies, and design processes. At the same time, students are provided with a specification written by an industry client. Students are expected to, in groups, co-ordinate the design and development of a product that will achieve the client's desired aims while, ideally, distinguishing themselves from their peers' work.

Students present a design document, with a requirements analysis, produce a demo video presentation and provide a final report that presents and critiques their final solution. The client reviews all presentations and awards a prize to the one that best meets their specifications.

Each year a new product brief is issued, deliberately leaving room for student interpretation and clear opportunities for further development. Teams are expected to play to their strengths and apply the processes and techniques covered in the lectures.

Why we believe it is successful

The module offers an intensive work experience encompassing the full project cycle, which for many students is a new experience.

The module immerses students in an intensive, end-to-end project cycle. This is a new experience for many. Graduates (including workshop participants in this study) have expressed positivity towards the module, highlighting how it provided relevant experience and made the transition from education to employment less difficult than it might have been otherwise.

Summary

The effectiveness of the module lies in its ability to provide a challenging piece of work with a clear brief, striking a balance between fostering student independence and offering structured

support. Students typically need more support around the social and behavioural aspects of the project, such as managing teammates and communicating well. Randomly assigned groups place these skills front and centre, forcing students to form new relationships to achieve a successful project. Technology choices remain largely open, encouraging teams to establish their own standards and critically assess alternative solutions.

The second key element is the use of an external client, who is eager to work with the academic department. This can be a difficult relationship to manage – but provides the project an extra layer of legitimacy, with an additional authority that can be consulted. The presence of an external client makes the project seem more 'real' to students, and makes it feel authentic rather than purely academic.

Adopting this model at other institutions and disciplines should be possible. However, it depends on first securing the commitment of an industry partner.

Other issues emerging from the workshops

The workshops not only uncovered areas of good practice, which informed the development of the case studies presented above but also highlighted several areas that warrant further enhancement. These emerging issues are briefly discussed below.

Department Level Alumni Networks

The universities involved in the study operated centralised alumni schemes supported by dedicated central teams. These teams played a valuable role in encouraging graduates to participate in the workshops. However, the connection between the computing departments or schools and these alumni networks was generally distant. Many workshop attendees maintained some form of direct contact with the project team, underscoring the relatively weak links between the computing departments and their alumni. Establishing local or department-level alumni schemes could offer benefits by strengthening these connections. Nevertheless, such initiatives would require a significant investment of time and resources and may involve navigating complex data protection considerations.

Cost of living pressures

The impact of cost-of-living pressures on students' access to higher education is well documented (Boffey, 2024). Recent reports indicate that over two-thirds of students now engage in paid work during term time, which consequently reduces the time available for study, social engagement, and participation in co-curricular activities (HEPI, 2025). These trends present challenges for the delivery of higher education and have implications for future projects that seek to involve students. Offering appropriate incentives will likely become increasingly important. Furthermore, framing engagement activities so that they directly benefit students such as contributing to their learning within modules, could enhance participation. Embedding these activities into formal taught sessions may be a practical approach worth exploring.

Use of technology

The combination of the online collaborative whiteboarding tool Miro (Miro, 2025) with Microsoft Teams proved effective in supporting the workshops. Teams' automated transcript generation was a significant time-saving feature. The Miro boards encouraged contributions from all participants and were quickly adopted even by those unfamiliar with the tool. Given these advantages, both tools merit consideration for use in similar future projects.

Duration of the workshop

Following extensive discussion, the project team settled on a workshop duration of one and a half hours. However, some feedback indicated that this length was challenging for certain participants, who suggested that an hour would have been more manageable. Future activities of this nature may benefit from timeboxing to approximately one hour to better accommodate participant availability.

Understanding of Commercial and Technical Contexts

An additional emerging issue highlighted by employers, concerns students' limited understanding of the broader commercial and technical environments in which they operate. On the business side, employers noted that students often struggle to grasp the wider context of their

work, which can hinder effective decision-making. From a technical standpoint, there were concerns about students' awareness of the complex integration within modern codebases. Employers emphasized the need for students to develop a deeper appreciation of how code components interact and the wider ramifications of their work. One employer remarked on the limitations of current coursework, stating that singular assignments do not adequately prepare students for real-world codebase interaction. Another stressed the importance of students fully understanding the underlying code and problems before relying on tools.

Interestingly, while employers generally reported positive experiences regarding graduates' use of generative AI, students themselves expressed less confidence. They acknowledged a lack of comprehensive understanding of the broader benefits of large language models (LLMs), especially as tools for learning and development beyond code generation. Additionally, some students voiced concerns about over-reliance on AI, underscoring the importance of using these technologies effectively and responsibly.

Recommendations

Building from the findings in the report, we propose the following recommendations:

1. **Grow engagement and collaboration with industry.** Engagement and collaboration with industry in the design and delivery of academic degree programmes has been a significant feature of many disciplines (including computing) in UK higher education for some time. From now on, this engagement and collaboration with related industry stakeholders will become increasingly important. This engagement and collaboration are crucial for a deeper understanding of the evolving opportunities, concerns, and professional job roles, particularly in light of the growing transformational impact of AI. These engagement and collaboration activities aspire to reduce skills gaps, which is in the interests of many stakeholders, including graduates, employers, and universities.
2. **Provide support to graduates to cross the "capability-competency chasm"** (Ward *et al.*, 2021)**.** Completing tasks in the classroom is not the same as achieving them in the complex set of conditions that emerge in the real world. Equally, it is essential not to underestimate the impact of skills such as understanding hierarchies, expectations, and professional behaviour and tone on a successful transition to the workplace. One approach to addressing this issue is to a competency-based approach. As indicated in the Introduction, such an approach is being increasingly promoted in computing (CC2020 Task Force, 2020) and other disciplines (e.g., (Royal Society of Chemistry, 2025)). It is recommended that undergraduates be given scaffolded access to real-world challenges as part of their preparation for transitioning to the workplace. Three mechanisms to do this surfaced in the report are
    a. **Support and maximise the value of work experience.** Work experience remains a critical aspect of graduate work preparation. Work experience in the form of traditional year-long sandwich placements or gained within Degree Apprentice programme remains significantly beneficial to both students and their employers. Support for such initiatives from the hosting universities is crucial, as illustrated by the case studies from Ulster and Bath. Such work experience enhances the professional competency (Prickett *et al.*, 2024) of graduates and eases the transition from university to the workplace. It is recommended that universities continue to embed and enhance placement opportunities, as there is much to be gained from them for students, employers, and the universities themselves.
    b. **Explore alternative models of work-based learning.** Accessing work placements is competitive, and while all students should be encouraged to complete one, obtaining 100% uptake at all universities is an unrealistic ambition. However, as the case studies from Cardiff, Northumbria, London Metropolitan, and Warwick indicate, there are alternative models for embedding work experience in degree programmes beyond the traditional full-time, year-long approach. It is recommended that universities explore alternative models of work-based learning, as there is much to be gained from them for students, employers, and the universities themselves. As with traditional work experiences, these activities will enhance the professional competency (Prickett *et al.*, 2024) of graduates and ease the transition from university to the workplace.
    c. **Address real-world complexity in more areas of the curriculum.** When considering the outcomes of the workshops, it was not uncommon to note that employers, graduates, and students welcomed the foundational skills they had

developed during their studies but missed the experience of handling the complexity of real-world challenges (e.g., large data sets or code bases). It is recommended that consideration be given to addressing this shortfall by further exploring real-world complexity within degree studies. Authentic assessment may be an important aspect of this exploration (Prickett *et al.*, 2025).

3. **Behavioural factors are a critical component of the curriculum.** The focus on non-technical skills by employers (rather than technical skills) in the feedback stands out. Hence, curriculum designers must reflect on the overall "balance" of technical and non-technical skills in the programmes they design. The automation of many of these human skills remains unlikely in the short to medium term. Incorporating a greater focus on the development and demonstration of non-technical skills is likely to require different pedagogical approaches to both the delivery and assessment of degree programmes. It presents a significant challenge for the higher education sector, particularly in the teaching of computing. However, the insights from the workshops suggest that there is much to potentially be gained for students, employers, and universities from doing so.
4. **"Adopting modern technologies" and "Expectations Management: What is it reasonable to expect from an undergraduate degree programme?" maybe two side of a coin!** The workshops identified strengths and weaknesses across a range of technical skills. However, in many cases, while a good foundational knowledge was evidenced by graduates, there was commonly some specialist knowledge that was missing. Furthermore, where core computer science competencies are in place, employers can help graduates fill any gaps, for example, in specialist technical skills, as long as the non-technical skills are also in place. The recommendation here is twofold.
    a. **"Adopting modern technologies" -** Firstly, where feasible, universities considered adopting common modern technologies that many employers use through enhanced engagement and collaboration with industry.
    b. **"Expectations Management: What is it reasonable to expect from an undergraduate degree programme?" -** Secondly, it is not feasible for every technology used by every employer to be embedded in every degree programme. As such, through enhanced communication between universities and industry, employers gain a better understanding of the constraints of a non-infinite curriculum and are thereby able to improve their onboarding procedures appropriately.
5. **SFIA Behavioural factors are a candidate model for use in programme, module and assessment design.** SFIA Behavioural factors presents a model that articulates the interpersonal skills desired by employers. It appears to provide a mechanism for determining the extent to which graduates are addressing these employer expectations. It may prove to be a valuable tool to consider within programme, module and assessment design. For example, it may help clarify the expectations for skills such as "communication". Since we have seen that universities cannot teach all the technical skills all employers want, "willingness to learn" becomes a key behavioural factor.
6. **The case studies presented in the report are candidates for wider adoption.** A set of case studies has been provided, which begin to address the issues in this report. These case studies include examples of work-based learning, competency-based learning and authentic learning. All of these are key areas to explore and develop further, with the potential to be rolled out more broadly in the sector.

Future work

Three possibly productive next steps are:

1. **Consider expanding the sample.** This work ran workshops at the computing departments of six universities. Whilst a variety of universities were included in the study, it is possible that different outcomes could have occurred if a different sample had been used. As such, replicating the study in more computing departments or across different disciplines could yield different results. The Futurespective and Behavioural Factors sections are reasonably discipline-independent.
2. **Skill-based hiring, Micro-credentials and life-long learning entitlement**. Whilst not explicitly mentioned by the employers involved in this study, skills-based hiring is becoming an increasingly popular recruitment approach (Fuller, Langer and Sigelman, 2022). Micro-credentials offer a mechanism to personalise professional development and demonstrate specific skills (Hunt *et al.*, 2020). Micro-credentials were welcomed by several of the employers engaged in this study. In England, the incoming lifelong learning entitlement (Department of Education, 2025) will facilitate the completion of Micro-credentials. A previous QAA Collaborative Enhancement Project (Ward and et al., 2022; Ward *et al.*, 2023) explored how Micro-credentials can be used within and around computing higher education qualifications. However, how Micro-credentials link to SFIA skills, behavioural factors, and other aspects highlighted in this project could benefit from further exploration.
3. **Exploring mechanisms for assessing competency (and behavioural factors) more broadly**. As indicated in the recommendations, assessing behavioural factors and competency more broadly presents a set of significant pedagogical challenges which could benefit from further exploration. Additionally, the consideration of competence within discipline accreditation regimes could benefit from further consideration.

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