Institutional Perspectives on Formal Work-Based Learning Programs in the UK

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ABSTRACT

Graduate and Degree Apprenticeships (G/DAs) are relatively new work-based learning (WBL) degree programs in the UK which were established with the aim "to meet key skills needs, enhance productivity, strengthen university and employer partnerships, and offer a new route into work" [16]. These programs have been growing in popularity in the UK in recent years. While work-based learning itself is not a novel concept and several countries in the international SIGCSE community offer WBL programs in higher education, formal degree programs remain rare. This work presents an exploration of some of the challenges and opportunities in running such programs in the UK as the programs became formalized. We sent an initial survey to all 61 institutions in the UK that offer G/DAs in computing. 18 institutions responded and we conducted in-depth follow-up interviews with representatives from 10 institutions. We report themes related to the kinds of students and employers participating in these programs, how the design of G/DAs differs from that of traditional degree programs, and differences between these programs that may not be initially apparent. These findings provide insights that can support educators interested in developing similar formal WBL programs.

CCS CONCEPTS

• **Social and professional topics** → **Computing education**.

KEYWORDS

degree apprenticeships, qualitative study, new degree initiatives

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1 INTRODUCTION

Employers in the UK and around the world have regularly reported difficulties in recruiting qualified computer science graduates [8, 12]. In response, Graduate and Degree Apprenticeships (G/DAs) were established in 2015 "to meet key skills needs, enhance productivity, strengthen university and employer partnerships, and offer a new route into work" in the UK [16]. They are work-based degree programs that integrate work and study and lead to a BSc or BEng degree, making them comparable to traditional undergraduate degrees.

Work-based learning itself is not new. Cooperative education models, where students alternate between work and study, are prevalent in the US and Canada and have been discussed in the SIGCSE community as early as 1978 [1, 7]. In Germany, the *Duales Studium* similarly incorporates work and study [7]. And in the UK, universities often offer placement programs that allow students to spend a year working in industry [6].

However, G/DAs are unique in a number of ways. First, with G/DAs, students apply directly to an employer rather than a university, spend part of their time at work and part at university in purpose-built programs, and receive a salary. Second, G/DAs reach beyond efforts at individual institutions and are part of a broader, national agenda in the UK. They are funded through the Apprenticeship Levy, which is a tax of 0.5% that employers with salaries of more than £3 million pay on their total payroll. While the Apprenticeship Levy applies UK-wide, G/DAs and their policy implementations haven taken different forms across the UK [9]. In general, however, G/DAs are based on "standards" or "frameworks" which are developed in collaboration with employers and describe the skills and qualifications required of graduates. Institutions then use these frameworks to develop G/DA programs.

G/DAs are offered for a wide range of disciplines, including business, engineering, nursing, public relations, and social work. In computing education, G/DAs have been studied from a variety of perspectives. For instance, research has shown that G/DAs can help to bridge the skills gap and address the gender imbalance in computer science [10, 14]. Studies also found that apprentices draw strength from their identity as employees [15]. However, with the exception of recent work on the social mobility potential of G/DAs [11], prior work has often focused only on individual programs, and, to date, there has not been a comprehensive investigation of practices across different programs in the UK.

Indeed, while different apprenticeship programs may follow similar frameworks, they can differ substantially in their implementation and the ways in which they are tailored to local circumstances. This work then aims to address this gap in cross-institutional knowledge by answering the following research questions:

- What are the design processes that lead to G/DA programs?
- What are the challenges and opportunities institutions face in implementing G/DAs?

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- What practices and curricular structures are used in different programs across the UK?
- What are academics' perspectives on the tripartite relationship with employers and students?

2 METHODOLOGY

2.1 Identifying G/DA programs

We conducted a survey of institutions offering G/DAs, followed by in-depth interviews. To do so, we first had to acquire a list of institutions which offered relevant programs, and ideally individuals to contact within them. No authorities or organizing bodies appeared to keep an up-to-date or complete list of G/DA providers at the time, so it was necessary to compile a list ourselves.

Most universities and colleges in the UK participate in the Universities and Colleges Admissions Service (UCAS), which provided the most comprehensive list of institutions in the UK. However, G/DAs are not typically included in the standard application process (as students apply directly with the employers), so while UCAS was able to provide a list of institutions, there was no indication of which institutions provided G/DAs and this information had to be gathered by other means.

For each institution on the list, we generated a search term in the form:

> "<Institution name>" + "degree apprenticeship" + "level 6"[1] + "software engineering" + "computer science"

In the case of Scottish institutions, "degree apprenticeship" was replaced with "graduate apprenticeship". The search term for each institution was searched, and in most instances if the institution ran a G/DA program then its institutional information page was the first search result. In cases where there was no obvious search result, some additional searching was conducted by navigating through the institution's program pages or searching prospectuses. If no evidence of a G/DA program could be found after this level of search, we assumed that the institution did not have a G/DA program. Of 377 institutions originally identified through UCAS, 61 institutions clearly advertised relevant programs.

2.2 Survey & Interviews

We sent invitations to take part in this project to all institutions that were identified in the previous step. We initially invited them to complete a survey about the G/DA programs they offered in computing. The survey asked about the following topics:

- the number and disciplines of programs offered,
- the number and kinds of employers participating,
- the motivation for offering a G/DA,
- what works well and what changes they would make.

We received 20 responses from 18 different institutions. In most cases, the respondents were faculty or program leads for the respective apprenticeships, although in three cases the survey was completed by an administrator involved in the G/DA instead.

Seven institutions were based in England, eight in Scotland, and three in Wales. Fifteen institutions reported offering only one or two G/DA programs in computing, whereas three offered four or more programs. Most of these programs were in Software Development or Software Engineering (8), with Digital Technology Solutions (5), Data Science (4), Cyber Security (4), and Computer Networks (1) also represented.

As part of the survey, participants were asked whether they would be willing to take part in a semi-structured follow-up interview. 14 respondents indicated that they would, and we ultimately conducted 10 interviews. As part of the follow-up interviews, we asked about the following topics:

- the design process that led to these programs,
- the resulting structure, i.e. courses and assessment approaches,
- the kinds of employers participating in the programs,
- developing and running the programs with employers,
- working with the students, especially compared to those studying for traditional undergraduate degrees.

The interviews lasted approximately 45 minutes each and were subsequently transcribed. One of the authors then conducted an inductive thematic content analysis, identifying recurring themes and grouping quotes into thematic categories [3]. These thematic categories are indicated by the headings in the following section.

3 FINDINGS

3.1 Degree Inception and Aims

In every instance reported, the introduction of the degree was based on a top-down decision from institutional management rather than being explicitly seeded by relevant faculty. At about half of the institutions involved, there were existing frameworks or programs already in place which predated the official formation of the G/DA. Most of these were existing vocational training and professional development programs, most of which already had a work-based component. However, even in cases where a previous program existed, the move to support G/DAs specifically appears to have been motivated by senior management.

There were different reasons put forward for why each institution made the top-down decision to implement a formal G/DA program. The most common reason was to diversify or improve the inputs of technical pipelines, with several interviewees noting that the G/DA and related frameworks attracted different kinds of students compared to typical undergraduate degrees. Another reason was to utilize resources which were being offered by the government to deploy these programs. A less common reason was more generally to keep up with the evolving landscape of tertiary education and to embark on a "voyage of discovery" to explore additional routes to degrees.

3.2 Delivery Structure and Content

Figure 1 shows the breakdown of delivery styles used, with most institutions using some form of the day-release model. In most contexts, day-release means that apprentices spend one day each week on-campus (or online), where they engage in typical academic learning, such as through lectures, labs, and discussion sessions. The day-release periods typically match up to the standard academic semester, with the remaining time spent entirely in the workplace. In instances where "other" was reported, institutions indicated that

[1] Level 6 describes the qualification level, which includes graduate and degree apprenticeships, as well as traditional bachelor degrees, in the UK.

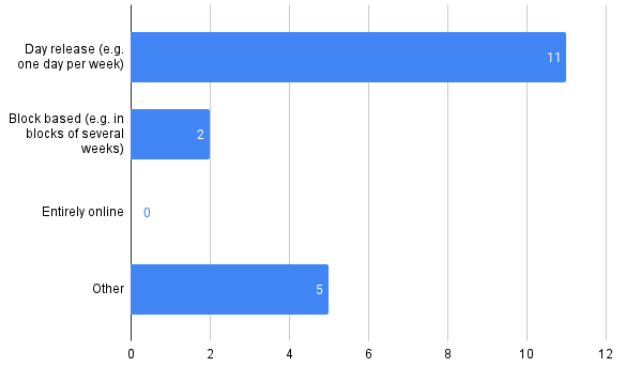

Figure 1: Delivery Format

they use various hybrid approaches, incorporating two or more of the provided options.

Institutions varied broadly in terms of content delivered: some developed an entirely bespoke degree with all-new courses designed specifically for the G/DA, while others adopted their existing BSc offering with some adjustments to make the work more practically focused. However, even in institutions where the content taught was a "carbon copy" of the typical undergraduate degree, apprentices were taught differently and separately from undergraduates:

> "I guess the learning outcomes are probably similar, but the way it's taught is probably quite different." (Institution S)

It was the case that most institutions, even with entirely bespoke courses, still had substantial overlap between G/DA and typical undergraduate degree:

> "Some of the modules have got not necessarily identical siblings on both things but certainly hugely related first cousins." (Institution M)

This may not be surprising, even when building a program from scratch, as G/DAs are intended to lead to the same qualification as a typical undergraduate degree.

Even with similar content being taught in both G/DA and more typical undergraduate programs, most institutions reported that they did not seat G/DAs with typical undergraduates. This was in part due to challenges associated with class scheduling, as G/DAs are typically not on campus as frequently as traditional undergraduates, and due to the need to compress their academic content into one day. Another reason for the split was the kind of students attracted to the G/DA program, which is further discussed in section 3.5.

While most institutions explicitly indicated that their program was developed with input from industry, some interviewees were also careful to note that they did not "cater to individual employers" (Institution A). Rather, institutions sought to identify broadly what areas and technologies were of importance across multiple employers, but would then teach them in a non-context-specific way. For example, one institution indicated that they teach "programming", but not in a specific language, similar to work conducted elsewhere [2]:

> "So when we consulted [employers] at the beginning for example, [we said] "Yes, okay we'll teach programming, we'll do this language." – "Well we don't want this language, we want that language." We want that language and they want that language and they want the other language. [So we said] "Okay, let's just teach *programming*." (Institution N)

3.3 Assessment

Course assessments varied broadly between institutions. Some institutions indicated that they tried to keep a proportion of each course as work-based assessment, so apprentices will complete a work-based project, reflection, or portfolio for all courses. However, this was seen to be fairly challenging. More than one institution mentioned that it was hard to negotiate these assessments with employers. Another noted that they had back-up case studies available in case a student or their academic advisor realised that they would not be able to complete a piece of work in their workplace. Despite these challenges, several institutions also noted that they wanted to include even more work-based assessment in their programs, as it was considered to be the most authentic and reliable form of assessment.

Most institutions indicated that the students complete a major capstone or dissertation project at the end of their final year of study, and that these projects are work-based. The work-based nature of the projects leads to some interesting outputs. Several interviewees noted that the projects generated are far more useful and fit for purpose than traditional undergraduate final projects. However, one interviewee observed that this can sometimes be detrimental to the expected academic procedure:

> "We had some employers where the apprentice comes up with a really good [project] idea at the beginning of their final 18 month period and the company goes, "Yeah, that's a great idea, let's do it" and then it's done before the project time." (Institution M)

Most assessment mentioned by interviewees was practical in nature, involving projects, portfolios, lab work, and coursework. Some explicitly mentioned that they are moving or have moved away from exams for G/DAs, with two main reasons given. One is that scheduling exams so that apprentices could all take them together – and sometimes alongside typical undergraduate students in shared courses – is very challenging. Interviewees also indicated that apprentices are different from other students and therefore require different forms of assessment, which is explored further in section 3.5.

Another practical consideration was the flexibility of requirements for different students in different contexts. Some institutions indicated that because students can have very different learning experiences (because they are in different workplaces), work-based assessments – particularly portfolios and projects – sometimes have to be varied for students who are not able to easily achieve them in their normal working context. There were two main solutions to this issue: The first was to offer alternative, lab-based assessment in cases where students weren't able to conduct the assessments in

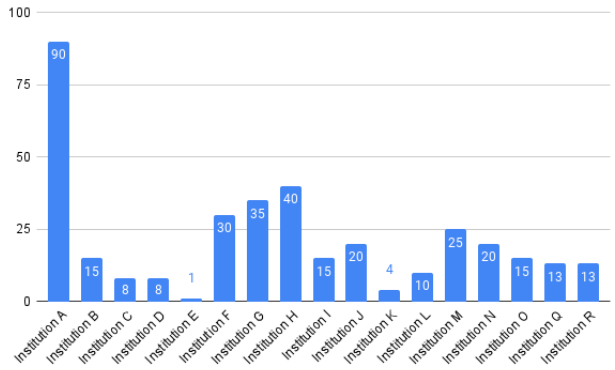

Figure 2: Number of Employers

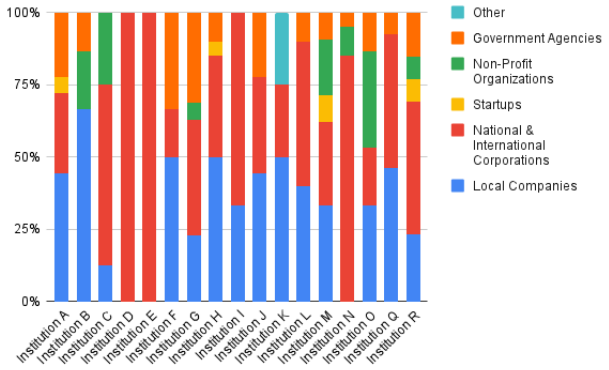

Figure 3: Types of Employers in G/DA programs

the workplace. The second was to permit more discursive, reflective alternatives to practical work; for example, regarding a project which required building a database:

> "Companies have their databases already, you don't have to have every student that's on the course from that company rewrite their databases…They have to explain what sort of world they live in, in their industry, and how they're going to build this database which reflects this, that, and the other thing." (Institution A)

In addition to supplying different forms of assessment for students in different contexts, most institutions also indicated that the assessment of learning outcomes could be negotiated. Although one institution indicated that they've "never known anyone to do a negotiated assessment" (Institution S), others suggested that the practice was common. One interviewee demonstrated the negotiation process by mocking up a discussion with a student:

> "What can you do in your workplace that can demonstrate to me that you can do this, you understand the how, why, when. You understand what feedback you get on it and you understand if it's right? Go away and talk to your mentor in the workplace and come back with a proposal as to how you'll demonstrate this. We'll give you feedback on the proposal and when we're agreed it's the right thing to do, go do." (Institution N)

3.4 Employers

The surveys indicated that institutions work with very different numbers of employers, ranging from one with a single employer to another with up to 90 employers (see Figure 2). About 40% of the employers involved in G/DAs across institutions were local companies and another 35% were national or international organizations, with the remaining proportion consisting of start-ups, nonprofits, and government organizations. The breakdown of employers involved at each institution is shown in Figure 3.

The sectors of employers involved in G/DA programs were also broad, with multiple interviewees deliberately reciting a long list of sectors they have apprentices based in: "defence contractors, energy companies, media and communications, transport, finance, food and drink, space and technology" (Institution N). In response to the question "what kinds of employers are participating in the program", one interviewee said: "All. *[Laughter.]* That's the short answer… There isn't a single sector or industry or type of employer you could identify there, it's quite an eclectic mix" (Institution F). In most instances, no single employer employed the majority of apprentices.

Most institutions reported good relationships with employers. Some indicated that there were occasionally tensions between what employers were looking for and what was being delivered, but the institutions noted that it is not possible to please everyone. With so many employers, for both parties "to expect the delivery to be perfectly aligned with what they're doing in the workplace is futile, it's not going to happen." (Institution M)

There were also some issues with levels of engagement and support for students from some employers; by no means a universal issue, but one that multiple interviewees mentioned they had to deal with on occasion: "There are some workplaces which are very supportive and provide a lot of training and mentoring, and so on, and there are other workplaces where people are left on their own." (Institution O)

3.5 Students

The majority of students involved in the G/DAs were reported to be adult students, particularly those who had been previously employed by their companies and were completing a G/DA to upskill while still at work, but most institutions still see a fairly diverse student body enrolled. Several institutions reported that the proportion of high school graduates enrolled in the program has been steadily growing, with one institution indicating that 18-19-year-olds are now the largest share of their cohort. This was attributed to better broadcasting and awareness of the program as a viable route for high school graduates: "People are a lot more aware of apprenticeships as an option to do a degree." (Institution S)

In terms of attitudes, most interviewees praised the apprentices. Several explicitly compared them to typical undergraduate students, indicating that "apprentices achieve significantly higher"

than students enrolled in full-time degrees: "Their performance outstrips the full-time undergrads hugely" (Institution M). In fact, one interviewee indicated that one reason for separating G/DAs and typical undergraduates in small-group learning, even when they were learning the same content, was because the typical undergraduates were "less focused and more disruptive" and that this impacted the apprentices' learning.

G/DAs were also reported as being more mature than other students in several instances. They were regarded as being "more serious", though two institutions noted challenges associated with this. One interviewee indicated that, as a result, the G/DAs were more "demanding" and would ask many more questions to reinforce their learning, requiring substantially more effort and attention for lecturers and other academic staff.

Broadly, most interviewees regarded the G/DAs to be distinct from typical undergraduates in terms of achievement in formal learning settings. Multiple interviewees stated that G/DAs may not always succeed in traditional assessments, such as exams, which was one reason for them not to be used frequently (see section 3.3). Additionally, participants explicitly indicated that prior academic performance was not always a good measure of apprenticeship performance (even in cases of high achievement). Another stated: "a lot of the people who are doing apprenticeships have not necessarily had a positive education experience and that will have been around the dependence on exams." (Institution N)

> "We excuse them on less than stellar A Level[2] results because some people, as I say, aren't into exams, even at A Level, and struggle with lots of things, with pressures and things. That shouldn't block them from having a route to a relevant, more pastoral, BSc degree program where they are committed." (Institution A)

This was not the case at every institution, with one interviewee indicating that they would only accept students who would be able to get into their standard undergraduate route, but also noted that this does make applications challenging for existing company employees looking to upskill due to the distance from formal education. Another stated that they do have entry requirements similar to undergraduate students, but that this is not necessarily "fair" for G/DAs.

3.6 Institutional and Administrative Challenges

In several instances, participants noted that the envisioned or hoped-for flexibility of the G/DA programs was complicated by their institution more broadly. One participant noted that they are still trying to "win over hearts and minds among some of [their] faculty" (Institution T). Another stated that they fought an uphill battle with their institution to adjust the levels of credit awarded. Yet another indicated that some of their teaching staff who are typically teaching standard undergraduate courses struggle to teach in the G/DA ecosystem because they are used to more traditional methods of instruction:

> "There's a lot of interaction, during the week, that you have to do, spontaneously sometimes, and your standard research academics are, 'I'm not going to do that.' " (Institution A).

Participants also discussed the additional administrative challenges associated with offering G/DAs:

> "The difficulty, for us, is that those administrative processes are, by and large, quite different from the ones we have already, so there's an additional cost for us to cater for these." (Institution T)

The terms "administrative overhead" and "bureaucracy" appeared as responses to a question about what respondents would change about the G/DA program in five different survey responses. One interviewee indicated that the process is vastly over-complicated for the scope of the program:

> "I think if I didn't try very hard I could tell you seven organizations whose processes and compliance we're having to meet and we could get audited on at any given point. [...] So whether it's the university's quality process, whether it's QAA, DfE, IfATE, Ofsted, ESFA.... We can confer PhDs with less bureaucracy than a degree apprenticeship which doesn't feel right."[3]

Notably, all but one of the institutions mentioning these issues were based in England, where interviewees indicated that such problems appeared to be exacerbated by the multiple governing bodies.

3.7 Liaising and Communication

Based on all the interviews conducted, it was clear that a substantial amount of effort and staff-power is dedicated to establishing and liaising between parties in a tripartite relationship between the university, the students, and employers. Every interviewee mentioned that they had dedicated staff for handling liaisons, with frequent, structured meetings between themselves and both the student and their employer contact (such as a team leader or mentor).

More than one institution also indicated that they conduct "mentor training days" or sessions, where mentors from industry are given guidance on how best to support their students:

> "There's a piece of work we'll do making it clear what our expectations of them are as a mentor for an apprentice." (Institution M)

Several institutions also conduct meetings with all parties involved (students, employers / mentors, and a university representative) several times a year: "Every apprentice needs a mentor...and we meet – all three of us – three times a year" (Institution H).

4 DISCUSSION

Our research questions were posed to frame a discussion around the current landscape of Graduate and Degree Apprenticeships across the UK through the lens of institutional practitioners. The G/DAs we have explored in this work are unique in that they are part of a broader response to a national initiative. We gathered data from a wide variety of institutions and it became clear that some changes have taken place since the inception of these programs, particularly in terms of the students now applying to and taking part in them. The shift from participants being predominantly company

[2]A Levels are a common high school leaving qualification in the UK.

[3]Attribution omitted to maintain institutional anonymity.

employees in need of upskilling or professional development to a more balanced intake of high school graduates indicates that the G/DA message is likely getting out in schools as a viable route to a degree. This is a meaningful development that may help to address the skills shortage and offer paths into computing for students who otherwise may not have been able to pursue it.

We also observed the wide range of employers involved in G/DA programs, cutting across sizes and sectors. It appears that there is value in G/DAs in many different contexts, whether an employer has a program which recruits 20-30 apprentices every year or they are a smaller organization that takes a single apprentice once every two years. This is a notable achievement of the programs examined, considering that any individual program ostensibly has the same content for every apprentice regardless of their employer and context.

While not a universal belief, interviewees made explicit reference to apprentices not being supported by typical academic practice or able to demonstrate potential in typical academic assessment. This matches prior findings in the literature [5]. In fact, for many interviewees, this seemed to be considered a given, as they qualified such statements with phrases like "of course" and "obviously". Yet, this was not apparent in every institution, with some institutions still expecting high assessment scores from typical secondary education. This demonstrates a fairly polarized set of expectations from different institutions as to what constitutes a good apprentice, or at least good predictive measures of success as expressed in the admissions standards.

However, despite recruiting apprentices through non-standard academic assessment, the students appear to be thriving. They are frequently considered to be more engaged and focused than typical students and in most cases appear to be excelling in their programs. Additionally, G/DAs are also typically well-regarded by their employers, who appear (at least from the perspective of their partnered institutions) to value the work they do. Therefore, even in cases where non-standard academic assessment is used, G/DAs are successful as students and employees.

While the success of these programs is quite clear, it needs to be seen in the context of the national effort to establish G/DAs. The resources going into a typical G/DA program appear to be substantially higher than for traditional undergraduate programs. Every institution incorporates some form of additional communication between the university teaching staff, the apprentice, and their employer, usually in what tend to be tripartite meetings with fairly high frequency [13]. The cost of these meetings alone requires additional staff to be employed to manage and maintain these relationships. In terms of effort, it was also noted that instructional staff teaching traditional undergraduate courses can struggle to adapt their teaching for G/DA programs and that G/DAs require more attention and face-to-face interaction time. Additionally, many institutions are putting more time and effort into ensuring their routes are flexible and accommodating to different contexts by adjusting student assessment and progression requirements as required.

Part of the success of the G/DAs may then be due to the extra resources and additional effort that they are receiving. Nonetheless, there may be lessons that universities – even outside the UK – can learn from the success of G/DAs to diversify their student body and to provide opportunities to students who may be well suited to success if measured by different means. While there are some substantial differences between a G/DA and a typical Computing Science or Software Engineering degree, perhaps traditional programs could consider ways to adjust assessment and progression criteria to make them more viable and achievable in different contexts. These contexts will not be the same as apprentices working with different employers, but could account for students' electives, prior experience, or planned future work.

Finally, while many similarities across institutions have been identified, there are still some large differences between institutions in the way that their G/DA programs are implemented: In the delivery, the level of liaising, and the content covered. The overarching perspective of G/DAs does not present like this. Institutions are typically beholden to a form of framework (such as the SDS framework in Scotland or the apprenticeship standards in England). This suggests a need for institutions to be clear and transparent about their institutional approaches to their programs, since the differences between institutions may be large, but not always clearly communicated to prospective students.

4.1 Limitations & Future Work

There are a number of limitations to this work. First, the initial search we conducted of institutions offering G/DAs may not have captured all programs and additional programs may have been launched since then. Second, while institutions from England, Scotland, and Wales participated, none from Northern Ireland did. Third, this work is focussed on G/DAs only from the perspective of academic institutions. This, however, is also an opportunity for future work, which could explore the experience of students in different programs and contribute an understanding of employer perspectives and practices. Indeed, prior work in the US has explored industry partners' perspectives on work-based learning and we hope to contribute a similar perspective from the UK in the future [4]. Finally, while we did not collect demographic or socio-economic data from students enrolled in G/DAs for this study, prior work has explored the potential for G/DAs to promote social mobility and to address the gender gap in computing education [10, 11].

5 CONCLUSIONS

In this paper, we have explored institutional perspectives on Graduate and Degree Apprenticeships following a national initiative in the UK. Through the survey and follow-up interviews we conducted, we identified challenges and opportunities institutions face in implementing G/DAs. We also observed similarities (and differences) across programs, such as in the wide range of employers involved, with numerous sectors represented, as well as in the shift in the population of students, with an increasing number of high school graduates pursuing G/DAs. Finally, there may be opportunities for traditional degree programs, including in other countries, to incorporate lessons from G/DAs – such as diversifying their student body and exploring alternative assessment methods – going forward.

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REFERENCES

[1] Barry Arnow. 1978. Cooperative Education and Realistic Student Preparation. In *Papers of the SIGCSE/CSA Technical Symposium on Computer Science Education (SIGCSE '78)*. Association for Computing Machinery, New York, NY, USA, 86. https://doi.org/10.1145/990555.990588

[2] Matthew Barr. 2023. How to Learn a New Language: A Novel Introductory Programming Course. In *Proceedings of 7th Conference on Computing Education Practice (CEP '23)*. Association for Computing Machinery, New York, NY, USA, 9–12. https://doi.org/10.1145/3573260.3573263

[3] Virginia Braun and Victoria Clarke. 2006. Using Thematic Analysis in Psychology. *Qualitative Research in Psychology* 3, 2 (Jan. 2006), 77–101. https://doi.org/10.1191/1478088706qp063oa

[4] Gail Carmichael, Christine Jordan, Andrea Ross, and Alison Evans Adnani. 2018. Curriculum-Aligned Work-Integrated Learning: A New Kind of Industry-Academic Degree Partnership. In *Proceedings of the 49th ACM Technical Symposium on Computer Science Education (SIGCSE '18)*. Association for Computing Machinery, New York, NY, USA, 586–591. https://doi.org/10.1145/3159450.3159543

[5] Sebastian Dziallas, Sally Fincher, Matthew Barr, and Quintin Cutts. 2021. Learning in Context: A First Look at a Graduate Apprenticeship. In *Proceedings of the 21st Koli Calling International Conference on Computing Education Research*.

[6] Sally Fincher and Daniel Knox. 2013. The Porous Classroom: Professional Practices in the Computing Curriculum. *Computer* 46, 9 (Sept. 2013), 44–51. https://doi.org/10.1109/MC.2013.261

[7] Joseph Maguire and Quintin Cutts. 2019. Back to the Future: Shaping Software Engineering Education with Lessons from the Past.

[8] Nigel Shadbolt. 2016. *Shadbolt Review of Computer Sciences Degree Accreditation and Graduate Employability*. Technical Report IND/16/5. Department for Business, Innovation & Skills; Higher Education Funding Council for England.

[9] Sally Smith, Martha Caddell, Ella Taylor-Smith, Colin Smith, and Alison Varey. 2020. Degree Apprenticeships - a Win-Win Model? A Comparison of Policy Aims with the Expectations and Experiences of Apprentices. *Journal of Vocational Education & Training* 0, 0 (March 2020), 1–21. https://doi.org/10.1080/13636820.2020.1744690

[10] Sally Smith, Ella Taylor-Smith, Khristin Fabian, Matthew Barr, Tessa Berg, David Cutting, James Paterson, Tiffany Young, and Mark Zarb. 2020. Computing Degree Apprenticeships: An Opportunity to Address Gender Imbalance in the IT Sector?. In *2020 IEEE Frontiers in Education Conference (FIE)*. 1–8. https://doi.org/10.1109/FIE44824.2020.9274144

[11] Sally Smith, Ella Taylor-Smith, Khristin Fabian, Mark Zarb, James Paterson, Matthew Barr, and Tessa Berg. 2021. A Multi-Institutional Exploration of the Social Mobility Potential of Degree Apprenticeships. *Journal of Education and Work* (July 2021), 1–16. https://doi.org/10.1080/13639080.2021.1946494

[12] Social Affairs and Inclusion (European Commission) Directorate-General for Employment. 2023. *Employment and Social Developments in Europe 2023*. Publications Office of the European Union, LU.

[13] Ella Taylor-Smith, Sally Smith, and Khristin Fabian. 2022. Apprentices' Longitudinal Perspectives of the Tripartite Collaboration at the Heart of Degree Apprenticeships. (Sept. 2022).

[14] Ella Taylor-Smith, Sally Smith, Khristin Fabian, Tessa Berg, Debbie Meharg, and Alison Varey. 2019. Bridging the Digital Skills Gap: Are Computing Degree Apprenticeships the Answer?. In *Proceedings of the 2019 ACM Conference on Innovation and Technology in Computer Science Education (ITiCSE '19)*. Association for Computing Machinery, Aberdeen, Scotland Uk, 126–132. https://doi.org/10.1145/3304221.3319744

[15] Ella Taylor-Smith, Sally Smith, and Colin Smith. 2019. Identity and Belonging for Graduate Apprenticeships in Computing: The Experience of First Cohort Degree Apprentices in Scotland. In *Proceedings of the 2019 ACM Conference on Innovation and Technology in Computer Science Education (ITiCSE '19)*. Association for Computing Machinery, Aberdeen, Scotland Uk, 2–8. https://doi.org/10.1145/3304221.3319753

[16] Universities UK. 2019. *The Future of Degree Apprenticeships*. Technical Report. Universities UK, London, UK.