Office for Students

Evaluation of new data science and artificial intelligence postgraduate conversion courses

Final report

Report to the Office for Students by the Careers Research & Advisory Centre (CRAC)

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1 Executive summary

This is the final report of an evaluation undertaken by the Careers Research & Advisory Centre (CRAC) of a programme through which the Office for Students (OfS) funded development of postgraduate conversion courses in artificial intelligence (AI) and data science. Course development was underpinned by funding for 1000 scholarships (of £10,000 each) for female, Black or disabled students (as three priority groups), and for a range of other underrepresented student groups. The total programme funding comprised £13.5 million – £3.5 million allocated to course development and £10 million as scholarships for students starting courses in academic years 2020/21, 2021/22 and 2022/23. Funded by the Department for Science, Innovation and Technology (DSIT), the programme aims were:

- To accelerate the number of highly skilled workers entering the UK AI and data science workforce by 2500 by autumn 2023;
- To increase the diversity of the AI and data science workforce by funding 1000 scholarships;
- To increase the knowledge base about conversion courses, flexible provision and outreach for mature students.

In practice, achievement of these aims could not be assessed fully within the evaluation period, so the evaluation's aims were to assess more observable, intermediate outcomes that could indicate whether the programme was progressing towards its long-term aims:

- Achievement of 2500 highly skilled AI and data science graduates by spring 2023;
- Achievement of increased diversity among those AI and data science graduates through the allocation of the scholarships.

The evaluation was designed and implemented as a mixed-methods approach, using monitoring information and student profile data from the funded providers, dialogues with funded project teams, programme-wide student surveys and a series of programme workshops to share challenges and emerging learning.

Progress against programme outcomes

Outcome 1: 2500 additional graduates in AI and data science

Courses developed for the programme are expected to produce at least 6000 new graduates in total (around 5000 by the time of this report), far exceeding the target. We estimate that students on the courses in the programme constituted 18 per cent of all entrants to UK postgraduate taught (PGT) courses, and 26 per cent of UK-domiciled entrants, in these disciplines in 2020/21. The number of students on such courses is over one third higher compared with the previous year. As new intakes to the courses grew in size, these proportions increased to 24 per cent of all students, 28 per cent of UK-domiciled students and 87 per cent growth in course entrants, respectively, the following year. This is evidence that the programme has had a substantial positive effect on the total pipeline of PGT students and graduates in AI and data science in the UK.

Evidence for post-course outcomes to date relies upon a modest number (265) of survey responses from graduates, as results from the Graduate Outcomes survey have not yet emerged. These early results strongly suggest most course graduates are achieving employment outcomes in the UK to which the programme aspires.

Outcome 2: Increased diversity of AI and data science graduates

There is a variety of data demonstrating that cohorts on courses in the programme are more diverse than broadly equivalent UK PGT course cohorts in relation to the key priority characteristics. This is at least partly due to the targeted scholarships. The overall proportions of female students, those declaring a disability, and UK-domiciled Black students are all far higher than in available benchmark student populations. Evidence for the effect of scholarships for the other underrepresented groups beyond the three priority groups is much more limited.

These results indicate that the programme's targeted scholarships have contributed to an enhanced diversity of student cohorts. The cohorts also comprise students with a wider range of first-degree backgrounds than overall, due to their design as conversion courses.

Programme activities and outputs

The programme funded projects at 28 institutions, 17 as independent projects and 11 of them in an Institute of Coding consortium headed by Coventry University. Between them they offered 37 postgraduate conversion courses in AI and data science, of which over 30 were entirely new.

To date, over 7600 students have enrolled on these courses, far exceeding original targets. While 56 per cent of students in 2020/21 intakes were of UK domicile, that proportion has since fallen and in 2022/23 intakes was 14 per cent. The strong demand led to far more providers offering multiple intakes per year to courses than they had proposed. Student intakes have been sustainable economically and in some cases become very large (intakes of over 100 students now being common). The 'success' of these new courses in terms of enrolments and fee income have led to institutional awards and underpinned development of new facilities or buildings.

Course intakes have included students with a wide range of domiciles and first degree backgrounds, with the majority having a first degree unrelated to AI or data science (i.e. 'conversion' students). Evidence to date suggests the majority of students entered from a position of employment, many as mature students, while those who progressed immediately from a first degree were in the minority.

More than 950 of the 1000 funded scholarships were awarded (according to student-level data provided through the programme, while final project reports from providers suggested the figure was over 970). The profile of students with scholarships was highly diverse in terms of elevated proportions of female, Black and disabled students. Although UK students obtained over 80 per cent of all the scholarships awarded for 2020/21 intakes, that proportion has fallen with time. Demand from UK students in the priority groups was insufficient to fulfil the higher annual allocations of awards after the first year of the programme, and just under half of scholarships in 2022/23 intakes went to UK students. There has been strong competition between international students applying for scholarships.

Graduate outcomes

Based on data from providers for course intakes in the first half of the programme, at least 85 per cent of students have completed or are expected to complete courses successfully. Based on 265 survey responses two months after course completion, 45 per cent of course graduates had already obtained a new job and eight per cent started a doctorate, and only

eight per cent remained in or returned to a pre-existing job and were not seeking new employment (although the response sample underrepresented part-time students).

Amongst graduates reporting a new job or offer, for 88 per cent this was employment directly relating to the course. Although these job offers were across a wide range of sectors, analysis of job titles confirmed that almost every new role achieved was quite strongly AI or data focused. Many who had been international students were achieving these outcomes within the UK.

Lessons for conversion course provision

A wide variety of experiences emerged from delivery of new courses in the programme. Challenges for higher education providers included the balance of content needed for students with a wide variety of subject backgrounds and career experiences, while student feedback emphasised the desirability of even more focus on industry examples and applications, and the use of industry software and technologies.

Providing the personalised support needed by some students without any background in programming or mathematics was challenging across large intakes and required a variety of additional resourcing. Some providers used streaming when teaching certain modules, recognising that groups of students had widely different needs.

Evidence suggested that one third of all students undertook an industry placement, although demand outstripped supply (and acutely during the period of Covid-19 restrictions). Feedback on placements and industry-focused projects was highly positive, while many providers offered other industry-related learning activities and specific career-related support to help conversion students engage with and transition to the AI or data industries.

Recommendations

For funders and the HE sector, in relation to programme aims

- There is evidence that PG conversion courses do increase the pipeline of AI and data science graduates, so we recommend that such provision should continue;
- Targeted scholarships have enhanced the diversity of the pipeline of graduate talent so, again, we recommend that Government continues to support such scholarships targeted towards under-represented groups (acknowledging that a successor programme is underway to support 2023/24 and 2024/25 intakes);
- We recommend that conversion courses are considered more widely as a response to desired enhancement of other skills pipelines.

For the OfS in relation to operating conversion course scholarship programmes

- We recommend that attention is given to ensuring greater consistency in providers' interpretation and implementation of scholarship eligibility criteria, where such awards aim to enhance participation by under-represented groups;
- Within the successor PG conversion course scholarships programme, we highlight the need to monitor and review scholarship demand and allocation, given its more restrictive criteria in relation to domicile, and recommend retaining the potential to adjust criteria without too long a lead time (i.e. guidance should not be fixed for too long).

For the OfS in relation to evaluating conversion course scholarship programmes

- We recommend close cooperation between the external evaluator and the OfS in designing monitoring requirements for funded providers, to avoid duplication of reporting effort;
- The use of administrative data, and sufficient evaluation duration to analyse such data, would be beneficial to obtain more robust data on rates of completion of students on conversion courses;
- Given the aspiration of this programme to enhance the number and diversity of those entering the AI and data science workforce (rather than graduates with that potential), we recommend any future evaluative activity is of sufficient duration to observe transitions into that workforce and that there is a clearer definition of the footprint of occupations in that workforce;
- We recommend continued assessment of programme outcomes for international students, to assess whether they should be included within targeted scholarships.

For HE providers in relation to conversion course provision

- As there is some evidence that very large class sizes are impacting on the experiences of students, continued monitoring of delivery and student experiences is needed and providers should ensure sufficient resourcing for teaching and support of such large numbers of students with a wide range of backgrounds and needs;
- We recommend that providers actively obtain feedback from students to continue to optimise design, content and delivery of new provision developed in this programme, including the extent to which it reflects contemporary industry needs for skills;
- Given evidence of the multiple benefits of student interactions with industry, the range of options for industry engagement should be reviewed and enhanced (and not restricted to placement and project opportunities);
- We recommend that alumni from the conversion courses are engaged by providers in order to (1) generate positive personal testimonies (including employment outcomes and career changes enabled) that will support course marketing and (2) offer additional support for students in relation to achieving their post-course career aspirations;
- Although not specific to this programme, we urge providers (and/or the HE sector more widely) to increase their ability to engage with programme alumni as they can provide critical evidence for assessing programmes' long-term outcomes and impacts.

2 Introduction and context

This chapter aims to provide context to this report which is the outcome of an independent evaluation by the Careers Research & Advisory Centre (CRAC) of a government-funded programme to support development of postgraduate conversion courses in artificial intelligence (AI) and data science. This funding was intended in the long term to address the current shortage of specialists in these areas (which is expected to continue) and diversify the pipeline of skilled graduates entering the UK AI and data science workforce.

2.1 Background

The UK Government's 2017 UK Digital Strategy predicted that most jobs in future will require some digital skills while high-level digital skills will be key to developing and implementing the new technologies, products and services that will comprise much of our future economy.[1] The 2017 Industrial Strategy highlighted data and AI amongst the 'Grand Challenges' for the UK to position itself for future prosperity.[2] Within the context of the industrial transformation known as Industry 4.0, AI and machine learning are new industries in their own right but are expected also to underpin new ways of doing business in many sectors. The Industrial Strategy sought to put the UK at the forefront of this AI and data revolution, potentially creating thousands of jobs and driving economic growth.

Demand from industry is outstripping supply for individuals with skills in data science, AI and machine learning.[3] A 2020 survey of UK public and private sector organisations using AI or developing AI-led products or services found that 62 per cent of responding organisations could not meet their goals because their staff or new job applicants lacked the skills needed.[4] Analysis of job advertisements between 2013 and 2018 suggested vacancies for data scientists and advanced analysts increased by 231 per cent, compared with a 36 per cent increase in the UK overall.[5] In 2021, the Department for Science, Innovation and Technology (DSIT) (formerly the Department for Digital, Culture, Media and Sport (DCMS)) estimated that the supply of data scientists from UK universities was unlikely to exceed 10,000 per year, yet there were potentially at least 178,000 data specialist roles to be filled.[6]

The Office for Artificial Intelligence (OAI) leads efforts to develop the skilled workforce necessary for the UK to harness AI. Its 'AI Sector Deal' suggested the UK needs: a large workforce with deep AI expertise; a more diverse AI research base and workforce; and better data and digital skills in the wider workforce to enable effective use of AI.[7] The subsequent National AI Strategy highlighted developing and attracting people with specialist data skills as key to maintaining international leadership.[8] In parallel, the National Data Strategy also recognised 'data skills' as one of its key underpinning pillars.[9]

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[1] *UK digital strategy*, Department for Digital, Culture, Media & Sport, 2017
[2] *Industrial strategy: Building a Britain fit for the future*, HM Government, 2017
[3] *Growing the artificial intelligence industry in the UK*, DCMS and BEIS, 2017
[4] *Understanding the UK AI labour market: 2020*. Ipsos Mori, 2021
[5] *Dynamics of data science skills. How can all sectors benefit from data science talent?* The Royal Society, 2019
[6] *Quantifying the UK Data Skills Gap*, Department for Science, Innovation & Technology et al., 2021
[7] *Industrial Strategy: Artificial Intelligence Sector Deal*, HM Government 2018
[8] *National AI Strategy,* Department for Science, Innovation and Technology et al., 2022
[9] *National Data Strategy*, Department for Science, Innovation and Technology et al., 2022

In 2017 there were only 26 UK universities offering first degree courses in AI, which between them also offered circa 30 postgraduate (PG) programmes (on which most students were from overseas). Although student numbers rose modestly through to 2019, the pace of growth was far lower than the apparent rising demand from industry for skills. The 2021 'AI roadmap' by the AI Council made two recommendations in relation to high-level skills and diversity:[10]

- *"Scale up and commit to an ongoing 10-year programme of high-level AI skill building. This would include research fellowships, AI-relevant PhDs across disciplines, industry-led Master's and Level 7 apprenticeships."*
- *"Make diversity and inclusion a priority. We suggest benchmarking and forensically tracking levels of diversity to make data-led decisions about where to invest and ensure that under-represented groups are given equal opportunity and included in all programs."*

The existing workforce with specialist computing and/or AI skills is far from diverse, and the current supply pipeline from education is little better in terms of diversity. It is acknowledged that this lack of diversity could not only limit the potential supply of future talent but also hold back its capacity for innovation and creativity.[11] While there is relatively little data about the profile of the AI or data science workforces in the UK, studies have indicated demographic disparities in AI workforces internationally including in relation to gender and ethnicity.[12]

For organisations working with AI and algorithms, a lack of workforce diversity can amplify existing inequalities and prejudices, for example through algorithmic bias where automated systems produce systematically prejudiced results.[13] This can perpetuate social inequalities when AI systems are used to make decisions, such as whether a person is invited to an interview or selected as a rental tenant.[14] In response, the Centre for Data Ethics and Innovations concluded that having more diverse teams made the identification of algorithmic biases more likely and their replication less likely, and advised organisations deploying decision-making algorithms to make diversity across their workforce a priority.[15]

2.2 Funding for new postgraduate conversion courses

Traditionally, the main strategic response to graduate-level skill shortages has been to try to increase the number of people that undertake first degrees in appropriate subjects, who could potentially enter employment as new graduates with the skills desired. However, this is a slow response and increasingly seen as insufficient, not least because the majority of the people who will be in the workforce in 20 years' time are already in the workforce. The inflow of new skills via additional graduates entering that labour force will only dent, and not satisfy, the rising demand. Fulfilment of that demand for high-level skills in data, AI or engineering, as examples, may require not only more new graduates to enter the sector but also the re-skilling of existing graduates and/or employees. An additional and potentially more rapid response is through conversion courses which re-skill recent graduates from other disciplines or up-skill (or re-skill) existing members of the workforce.

[10] *AI Roadmap*, UK AI Council, 2021
[11] *AI sector deal review*, HM Government, 2019
[12] *Where are the women? Mapping the gender job gap in AI*. The Alan Turing Institute, 2021
[13] *Understanding algorithmic bias and how to build trust in AI,* PricewaterhouseCoopers, 2022
[14] *Notes from the AI frontier: Tackling bias in AI (and in humans).* McKinsey Global Institute, 2019
[15] *Review into bias in algorithmic decision-making*, Centre for Data Ethics and Innovation, 2020

Some MSc courses already provide 'conversion' to subjects like engineering, targeting graduates with first degrees such as mathematics and physics.[16] In 2015 the Higher Education Funding Council for England, Department for Business, Innovation & Skills and DCMS funded development of 45 pilot conversion courses at Master's level in engineering, data science and computing. The scheme explored whether these could enable graduates without a prior STEM[17] first degree to enter engineering or computing careers. CRAC's evaluation of the scheme demonstrated that some courses successfully achieved that aim, and that courses in data science were particularly successful in terms of participation.[18]

In 2019 DSIT and OAI announced support for development of postgraduate conversion courses in AI and data science, to help address the shortage of specialists in these areas. Following a funding competition, 18 projects (comprising 17 individual universities and a consortium of 11 other universities) were awarded funding from the Office for Students (OfS) starting in April 2020 to develop and deliver new conversion courses. This was underpinned by funding for 1000 scholarships (of £10,000 each) to be offered to increase the diversity of participating graduates. These scholarships were specifically prioritised for Black, female and disabled students, and could additionally be made available for a range of other student groups who are identified as under-represented in the UK. The total programme funding comprised £13.5 million – £3.5 million allocated to course development costs and £10 million as scholarships for students starting courses in academic years 2020/21, 2021/22 and 2022/23. CRAC was appointed by the OfS to evaluate this programme.

2.2.1 Programme aims

The aims of the new programme, through the funded projects, were stated as:

- To accelerate the number of highly skilled workers [entering the UK AI and data science workforce] by 2500 by autumn 2023;
- To increase the diversity of that workforce by funding 1000 scholarships to support the following under-represented groups (with particular focus on the first three):
  - Female students
  - Black students
  - Students registered disabled
  - Students from POLAR Q1 and Q2[19]
  - Care-experienced students
  - Estranged students
  - Gypsy, Roma, and Traveller students
  - Refugees
  - Children from military families, veterans and partners of military personnel;
- To increase the knowledge base on conversion courses, as a means to re-skill or up-skill mature learners.

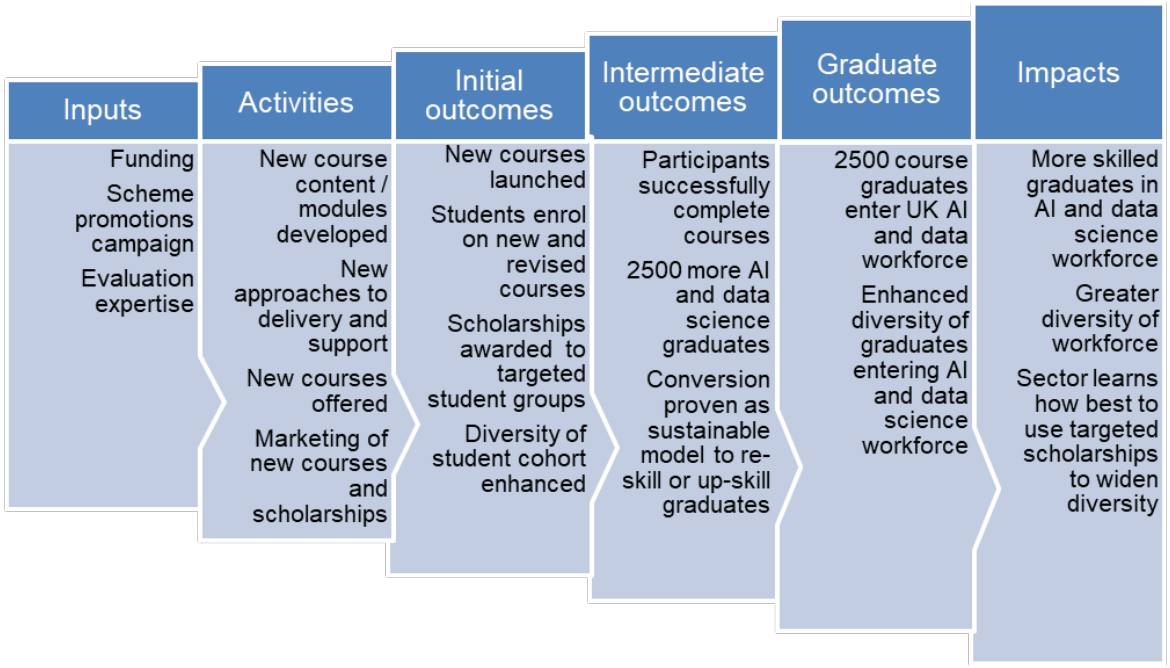
[16] *Transition to Engineering,* HEFCE, 2015
[17] Science, technology, engineering or mathematics
[18] *Evaluation of a scheme to develop pilot engineering and computing conversion master's courses*, Office for Students, 2019
[19] Participation of local areas (POLAR) classification based on proportions of young people who participate in higher education, in five bands (quintiles).

3 Evaluation aims and approach

3.1 Evaluation design

Two of the programme aims, to enhance the number of highly skilled workers entering the UK AI and data science workforce and to increase the diversity of the AI and data science workforce, are impacts within the theory of change we developed to underpin the evaluation (Figure 3.1). We added a third impact which was to establish PG conversion courses as a proven and potentially scalable method with which to achieve the first two. This was essentially an articulation of the third programme aim in the previous chapter. The primary evaluation objectives were to assess whether, and the extent to which, these impacts were achieved.

Figure 3.1. Simple theory of change depiction for the conversion courses programme



In practice, not all graduates from the courses in the programme will enter (or progress within) the UK AI and data science workforce, because they would be widely employable and many will be international students who might not wish to or be able to work in the UK. Within the timetable of the evaluation, it would also not be possible to measure the employment outcomes of all programme graduates, because some students would still be studying their course and not all graduates will make post-course employment changes immediately. Recognising this, the evaluation focused on observable initial, intermediate and graduate outcomes (in the theory of change) that could indicate whether the programme was progressing towards the desired long-term impacts. Two such specific outcomes for the programme were:

- To achieve 2500 highly skilled AI and data science graduates by spring 2023;
- To achieve an increased diversity of those AI and data science graduates through the allocation of 1000 scholarships.

Practically, the evaluation aimed to combine a summative, programme-level assessment (e.g. did the funding programme achieve its aims?) and more formative investigations at individual project level including identification of innovation or effective practice (e.g. what worked well?). The following research topics were identified from the theory of change, listed here with the key sections of this report in which they are addressed:

Initial outcomes

- The new courses launched (section 4.1) and number and profile of students enrolled (5.1, 5.3);
- Number of scholarships awarded to targeted groups of students (5.2);
- The extent to which targeted scholarships were successful in widening diversity of participation, and whether this worked better for some groups than others (5.3, 8.1);

Intermediate outcomes

- Number of students successfully completing courses (5.6);
- Identify approaches to delivery that worked well (especially for those returning to study and/or for students 'converting' from non-cognate and non-STEM first degrees) (4.2);

Graduate outcomes

- Identify, where observable, course graduates' subsequent career and employment outcomes (e.g. entry to relevant occupations or job changes/progression) (6.2);
- Establish measures and indicators of success or impact for sustained use beyond the timescale of the evaluation (7.3);

Formative aims

- Provide recommendations for the sector and institutions about future provision of conversion courses and their contribution to workforce development (8.3);
- Consider the effectiveness of the design and implementation of the programme and its evaluation, to inform future OfS evaluations of its programmes (7.1, 7.2, 7.3);
- During the programme, support the sharing of practice, knowledge and learning that emerged across the programme.

3.2 Methodological approaches and samples achieved

In designing the evaluation, we assumed there would be three main sources of information available to us during the period of evaluation activity:

- Information submitted by funded providers to the OfS (original proposals, progress reports);
- Staff involved in course provision in the funded providers (directly as informants, and to provide other monitoring information that we might request);
- Course participants themselves (through programme-wide research instruments we could deploy at various stages).

The evaluation design took into account our experiences evaluating the pilot conversion courses programme and recognition of the potential reporting burdens on funded providers, as well as the aspiration to maximise opportunities for sharing emerging learning during the programme. The following strands of research activity were undertaken during the period autumn 2020 to summer 2023.

Provider dialogues

Members of the evaluation team at CRAC engaged with key staff (principally project leaders) at the funded providers through scheduled provider 'dialogues'. These were informal, lightly structured interviews in which progress, experiences, challenges and key issues were shared, to deepen our understanding beyond progress monitoring returns submitted to the OfS by funded projects. These dialogues were held three times per year for each project, and interview notes were used as a key information source. In practice, these interviews also helped to ensure that projects provided data about their students and that they disseminated our surveys. Overall, the level of engagement obtained was high and in most cases persisted throughout the evaluation. We are grateful for that support and enthusiasm to share experiences.

Information and data from providers

Initial desk research to study the proposals submitted by funded providers helped us understand approaches, target market/s and projected outcomes including numbers and range of students. Monitoring templates that funded providers returned to the OfS to report their progress were shared with us and reviewed, throughout the programme. To minimise potential duplication in reporting by providers, each template was reviewed by CRAC prior to issue so that the information sought dovetailed with, rather than duplicated, requests we made directly to providers for data/information.

For each intake to their course/s, we sought from each funded provider a completed 'student demographics template'. In this they provided detailed profile data about every student, including scholarship awardees, such as personal characteristics, nationality, course, mode of study and first degree subject. Collating these data systematically across the programme enabled us to analyse and monitor the total number and profile of students as it progressed. The amount of data increased as courses flourished, requiring substantial effort by providers' to collect these data for every student. Nonetheless, we obtained near-complete coverage of students although with some decrease in completeness during the third year of the programme. One exception was that providers reported limited ability to identify whether students were within the under-represented groups other than the three priority groups (female, Black and disabled students). Providers reported that collecting data from PG students about their family and socio-economic background was challenging and these data were much more partial (and its absence could not be taken to mean a student did not have that characteristic).

Identifying students' first degree subject required manual data collection by providers, sometimes including a review of individual application forms, as this was not recorded in admissions systems and/or available from them. The extent of coverage of first degree subjects was admirably high (88 per cent) in the circumstances.

Student-level data about course completion were also requested within the data returns we sought from project teams for subsequent intakes. In retrospect, seeking these data at the same time as data about students in new intakes was not ideal, as it did not correspond to when students were completing courses. Completion data collection was also hampered by the differing durations of courses and the occurrence of deferral and/or repeat of modules or assessments by students. However, data about completion status were provided for around 1100 students who commenced courses in Year 1 (and a few intakes in autumn 2021 of

Year 2), after which it was agreed with the OfS that projects should not be asked to provide student-level completion data, to avoid overloading them with data tasks.

Programme-wide surveys

Three online surveys were developed and implemented, with the aim of eliciting key information from course students across the programme at specific points in their participation. The first aimed to engage students around two months after enrolment on a course, while a second 'completion' survey was deployed shortly after students had completed their course. A further, third survey was attempted with course graduates ('alumni') approximately one year after graduation. Due to the incidence of multiple course intakes per year by many providers, and some different course durations, deploying these surveys required a complex plan of survey waves.

The student survey aimed to provide insights into key issues such as students' rationales for enrolment, prior education/work trajectory, funding, experiences of course delivery, and career thinking including aspirations for post-course outcomes. The completion survey with recent course graduates sought further reflections on participation and, critically, details of next steps intended or taken, such as job applications or new jobs secured, and/or changes to career intentions. The subsequent 'alumni' survey was designed to confirm post-course career steps and obtain further employment outcomes data. Invitations to students (and subsequently as graduates) were disseminated by the providers on our behalf.

After data cleaning, 1012 unique responses were obtained to the student survey, with respondents from 25 of the 28 funded providers, representing a response rate of over 14 per cent. Scholarship awardees were significantly overrepresented in the response sample (37 per cent of responses, which corresponded to a response rate of almost 40 per cent amongst scholarship awardees).

Engagement in the completion and alumni surveys was, predictably, lower, partly because not all students had reached these stages during the evaluation period. In practice the completion survey could only be targeted to students who started courses in Years 1 and 2 of the programme (2020/21 and 2021/22) on a full-time basis, as those in Year 3 intakes and most studying part-time had not completed their course by the end of the evaluation fieldwork period. A total of 292 unique responses were obtained to the completion survey, from students at 23 of the providers (noting that by this time no students had yet completed one provider's wholly part-time course). This was an estimated response rate of around 10 per cent of those in scope. This lower rate (than for the student survey) partly reflected that not all provider project teams retained or could access contact details for students after they had left the university, hence were limited in whom they could invite.

Only those starting a course in 2020/21 were in scope for the alumni survey by the time our fieldwork ended and even among those it proved to be much more problematic to engage graduates. Most providers were not permitted to retain student contact data at this stage and had passed such data to alumni teams. The latter were reported to be reluctant to circulate invitations to this survey when requested as they prioritised institutional communications. We were able to collect contacts data and consents directly from some student and graduate survey respondents, which we could use for the alumni survey. However, only 37 complete responses to the alumni survey were obtained by the end of the evaluation (although we estimate that up to 900 students would have been in scope had they been contactable practically). The difficulty of maintaining engagement with alumni, to ascertain longer-term

impacts of a programme, was not unique to this programme. An alternative approach to assessing such impacts using alumni data could be beneficial in future programme/ evaluation designs.

Programme workshops

To promote the sharing of learning and disseminate key information across and between funded projects, online workshops were held in May 2020, May 2021, May 2022 and March 2023. These enabled funded provider representatives to raise common concerns and foster personal contact with other projects so that they could reach out informally for mutual support. Either one or two staff from each of the funded projects attended most of the workshops. In each case, CRAC co-designed the workshop programme and members of our evaluation team facilitated discussion groups. Notes from these discussions were collated and together provided another information source for the evaluation. We heard many times that provider teams found these workshops highly valuable.

Table 3.1 summarises how these different strands of evaluation activity provided data or other evidence with which to address key research topics and questions.

Table 3.1 Key research topics/questions and how they were addressed by research strands

Information sources/research strands	**Provider data**	**Provider dialogues**	**Programme-wide surveys**	**Programme workshops**
Research topics				
Courses / students / scholarships: Courses delivered Enrolments Scholarship awards Student/scholarship profiles Whether 'conversion' students	 ✓ ✓ ✓ ✓ ✓	 ✓	 ✓ ✓	
Graduate / employment / career outcomes: Completions Next career destinations Number/profile entering target workforce Occupations/roles entered	✓	✓ ✓	 ✓ ✓ ✓	
Learning from the programme: Sharing emerging learning between providers What approaches worked well Enhancements for future provision		 ✓ ✓ ✓		 ✓ ✓
Effectiveness of programme design: Enhancing future programme design/s Effectiveness of evaluation approach	 ✓ ✓	 ✓	 ✓	 ✓

3.3 Evaluation reporting and recommendations

A number of interim evaluation reports were produced and published during the course of the evaluation, which included certain recommendations on the basis of emerging results.[20] While this is the final evaluation report, those previous recommendations are described within the sections on lessons learned, rather than duplicated here as recommendations (noting that some have already informed subsequent programme and funding decisions).

[20] See https://www.officeforstudents.org.uk/advice-and-guidance/skills-and-employment/postgraduate-conversion-courses-in-data-science-and-artificial-intelligence/evaluating-impact/

4 Course provision and delivery experiences

This chapter presents results on the extent and nature of course provision developed, a key initial programme outcome. It then considers conversion course provision in more depth and draws out some lessons learned from these new delivery experiences, reflecting one of the desired outcomes of the programme and the formative aims of the evaluation.

Results in brief

As a result of the funding, 37 postgraduate conversion courses in AI and data science were offered by 28 providers within the programme, of which 30 were entirely new. The remainder were pre-existing courses revised to accommodate students with a wide variety of backgrounds.

Strong demand led to 15 of the courses (offered by 12 providers) offering more than one intake per year.

Courses were sustainable economically and in some cases intakes became very large as student interest grew. The success of some courses led to institutional awards and underpinned development of new facilities or buildings.

Challenges for providers included the balance of content and personalised support needed by some students without a background in programming or mathematics, at scale.

Around one third of students undertook an industry placement, although demand outstripped supply. Feedback on the value of placements and industry-focused projects was highly positive and recommended including even more industry-focused content and applications as part of course delivery.

Student satisfaction with the study experience was high according to our surveys, with over 80 per cent satisfied overall. Over two thirds of course graduates surveyed would recommend their course to somebody who had not previously studied data science or AI.

4.1 Course provision

The programme encompassed activity by a total of 28 institutions, 17 as independent projects and 11 in an Institute of Coding (IoC) consortium headed by Coventry University. Ultimately these institutions offered a total of 37 courses in total, 19 of which we classified (on the basis of course title) as data science, nine as AI and the remaining nine spanning both disciplines (Table 4.1). Largely due to impacts of the Covid-19 pandemic, 11 of the providers deferred their first intake to January 2021 (rather than October 2020 as proposed) and three to autumn 2021, as shown in Appendix 1.[21]

Although only two providers originally proposed multiple intakes per year, this grew to 15 courses (offered by 12 providers) with the progressive introduction of extra intakes in response to strong student demand.

[21] 'October' is used as a shorthand to cover intakes in September or October each year, and 'January' to cover January or February.

Table 4.1 Providers and courses within the programme

Broad course theme	Number of courses	Number of providers
Data science	19	17
AI	9	9
AI and data science	9	9

Our understanding is that almost all the courses were new provision, developed using the programme funding, with a few pre-existing courses revised (including introduction of new specialisation options) or opened to wider eligibility to make them conversion courses. Due to the range of the latter 'revisions' (and some course variants that were offered) it is hard to be definitive about which were truly new, but our view is that more than 30 entirely new courses were launched as a result of the funding programme.

An impressive feature of these results is that all but two of the funded providers designed and developed new provision, gained institutional approval for it, and then promoted that new provision and admitted students by October 2020 or January 2021, given that funding commenced in April 2020. Project leaders reported that this rate of progress was more rapid than they were accustomed to. It was also achieved against the backdrop of Covid-19, which placed additional burdens on providers as they switched teaching online and introduced new ways to support remote students.

The rapidity with which funded providers progressed was reported to have been assisted by expectations of a strong market for postgraduate taught (PGT) courses amongst new and recent graduates in 2020/21, as a result of perceptions of a sharp downturn in the graduate labour market due to Covid-19. Dialogues with project leaders confirmed that expectation had led to increased flexibility being available in some institutions' approval processes and their duration.

All the courses were offered as MSc provision with the exception of Birkbeck's PGCert course on Applied Data Science. A variety of modes of study were offered, with most courses being offered either as only full-time or a choice between full- or part-time study, while two were offered solely for part-time study. A number of providers that launched courses initially only for full-time study, due to haste in development, subsequently introduced a part-time option too. The vast majority of full-time courses were a single year in duration (including a project and dissertation), with a few exceptions being two years full-time. Some providers additionally offered a course variant with a compulsory placement which extended the duration. Brunel University developed and introduced a degree apprenticeship path option too, towards the end of the programme. The University of Bath's wholly online AI course allowed students to enrol/pay on a modular basis and build an MSc qualification over up to five years, with three intakes per year (and some opportunity to switch cohorts should a student need to 'step off' the course for a period). The University of Wolverhampton's courses, delivered using a carousel approach with four intakes per year, offered some similar flexibility for students with unexpected commitments to defer to a subsequent cohort.

4.2 Provider experiences and lessons learnt

In this section we present information drawn largely (but not exclusively) from dialogues with funded providers and their monitoring reports to the OfS, together with some quotations from graduates. The aim is to showcase distinctive or effective aspects of practice in delivery of conversion courses, to learn from those experiences. Where a specific provider's practice is described, this does not mean it was unique, but rather is featured as an example. Equally, comments from course graduates do not indicate representativeness of those views.

4.2.1 Enrolment success and large class sizes

Student-level profile data enabled us to monitor and analyse mean intake sizes through the programme. Courses we classified as AI had the smallest mean intake, at just over 30 students, which was roughly consistent through the programme (Table 4.2). In contrast, the mean intake for data science courses grew from just over 30 in Year 1 to 65 in Year 3. Growth in courses spanning AI and data science was even stronger, from a mean of 38 in Year 1 to over 100 in Year 3. A number of providers reported large intakes in Year 2 and some very large intakes towards the end of the programme, to courses in data science and combined AI and data science, including one of over 400 students at the University of Hull.

Table 4.2 Mean course intake sizes, by programme year

	AI	AI and data science	Data science
Year 1	35	38	31
Year 2	31	85	51
Year 3	34	105	65
Cumulative students	1237	2726	3641

In their final reports, several providers commented on the spectacular growth they had experienced through the programme. Enrolments on the University of Hull's course grew from a single intake of 31 in Year 1 to over 600 students in Year 3, spread across two intakes. The University of Wolverhampton mapped growth in application numbers from 500 in Year 1 to over 2500 in Year 3, enabling multiple intakes per year, and a total of 240 students, of whom 89 per cent were reported to be conversion students. In parallel, Solent University's applications also grew from under 500 in Year 1 to over 1200 in Year 3.

The attraction of large numbers of applications and enrolments led to several providers winning accolades or awards within their institution, recognising that success. Nottingham Trent University's course was recognised as the university's 'highest recruiting course' (at PG level), and Loughborough's team won its Vice-Chancellor's award for EDI[22]. Meanwhile the growth in international students on the course at the University of Suffolk helped to establish its visibility internationally and led to launch of several new PG courses, including a further conversion course.

[22] Equality, diversity and inclusion

Success in recruitment in this way supported development of new facilities at several providers, including new labs for data science at the University of Essex and an entirely new building and Centre for Excellence in Data Science, AI & Modelling at the University of Hull. On the other hand, some providers noted that these sizes of intakes had placed heavy requirements on those teaching the courses and, especially, on how to support large diverse student intakes. Many reported on additional staff that they had recruited and continued to seek to handle the large number of enrolled students.

However, there were also some adverse comments from course graduates in relation to large class sizes, and it should be remembered that these were mainly from students in Year 1 or autumn Year 2 intakes, not students in the most recent and largest intakes, so this is an area that providers will need to continue to focus on in terms of providing sufficient resourcing for teaching and support:

> *"I felt that the course was seriously oversubscribed, I was very surprised to see 70 or so people on our MS Teams calls for the main teaching components. This meant there was little individualised tuition, and this made it hard as a beginner to progress."*
>
> *"The course was enjoyable and I learned a lot. One area of improvement would be smaller class size."*

4.2.2 Course design and structure

Bootcamps and/or pre-sessional training

Many courses featured an initial bootcamp or introductory module, either at the start of the formal course timetable or beforehand (i.e. prior to formal enrolment on the course and commitment to fees, as 'pre-sessional' learning). A bootcamp or similar could play a variety of roles in terms of the teaching and learning, and/or assist in promoting understanding about and interest in a conversion course.

At the University of Liverpool, performance in pre-sessional learning (in mathematics and programming) was assessed informally to check whether students had the right aptitude to succeed on the course. Newcastle University reported that the pre-sessional training it developed for this programme subsequently led to its introduction for other data-related distance learning courses being developed, due to the role it could play in ensuring success when widening participation. The University of Sussex focused on programming skills in Python within its pre-sessional course. Birmingham City University pitched its bootcamp as a hackathon, with taster sessions prior to selection and enrolment, which also had the aim of producing a pool of motivated and suitable candidates for the course itself.

Delivery feature – Introductory bootcamp

Coventry University developed and implemented a different kind of bootcamp, offered as a taster to undergraduates and other prospective students prior to each planned intake. It aimed to promote awareness of conversion courses and furnish prospective students with the core principles required to study a conversion course in the Coventry-led consortium of providers. The open nature of the bootcamp was designed to promote diversity, being free to attendees and with no entry requirements that might be a barrier to engagement. In total, 5600 students were reported to have attended one of these bootcamps.

Inclusive delivery designs

For delivery of the main course, many providers adopted block structures where discrete modules of the course were delivered as a block of learning, of a month or six weeks duration, followed by subsequent blocks to build up the entire course. In many cases there was a project and dissertation at the end. A number of providers highlighted that to offer some flexibility for students who were also working, they organised teaching so that there were one or two fixed teaching days per week (on campus, or in some cases online) with the remainder of the week dedicated to self-paced and/or online study. Some amount of asynchronous online study was introduced as means to offer maximum flexibility to the student.

Delivery feature – Flexible timetabling and online learning

Teesside University, among others, introduced evening lectures and more online learning modes in order to widen access to those who were employed, recognising that as the cost of living was rising, more and more students would need to work while studying. A number of providers explicitly referred to inclusive course designs and curricula, to take into account both the non-cognate background of many students and the diversity of personal circumstances, including those remaining employed while studying.

Industry-focused course content

With the programme's intention that the courses would produce graduates who would be strongly employable in the UK AI and data science industries, all providers paid attention to what they perceived were industry's needs in their content design and course delivery. In practice, courses had a balance of fundamental knowledge and industry-relevant examples and applications, with varying extents of access to tools currently used in industry so that practical skills could be developed. We found evidence that the software and technologies being used varied across the courses, so student experiences were not universal. Some students specifically commented that they understood that a university could not be expected to keep up with industry technology and therefore that industry's contemporary tools might not be used.

Delivery feature: Industry skills focus

Nottingham Trent obtained strong involvement from industry in co-creating their syllabus, while industry partners contributed to delivery through guest lectures and research seminars as well as proposing and co-supervising projects. The course was also designed to enhance the employability of students, with bespoke employability events involving alumni and local industry and field trips to data science industry conventions where the students could see how the knowledge and skills they were developing could be put to use. Students had access to rich resources of tools and commercial links and gained a data science skills portfolio, while the course was also certificated with the Institute for Analytics to demonstrate their learning.

The feedback we obtained from students and graduates reflected these variations but clearly showed a demand from many for even greater industry focus, with graduates from some courses explicitly feeling they were not taught the software/languages that are currently used in and could help them transition into industry:

"Overall, my MSc studies covered a wide range of possible data science fields/topics/applications (e.g. machine learning, applied statistics, modelling experimental data) and provided the required data science academic materials. I was able to improve my existing R programming skills as well as learn Machine Learning using Python and manage databases using SQL."

"The course content was very theory-based, with few opportunities to practice the methods we were being taught about, so I feel I have graduated with a distinction in Data Science but am still very inexperienced in data science."

"I think the modules can be improved. It should reflect the actual problems solved in today's industry. I expected the program to be one that would help you transition easily into the AI and data science industry."

"The data science course is not fully updated as per the industry and research requirements. We have a few modules which are not viable for a data science career. It would be great if we can add modules related to deep learning, data visualization, big data and deployment tools."

"I feel like I did not learn the tools to be a successful data scientist. I learned how to code in Python but that's about it. There was nothing about common data science tools such as R studio, Power BI, Tableau, docker/hadoop etc."

Responding to student feedback

Feedback from students in early years of the programme was reported to have been instrumental in a number of course re-designs, to varying extents. There were many instances where specific modules were adjusted after first delivery, in order to cater better for conversion students.

Delivery feature – Revising course structure based on student feedback
At the University of Bradford, following Year 1 student feedback, labs and practical workshop sessions were delayed to week five of the course, to allow all students to get up to speed. Step-by-step user guides and materials were provided in advance of this so students could access and familiarise themselves with the platforms and software before the first planned session.

The completion survey provided examples of this sort of feedback from students, both positive and negative. Two of the themes which arose from numerous graduates in the survey were that they felt that course organisation should be better, although some appreciated that they were in the first intake of a new course, and the balance of content. We anticipated the latter to be challenging given the wide variety of student backgrounds, and feedback from conversion students that it was too advanced (and the pace too fast) together with different feedback from cognate students, i.e. that some teaching was too basic and slow, was to be expected. Some examples illuminate this issue:

"I think that conversion students should be encouraged to take this course over two years, in order to cement the basics required in maths and programming. I have a patchy understanding of many of these concepts because I was rushed to learn them, and now have to go back and relearn them. However, the course was very well run and there was a good level of support, the modules were interesting, with a good amount of variation between the module choices, and I enjoyed my year."

"I was initially a bit disappointed with the level of programming skills being taught but this is mainly due to the fact that I already do a bit of data analytics and machine learning. Subconsciously I expected more. Overall, I was exposed to more new tools, platforms, and other modules like ethics and governance that I am very satisfied with."

"While the course was good in that it provided me with a MSc, the fact that the first half of the year was tailored to non-computer science students meant I was repeating stuff instead of adding to my knowledge."

4.2.3 Support for conversion students

Given the large intakes of students on courses in the programme, offering personalised support to conversion students had been expected to be a challenge for providers. To help, some providers introduced an element of streaming within their teaching, so that conversion students could have more focus on core principles, mathematics or programming. Many providers offered additional support in skills such as mathematics or programming delivered by other parts of the university, that could be accessed by conversion students if they needed them, in addition to regular study support services. A reported benefit of a mixed cohort (both conversion and cognate students) was greater opportunities for peer-to-peer support. Cognate students with prior programming or mathematics or technical knowledge could help conversion students with lower skills in those areas, while the inherent high levels of enthusiasm and determination of many conversion students greatly helped all students during group work, for example.

Delivery feature: Approaches to providing support at scale

Keele University streamed conversion and cognate students separately for the first six weeks, enabling conversion students to have more intensive teaching of fundamentals. Similarly, at the University of Hull, streaming into those from STEM and non-STEM backgrounds was undertaken to offer more appropriate levels of support to students in these different groupings.

The University of Wolverhampton, amongst others, offered to all their students a free, self-paced online course in fundamental mathematics and programming.

In order to provide personalised support at scale, the University of Exeter introduced a mentoring offer by current doctoral students to add capacity to their support for conversion course students.

Beyond this, it was clear that the academic and teaching staff at providers themselves provided vast amounts of personal support to students, as student comments showed:

"Staff are very supportive and reply to emails during their private hours. They also [are] willing to adjust lectures based on student needs."

"I am highly satisfied with the support that I received from professors. However, I find one year to be very short in terms of time for this course. If we had more time (let's say two years) we could learn much more."

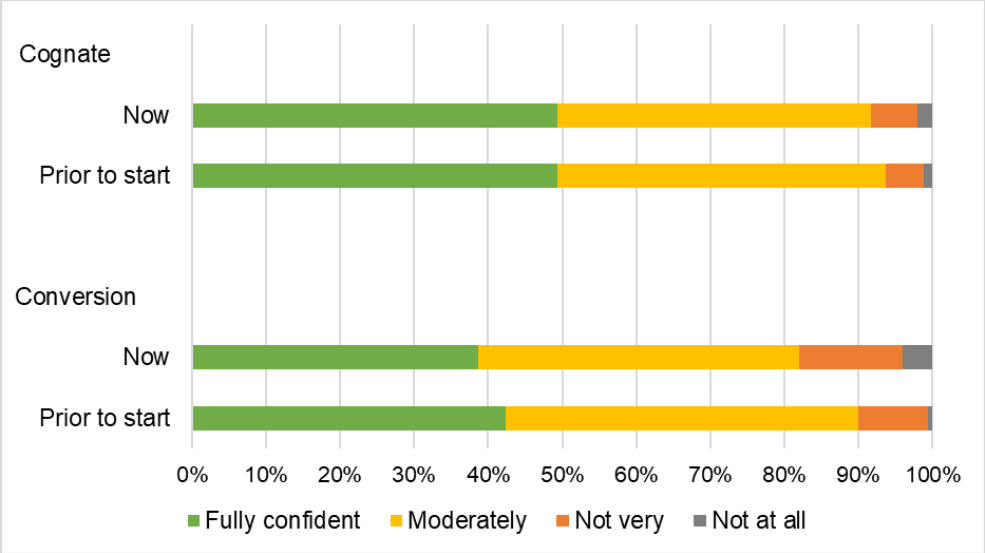
"The support from all staff was incredible. By far the best university experience I have had. The course was very interesting and I really enjoyed myself."

In the student survey we specifically investigated the challenges that non-cognate students faced when undertaking a conversion course, and whether they were different in practice from the challenges they had perceived in advance.

Confidence and challenges

Students were asked in the survey how confident they had felt about coping with studying the course and whether they would graduate successfully, prior to starting the course and also at the time of the survey, two months into the course. Figure 4.1 illustrates the results for conversion and cognate students.[23]

Figure 4.1 Student survey respondents' confidence to cope with requirements of study and graduate successfully, prior to start of course and when surveyed, by first degree type (Ns: cognate 407; conversion 488)



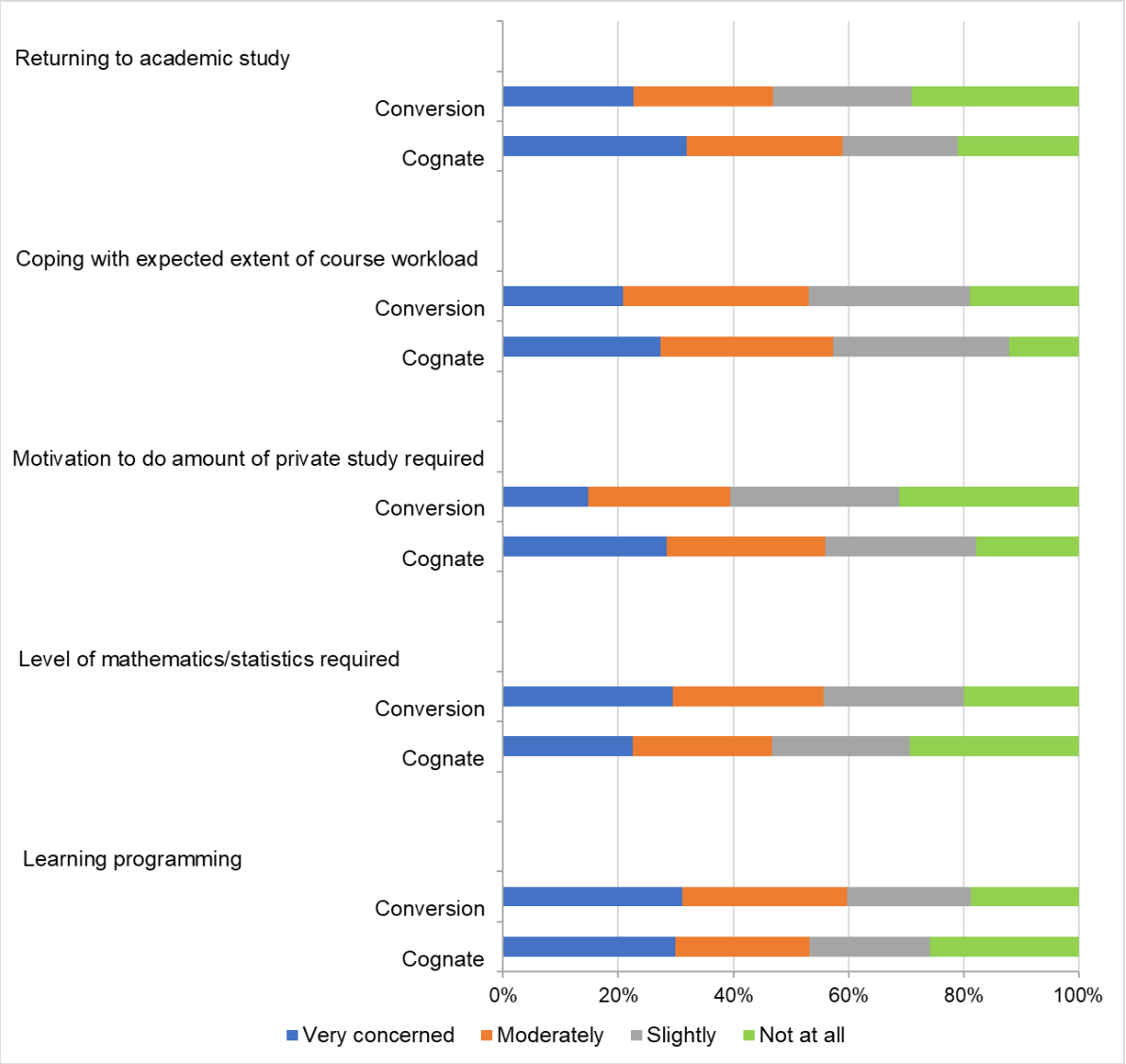
Conversion students were slightly less confident than cognate students, with more of them being concerned about the level of study in statistics, mathematics and programming (Figure 4.2). Conversion students' confidence levels were slightly lower still when surveyed, with one in five not being confident they would complete the course, compared to before they had started the course. On the other hand, fewer of the conversion students were concerned, than cognate, about some of the more generic challenges of PG study, including the amount of motivation required for self-study and the ability to cope with the anticipated workload. These results chimed with reports from course leaders that many conversion students had very high levels of motivation and enthusiasm (in some cases higher than seen amongst many of their cognate counterparts).

Using comparable questions in the student and completion surveys, it was possible to compare the extent of challenges anticipated by students prior to study with those they experienced in practice. This suggested the extent of challenge actually experienced in relation to mathematics or statistics was lower than feared, although learning programming was about as challenging as anticipated. More generic challenges of PG study, such as

[23] See section 5.3.2 for more detail about conversion and cognate students.

coping with course workload and having the motivation to undertake enough self-study, were reported as more challenging in practice than anticipated.

Figure 4.2 Extent of challenge anticipated by student survey respondents prior to starting their course, for cognate (N=405) and conversion students (N=480)



Respondents were also invited to indicate the most challenging aspect of their course, through a free-text response. Amongst the more than 200 comments made, the three most common themes (all comprising over 30 comments) were:

- Covid-19 effects, such as the wholly remote learning style preventing social interactions with other students and/or group work (which was the dominant theme from those in Year 1 of the programme);
- The challenge of learning programming/coding (or a specific new programming language);
- The rapid pace of the course and lack of time, especially for those trying to balance study with continued employment.

A number of quotations exemplify these challenges (focusing on the last two, as to some extent the Covid-19 related challenges were temporal):

> *"[Biggest challenge was] having to build a strong programming knowledge and use it for complex problems in a short period of time."*
>
> *"Learning the programming aspect was a six week module and only 1-2 lectures a week to cover the entirety of Python/SQL. The approach was to briefly outline topics and leave the rest up to our own learning in our own time."*
>
> *"The course was very intense, and some courses are learning a lot of things within one lecture, it was challenging to balance between the time spend on understanding and doing the actual assignment."*
>
> *"Personally, I found the most challenging aspect to be the workload. Because of the significant amount of new concepts and skills to learn and understand during the course, I found that I struggled to keep up with the lecture material and assignments on a weekly basis. As a result, I missed a large number of optional seminars and programming workshops because either I had not yet completed the relevant lecture material or assignment. I have a learning difficulty [… but] I was provided with support/mitigating circumstances for this by the university."*
>
> *"I would say that the most challenging aspect is trying to get up to speed with all the maths required to understand everything. It takes a substantial dedication and a person that is working at the same time may not be able to cope with the workload."*

4.2.4 Industry experiences

A few courses included an integrated/mandatory placement and several providers offered course variants with or without an integrated placement. The University of Sussex noted that the optional placement year it offered appealed especially to international students as they could then gain working experience while on a student visa. However, many more providers offered the opportunity of an industry placement as an option. Our (somewhat limited) evidence suggested that up to one third of all students had done one.

Delivery feature: Industry placements and related opportunities

Keele University reported to us that around half of its 130 students had gone on an industrial placement as part of their course, while as many as 130 placements were undertaken by students at the University of Bradford.

The University of Wolverhampton encouraged students to undertake some kind of industry experience of up to 12 weeks duration as a part of its (14 month) course. This could be in the form of a paid internship (ideally) or – as such opportunities were limited – as an unpaid placement such as working on a research project with university staff.

Brunel University also promoted a range of different types of paid work experience opportunities during its programme.

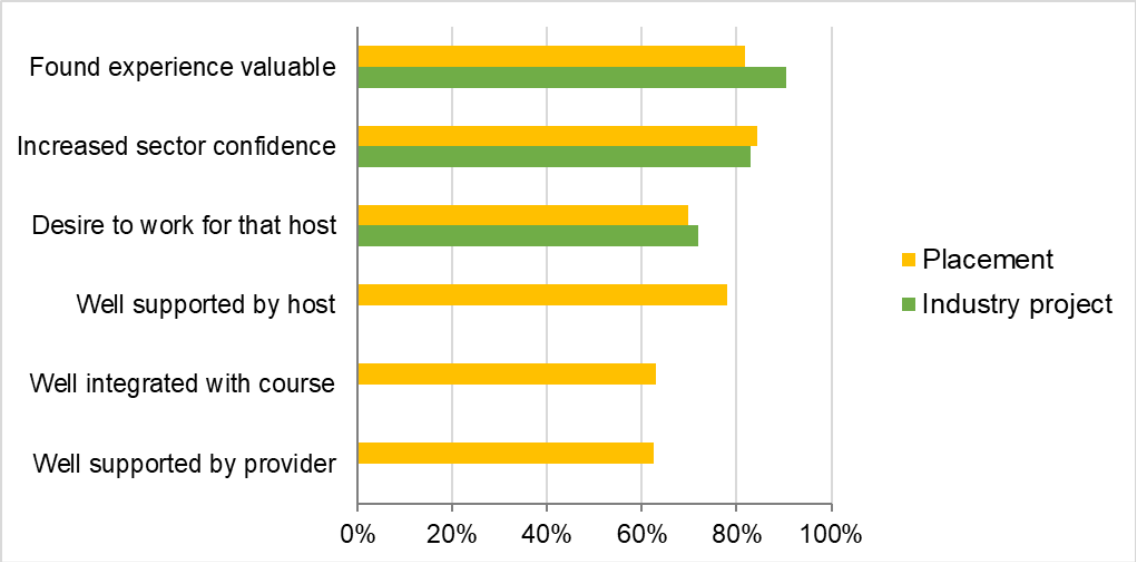
Students' experiences of placements and industry-focused projects were probed in the completion survey. As these were predominantly Year 1 intake students, placement options had been limited in the context of the Covid pandemic and many respondents had not undertaken one, despite some of these hoping beforehand to be able to do so and/or

anticipating that their provider would facilitate this. Amongst the 54 respondents who had undertaken an industry-focused project and 34 who had undertaken an industry placement, reported experiences were very positive (Figure 4.3). Over three quarters found their placement or project valuable and that it increased their confidence in potential work in the AI or data science sector, and over two thirds stated they would like to work for that industry partner in the long term. Perceptions of relevance to the course and the extent of support provided were also mostly positive.

Other respondents attested to the value of these industry interactions during the course:

> *"The course and especially the placement exposed me to the foundations of data analytics and applying it in real life situations, using live data."*
>
> *"Overall, this course involves many opportunities to work with the industries, a wide range of [content] that a data scientist should know, and very supportive learning environment. When I was doing my final project (dissertation), I had the opportunity to work with an international company."*
>
> *"The course taught the fundamentals required to have a broad understanding of data science. The projects we did were relevant and a good way to showcase skills to employers."*

Figure 4.3 Proportion of completion survey respondents strongly agreeing or agreeing with statements about industry project or placement experience (Ns: projects=53; placements=34)



Guest lectures by figures from industry partners were commonplace in courses across the programme. Other methods of giving attention to industry-related experience included an industry mentoring scheme for students (University of Sussex), while other institutions provided a range of engagement with industrial partners, either bringing people from industry into the course or taking students out to local industry organisations.

Delivery feature: Engagement with industry

Keele University offered a range of opportunities for its students to interact externally with industry organisations, in addition to placements, including an ambassador scheme and its Digital Advisor Programme where students supported a local business in a consultancy capacity.

The University of Wolverhampton developed a partnership with a government department locally in which one of its graduates had obtained a data leadership position. That organisation sent a team to visit campus on a quarterly basis to support students interested in the internships it could host and to offer mentoring and support with projects. We assume that as the courses mature, more providers will be able to engage alumni in this way to support current students and/or promote courses to prospective students.

Birmingham City University was notable in offering extra workshops with industrial partners for conversion students on how they could transition into an AI career – recognising that non-STEM students might face some anxieties in attempting this – which included learning how to network with those in the AI industry and how to leverage different AI-focused events.

While comments from graduates included positive reflections on industry inputs, several respondents commented that a greater level of support from the provider in relation to gaining a placement, or other industry experience, would have been valuable.

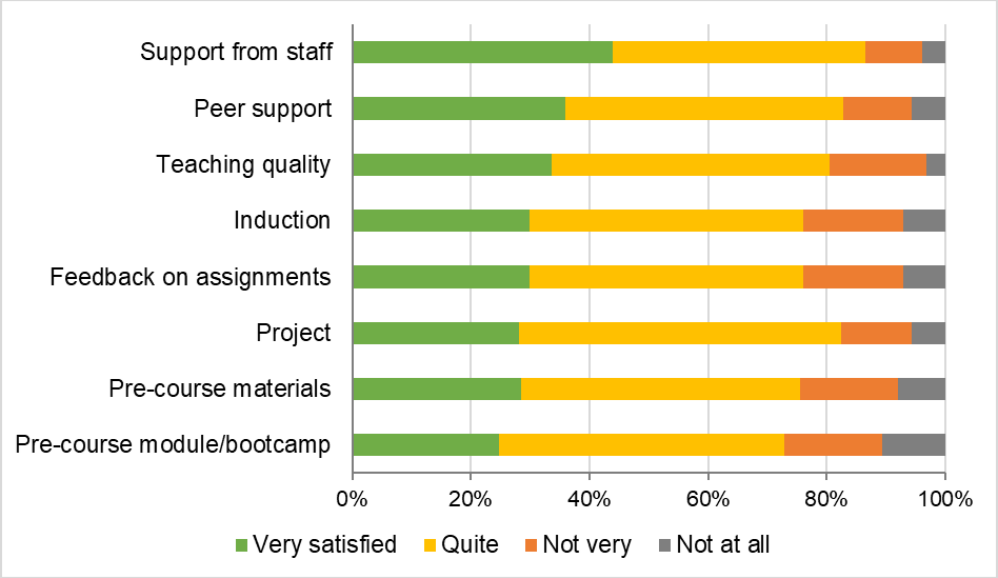
> *"Consideration was also put into including content and talks (e.g. from external speakers within the tech/data science/AI industry), that could inspire thought and direction into the spectrum of possibilities available during and post-course."*
>
> *"This course allowed me to work on industry and academic projects, giving me the confidence I needed to go out there and apply to these employers as a fully trained professional."*
>
> *"Students would require more support from the university to look for and to acquire placement/job opportunities."*
>
> *"The course on its own does not make you job-ready for a career in AI/data science."*

4.3 Student satisfaction

Based on survey responses, most graduates in the completion survey (81 per cent) were either very (32 per cent) or quite (49 per cent) satisfied with their course overall, which compares closely with recent national results for PGT courses.[24] Only four per cent reported being not at all satisfied. Slightly lower levels of overall satisfaction were reported by those in Year 1 intakes than Year 2. Amongst students, support from course staff and from peers were most positively rated (44 per cent very and 43 per cent satisfied with staff support; 36 per cent very and 47 per cent satisfied with peer support, respectively), as shown in Figure 4.4.

[24] *Postgraduate Taught Experience Survey 2022: findings for the sector*, Advance HE, 2022

Figure 4.4 Student survey respondents' extent of satisfaction in relation to aspects of their study experiences at time of survey (Ns=890-540)

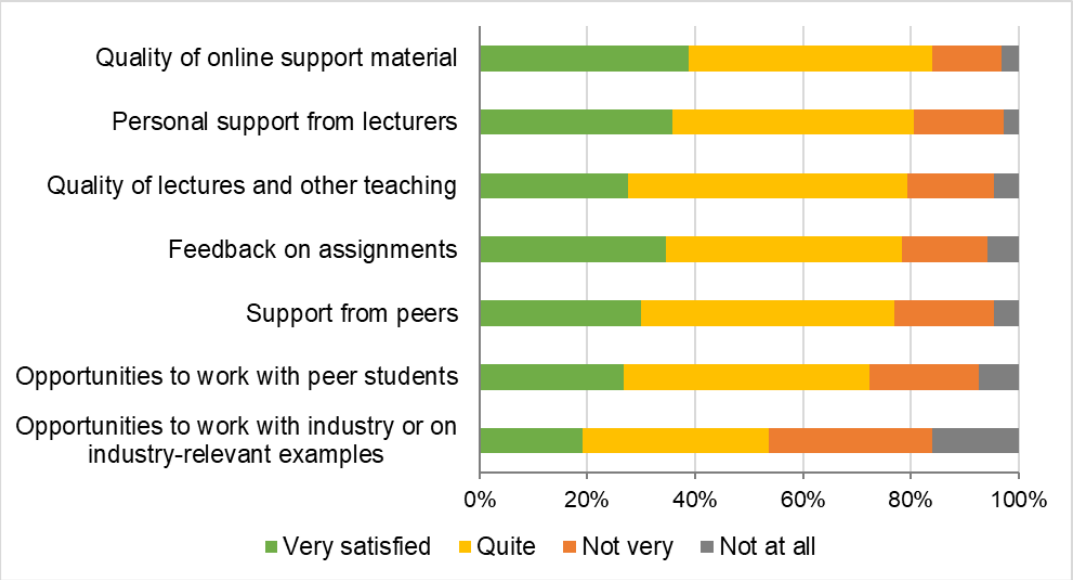


Retrospective perceptions of satisfaction with aspects of their study from graduates also suggested personal support was rated highly, as was teaching quality (Figure 4.5). However, graduates were least satisfied in relation to opportunities to work with industry or on industry-relevant examples, with over half the completion survey respondents stating they were not very or not at all satisfied (highest for those in Year 1 intakes). It was clear from open-ended comments that some of the dissatisfaction was from students who had hoped for a placement but could not find one on practice. Retrospective rating of satisfaction with peer interactions was also low from graduates who were students in Year 1, presumably because they undertook their course during the pandemic and studied largely remotely (over 60 per cent of them reporting that they did not attend any sessions in person).

While these results depict mostly positive views of course delivery, a minority of respondents indicated low satisfaction or dissatisfaction, including a few negative experiences about course organisation (from those in Year 1, in particular) and variable quality of teaching.

Considering their experiences overall, just over two thirds of graduates in the completion survey said they would recommend their course to somebody who had not previously studied data science or AI (69 per cent), while 12 per cent would not, with the remainder unsure). These results were the same for conversion students and cognate students.

Figure 4.5 Course graduates' extent of satisfaction in relation to aspects of their study experiences (N=264)



Many respondents provided comments to support their views on overall satisfaction through an open-ended question, of which these are a selection:

> *"Overall the course was a good experience, I gained useful skills and the final project in particular was interesting and rewarding. I found my project supervisor to be generous with his time and supportive."*
>
> *"It has opened up a new world to me that was previously inaccessible. I am not yet earning an income from this knowledge but I hope that I will be soon."*
>
> *"This course has changed my life. Apart from a very flaky placement. I have learnt so many new, up-to-date skills and I feel more confident in myself. [ ] Uni staff have been amazing from start to finish."*
>
> *"I think the course content and modules provided a great foundation for programming skills for those with very little to no experience with coding or programming at all. The assignments were challenging but for the most part achievable and the lecture content/tasks generally encouraged you to put into practice things you'd learnt as well as stretch and expand your understanding. Some lecturers/supervisors were really supportive, helpful, listened, gave constructive feedback and provided an excellent quality of lecture content, resources and tasks to develop skills and understanding of course materials; whereas a couple of staff facilitating provision of modules lacked in these areas and so there is room for improvement. Overall I feel that the skills and information acquired by progressing through this course, as well as the resources and careers assistance, have given me the knowledge and confidence to transition into an AI/data science oriented career."*

Conversely, a small number felt strongly that their experience had not been good or worth the course fee, although most did not expand upon why this was the case (and a few others made comments that were very specific about individual relationships or experiences).

5. Participation and scholarships

The programme aimed to develop 2500 more AI and data science graduates. This chapter presents evidence about the number and type of students who enrolled on the courses (and insights into completion) to assess progress against that aim. It also explores the role of the scholarships and the extent to which funding of targeted scholarships enhanced the diversity of the student cohort.

Results in brief

Over 7600 students enrolled on programme courses, far exceeding original targets, and over 950 of the 1000 programme funded scholarships were allocated.

The profile of students with scholarships was highly diverse with elevated proportions of female, Black and disabled students. UK students obtained over 80 per cent of 2020/21 scholarships but this has fallen since to just under half in 2022/23. There has been strong competition among international students applying for scholarships.

UK-domiciled students comprised 56 per cent of enrolments to 2020/21 intakes but international students have become the strong majority as intakes have grown since.

Course intakes have included students with a wide range of domiciles and first degree backgrounds, the majority having a first degree unrelated to AI or data science (i.e. 'conversion' students).

Most students entered courses from a position of employment, many as mature students. There is evidence that overall course intakes were more diverse than comparable PGT or computing degree courses.

Students were strongly motivated to study these courses for career-related reasons, and many would like to enter the workforce the programme aimed to support.

Survey results suggest one third of scholarship awardees would not have enrolled on their course without it. Non-scholarship students funded their course fees and costs from their own sources, with almost none funded by an employer.

We estimate that at least 85 per cent of students have successfully completed their courses to date, with no evidence to suggest conversion students are any less successful than those with a cognate first degree.

5.1 Numbers of enrolments and scholarships

Overall, just over 7600 students have enrolled on courses in the programme to date (Table 5.1), well above the original aspirations for the total programme of 2500. More detailed results, for different intake periods, are shown in Appendix 2.

Table 5.1 Enrolments and scholarships to 30 June 2023, based on providers' data

Programme year	All enrolments			All scholarships		
	Target	Total	Per cent UK domicile	Target	Total	Per cent UK domicile
Year 1 intakes	605	1393	56	220	218	82
Year 2 intakes	835	2555	30	350	293	67
Year 3 intakes	1060	3656	14	430	441	47
Cumulative total	2500	7604	28	1000	952	61

UK-domiciled students comprised the majority of entrants to courses in Year 1 (2020/21; 56 per cent), but this proportion fell subsequently as the number of international students grew and was only 14 per cent in Year 3. That reduction is due to relatively similar numbers of UK students in Years 1 and 2 (780 and 767, respectively) but a fall to 512 in Year 3, while international student numbers grew radically after Year 1. It is possible that the fall in UK student numbers reflects perceptions of a stronger graduate labour market post-Covid (as it is widely recognised that more UK students tend to take up PG study when the labour market is weak).

Responses to the student survey suggested courses have drawn students from at least 69 different countries to date, with the majority (92 per cent) of international students from nations outside the European Union.

Table 5.1 also summarises the numbers of scholarships awarded, which totalled 952 based on data reported to us by providers progressively through the programme. There was a modest overall shortfall in Year 2, compared with that year's target, for which over-performance in Year 3 did not fully compensate, so the cumulative total was a little below the target of 1000. There was a small discrepancy between this total and the sum of reported cumulative numbers of awards reported by providers to the OfS at the end of the programme (975 scholarships), which could reflect the award of a few scholarships later than the point of data collection for each intake. More detail about the profile of scholarship students is given in the next section.

Analysis of enrolment data showed that almost all course intakes were of a healthy size (and thereby sustainable financially) and in many cases grew through the programme, with a number of extremely large intakes.

5.2 Profile of scholarship students

Given the aim of the programme to award scholarships to certain types of under-represented student to increase the diversity of entrants to the UK AI and data science workforce, particular emphasis is given here to the profile of the students who obtained scholarships. Results largely focus on UK-domiciled students, in line with the designated data body (DDB) convention of only collecting and reporting ethnicity data for students of UK domicile,[25] but also because they are potentially the most important group in relation to the programme

[25] Higher Education Statistics Agency: https://www.hesa.ac.uk/collection/c20051/a/domicile

aims, as they inherently have a higher likelihood of entering the UK AI and data science labour market.

Table 5.2 summarises the key characteristics of the students to whom funded providers reported they had awarded a scholarship (952 students in total). Of the 581 UK-domiciled students awarded scholarships, 72 per cent were women, 35 per cent of Black ethnicity (and a further 21 per cent of another ethnic minority background), while 25 per cent had declared a disability. These percentages sum to over 100 because of the very many cases of intersection of these characteristics. Their relative proportions, amongst UK-domiciled awardees, remained relatively consistent throughout the programme.

Around one third of the UK-domiciled awardees were reported also to have characteristics placing them in one or more of the other under-represented groups eligible for a scholarship (see section 2.2.1), although those aspects of profile data were less completely reported. We identified 37 instances where a scholarship appeared to have been awarded to a student in one of these under-represented eligibility groups who was not in one or more of the three priority eligibility groups.

Table 5.2 Key characteristics of UK-domiciled students awarded scholarships, based on providers' student data. A more detailed table appears in Appendix 2

Year of intake	**UK-domiciled scholarship students (per cent)**				
	Female	Black	Total of ethnic minority	Declared disability	*Number*
Year 1	77	40	56	29	179
Year 2	71	34	56	24	196
Year 3	67	33	55	22	206
Cumulative total	72	35	56	25	581

A further important dimension of the data about scholarships was the decreasing proportion of awards to students of UK domicile, which fell from 82 per cent in Year 1 to just under half in Year 3 (Table 5.1), although numerically this was an increase from 179 awards in Year 1 to 207 in Year 3. This was important in the context of the programme aim of increasing entry to the UK AI and data science workforce, as UK-domiciled graduates are more likely both to wish to work in the UK and to be able to do so practically (as international graduates may require a visa to do so).

Dialogues with course leaders suggested that most providers did prioritise UK students in their award-making in Year 1, when 10 providers awarded scholarships only to UK students. While some initially restricted scholarship eligibility to UK students, others found ways to prioritise UK students through their particular implementation of processes to select between scholarship applicants. Others held a fully open process as they did not see any way practically to prioritise UK students. However, with time, an increasing number of providers awarded progressively higher proportions of their scholarships to international students. In the autumn 2022 intakes, for example, half the providers awarded more than half their scholarships to international students, and only two providers made awards only to UK students. Overall, providers reported more demand for scholarships than they could allocate,

but this was driven by demand from international students (and many providers did not have enough UK-domiciled eligible applicants to absorb their allocation). We emphasised this trend in interim reports to the OfS and understand that it informed decisions by DSIT to implement a revised set of eligibility criteria for scholarships within the new scholarships programme it announced in autumn 2022.

Detailed analysis of the profile of UK-domiciled scholarship awardees (see Appendix 2) showed that most awards were made on the basis of the awardee being female (most commonly) or female and Black (second most common). Amongst other domiciles, the most common criteria grouping was Black and female, reflecting large numbers of international applicants from nations where Black ethnicity is dominant such as Nigeria (reported in dialogues with course leaders, but also evident in student survey data). Many were reported to have been attracted by the possibility of a scholarship as they would fall into at least one priority eligibility group for an award.

Of the 371 scholarships awarded to students who were not of UK domicile, only 11 (equivalent to 1 per cent of all scholarships) went to students from EU nations.

5.3 Profile of all enrolled students

5.3.1 Key personal characteristics

The key dimensions of profile of all enrolled students on courses in the programme are shown in Table 5.3 by year of intake, while Table 5.4 shows the profile of key sub-groups for the entire programme. In total, 38 per cent of all students were female and this was fairly consistent through the programme. The proportion of students declaring a disability fell from 12 per cent in Year 1 to just four per cent in Year 3. Further analysis showed that this was much higher among UK domiciles (17 per cent overall, and 21 per cent in Year 1) than amongst international students. The overall decrease directly reflects the falling total proportion of UK-domiciled students.

Ethnicity profile data can be reported only for UK-domiciled students, by convention. Table 5.3 shows that amongst UK domiciles, 23 per cent were of Black background and around half had an ethnic minority origin (including Black), again fairly consistently through the programme.

Table 5.3 Key profile of enrolled students by year of intake (from provider data)

Intake	**Enrolled students**					
	Women	Declared disability	UK domicile	Black (of UK)	All ethnic minority (of UK)	*Total*
	Per cent					*Number*
Year 1	38	12	56	24	52	*1393*
Year 2	36	6	30	22	49	*2555*
Year 3	40	4	14	23	51	*3656*
Total	**38**	**6**	**28**	**23**	**51**	**7604**

Table 5.4 Profile of total enrolled students for various sub-groups (from provider data)

Grouping	**Enrolled students**				
	Women	Declared disability	Black	All ethnic minority	*Total*
UK-domiciled	*Per cent*				*Number*
Scholarship	72	25	35	56	*581*
Non-scholarship	28	15	17	47	*1548*
Total	41	17	23	51	*2129*
International					
Scholarship	72	6	-	-	*371*
Non-scholarship	34	2	-	-	*5104*
Total	37	2	-	-	*5475*
All domiciles					
Scholarship	72	16	-	-	*952*
Non-scholarship	32	5	-	-	*6652*
Total	38	6	-	-	*7604*

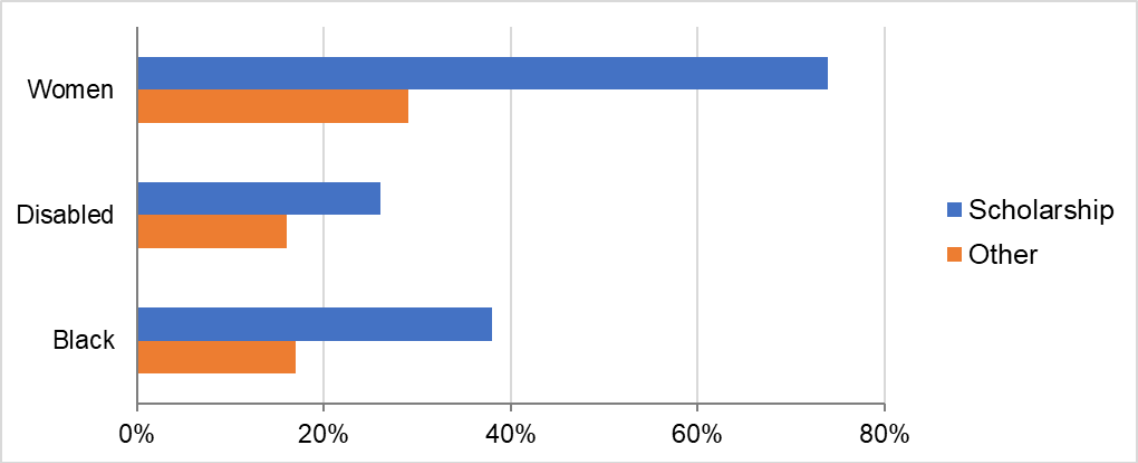
The proportion of female students amongst scholarship awardees (72 per cent) was much higher than amongst other students (i.e. non-scholarship, 32 per cent). This was as hoped given that female gender was a priority scholarship eligibility criterion.

As intended by making disability a priority eligibility criterion, the proportion of scholarship awardees declaring a disability (16 per cent) was higher than amongst other students (five per cent).

Finally, a much higher proportion of UK-domiciled scholarship students were Black (35 per cent), than of other UK-domiciled students (17 per cent), as intended through the scholarship eligibility criteria. The total proportion of those from an ethnic minority background was highest amongst scholarship awardees at 56 per cent, but was also high at 47 per cent amongst other UK-domiciled students (in comparison with potential benchmark student populations, see Chapter 8).

These results all indicate that the profile of scholarship awardees was more diverse in relation to the three priority characteristics than that of other students on the courses (Figure 5.1), suggesting that the targeted scholarships had the desired effect of enhancing diversity. The impact of the scholarships is discussed further in Chapter 7, with reference to wider benchmarks. More insights into the profile of students, including intersections between different characteristics, are given in Appendix 2.

Figure 5.1 Key profile characteristics for UK-domiciled students with and without scholarships, from provider data (Ns: scholarship students 581; others 1548)



5.3.2 Students' first degree subjects

Analysis of students' first degree subjects was important to assess the extent to which the courses were taken up by conversion students (i.e. those without a prior degree in the same broad subject area as the course) as opposed to those with a cognate first degree. It was important to establish this as one aim of the programme was to expand the pipeline of AI and data science graduates through 'conversion' of students with an unrelated prior degree. In reporting student profile data to us, providers were asked to classify each student's first degree subject into one of the following groups:

- Cognate: same broad subject area as conversion course (e.g. AI, data science, computer science);
- 'Core-STEM' (e.g. physics, engineering, mathematics, statistics, IT);
- 'Far-STEM': other STEM subjects (e.g. biology, geology, psychology, medicine);
- 'Non-STEM': any other subject (including economics, business, arts etc.);
- None: no first degree held.

Such first degree information was provided for 6668 students (88 per cent of all students).[26] Overall, using this classification, 74 per cent of all students with a known prior degree subject have been conversion students to some extent (i.e. only one quarter had a cognate prior degree). 42 per cent had either a non-STEM or a far-STEM background (Figure 5.2). These are the student groups for whom we consider the extent of 'conversion' to have been substantial as the mathematical content of their first degree will in most cases have been limited (or non-existent). A small number of providers reported the specific first degree subject for every student, from which data (*N*=1070) we can see their courses drew students from across the entire width of disciplines. Thus, we can see that the conversion courses were effective in attracting 'conversion' students.

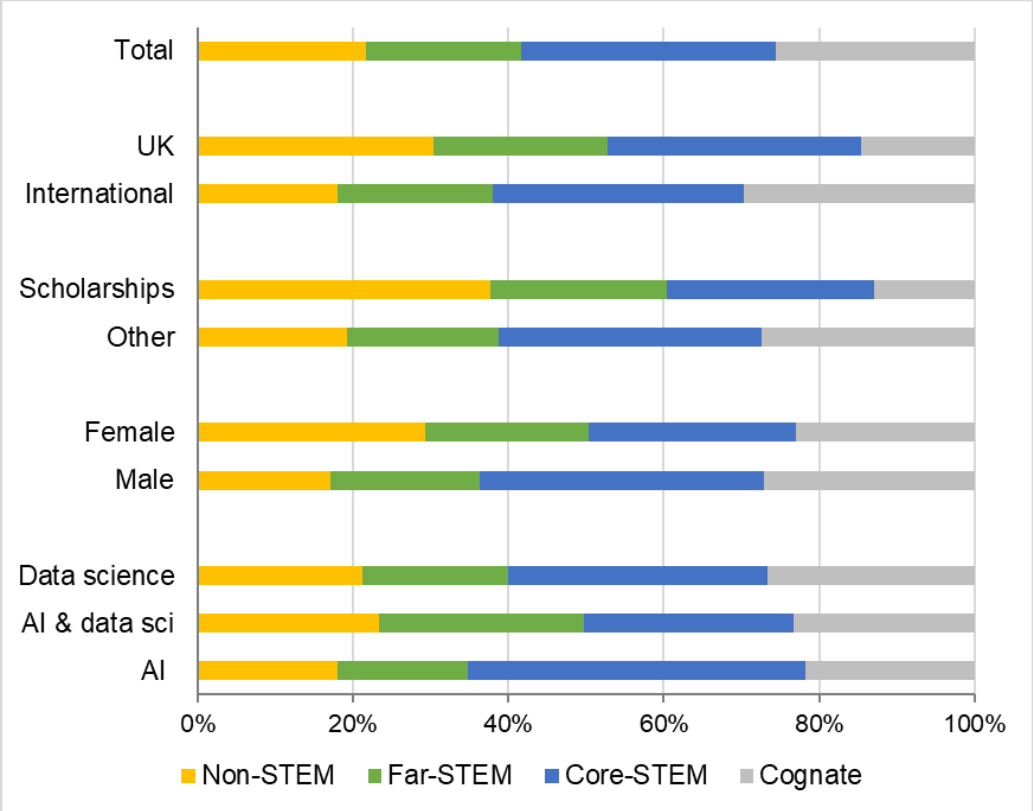
Figure 5.2 illustrates the first degree subject backgrounds of students, overall and for a variety of sub-groups. This shows that higher proportions of scholarship students were conversion students (60 per cent with a non-STEM or far-STEM first degree) than of

[26] 62 students (just under one per cent) were reported as without a first degree, and were omitted from the analysis.

students without a scholarship (39 per cent). More of the UK-domiciled students were in these groups (53 per cent) than international students (38 per cent).[27]

These trends at least partly reflect that some providers prioritised conversion students in their scholarship award-making, despite this not being an overt requirement in programme guidance. Those that had done so indicated that they had chosen to prioritise non-STEM students to enable their project to meet the programme aims better, given its focus on entry to the UK labour market.

Figure 5.2 Students' first degree discipline categorised in broad groups in relation to conversion course subject (students with a known first degree: N=*6610)*



5.3.3 Student ages and prior circumstances

An aim of the programme was for the conversion courses to be launched as provision that could enable mature learners to re-skill or up-skill. Student age data were not reported to us by providers, but collected through the student survey (see Appendix 2). Although the response sample was not representative of all students, on the basis of this sample there was evidence that the courses drew students with a wide range of ages (83 per cent were aged 25 or over), including many potentially in mid-career (13 per cent were aged 40 or over). Analysis of the year of first degree graduation, provided by student survey

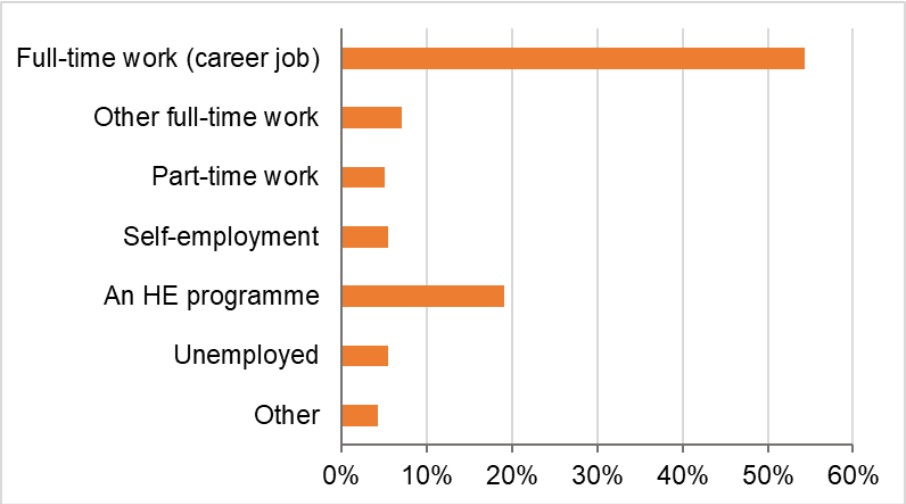
[27] In practice these results are related, as scholarship candidates comprised a higher proportion of all UK-domiciled students (28 per cent) than of international students (seven per cent). However, 64 per cent of UK-domiciled scholarship students had a non-STEM or far-STEM first degree, higher than amongst other UK students (just under half), so both scholarship and domicile had effect.

respondents, showed that under one third of respondents had obtained their first degree in the previous two years.

Where the conversion course fitted into students' career trajectories is shown in Figure 5.3, which illustrates the circumstances of enrolled students prior to enrolment, as reported in the student survey. Over half the respondents (54 per cent) had been working full-time in a long-term job (i.e. a 'career job') the year before they started the course, and in total 73 per cent had been in some kind of work. Only 19 per cent had progressed directly from a prior HE programme (in almost all cases a first degree).

These results are clear evidence that the courses were taken up by many individuals who have spent some time in the workplace, more than by recent graduates (although the latter made up a substantial minority). This is important in the context of the programme aim for courses to provide opportunities for up-skilling or re-skilling of those already in the workforce, to support progression or potential career change.

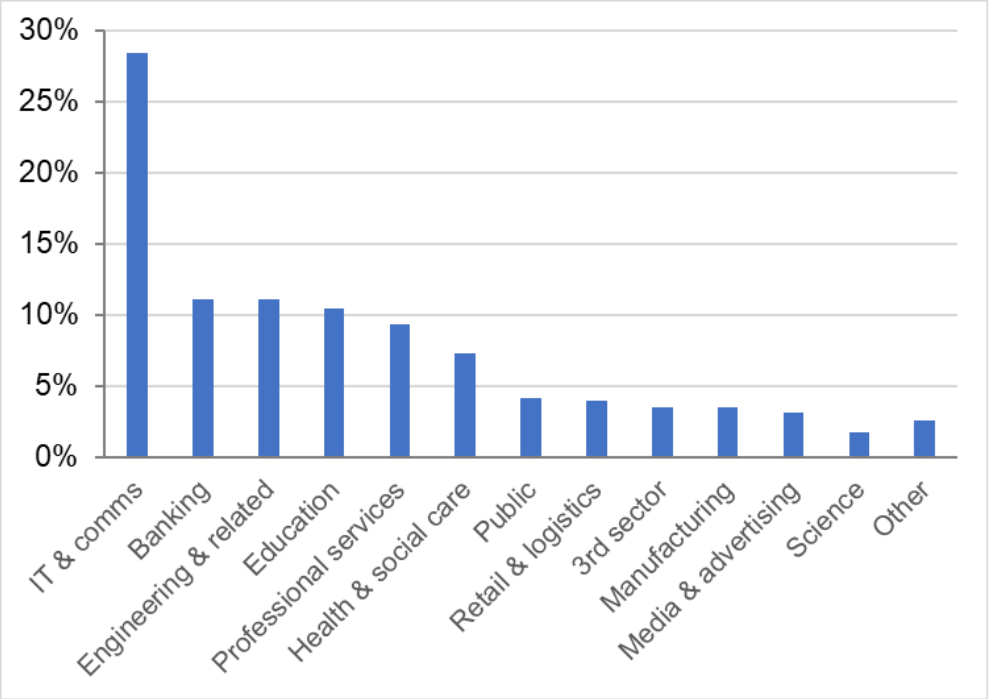
Figure 5.3 Circumstances of student survey respondents prior to enrolling on a course (N=1004)



There was also some evidence that the prior circumstances of students in Year 1 of the programme (courses starting in 2020/21) were somewhat distinctive. Relatively fewer of them had been employed long-term (under 40 per cent) while more had progressed directly from HE study or had been unemployed, than overall. A greater proportion progressing directly from a prior degree that year would be in line with perceptions of a weak labour market influenced by the Covid-19 pandemic. Rises in PG study have been seen in previous periods of economic recession, as more new graduates 'take refuge' in HE rather than trying to enter what they think is an adverse graduate labour market.

The nature of prior employment was also investigated in the survey (Figure 5.4), revealing that the highest proportion had been working in IT and communications (28 per cent), but demonstrating that the courses had drawn students who had previously been employed in a very wide range of sectors right across the industrial spectrum.

Figure 5.4 Sector of employment of students prior to starting their course (N=633)



Analysis of their job titles suggested that the vast majority had been in professional or associate professional roles, but fewer than one in six of them were in job roles which had data or analysis in the given job title.

Together these data about prior subjects of study and prior occupations/employment are fully consistent with one of the strategic aims of the programme, i.e. to offer an opportunity for a wide range of graduates already in the workplace to re-skill, as well as for recent graduates from a variety of backgrounds yet to enter the labour market.

5.3.5 Mode of study

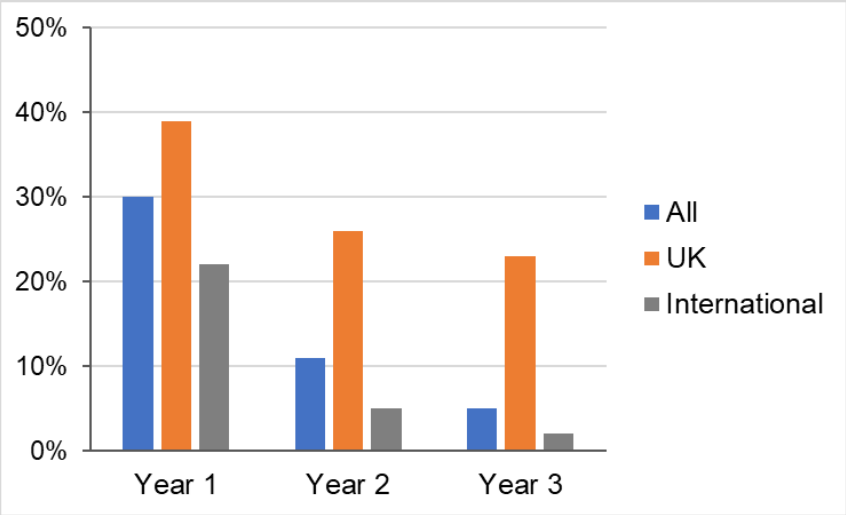
Across all intakes to date, 12 per cent of students have studied (or are still studying) on a part-time basis. However, this masks some strong variations during the programme, as the proportion was much higher at nearly 30 per cent in Year 1 intakes. Part-time study has also been more common amongst UK-domiciled students than international throughout. However, the proportion studying part-time has fallen for UK-domiciled and international students alike (Figure 5.5).

We infer that the (relatively) raised rates of part-time study in Year 1 related to some extent to the delivery models of courses and wider circumstances at that time:

- In Year 1, two of the largest student intakes were at institutions which only offered part-time courses, contributing to a relatively high total number of part-time students. In subsequent intakes, the largest cohorts have been dominated by full-time, international students;
- In Year 1, almost all courses were delivered wholly remotely, enabling great flexibility for those studying. We infer (and have some student response data to confirm) that this enabled some working individuals to study a course part-time without leaving their job,

irrespective of their location (including those outside the UK). By contrast, almost all courses starting in subsequent years have required some physical presence on campus, whether full- or part-time. This will have limited the range of students who could study; a student continuing their employment would only be able to study at a local provider, and international students will have had to be physically present in the UK to study (in which case they were more likely to enrol in full-time study for cost reasons). Thus, in Year 1, the pandemic-induced flexibility of provision temporarily enabled an unusually wide variety of individuals to participate.

Figure 5.5 Proportion of students studying part-time, by domicile, across the programme (from provider data)



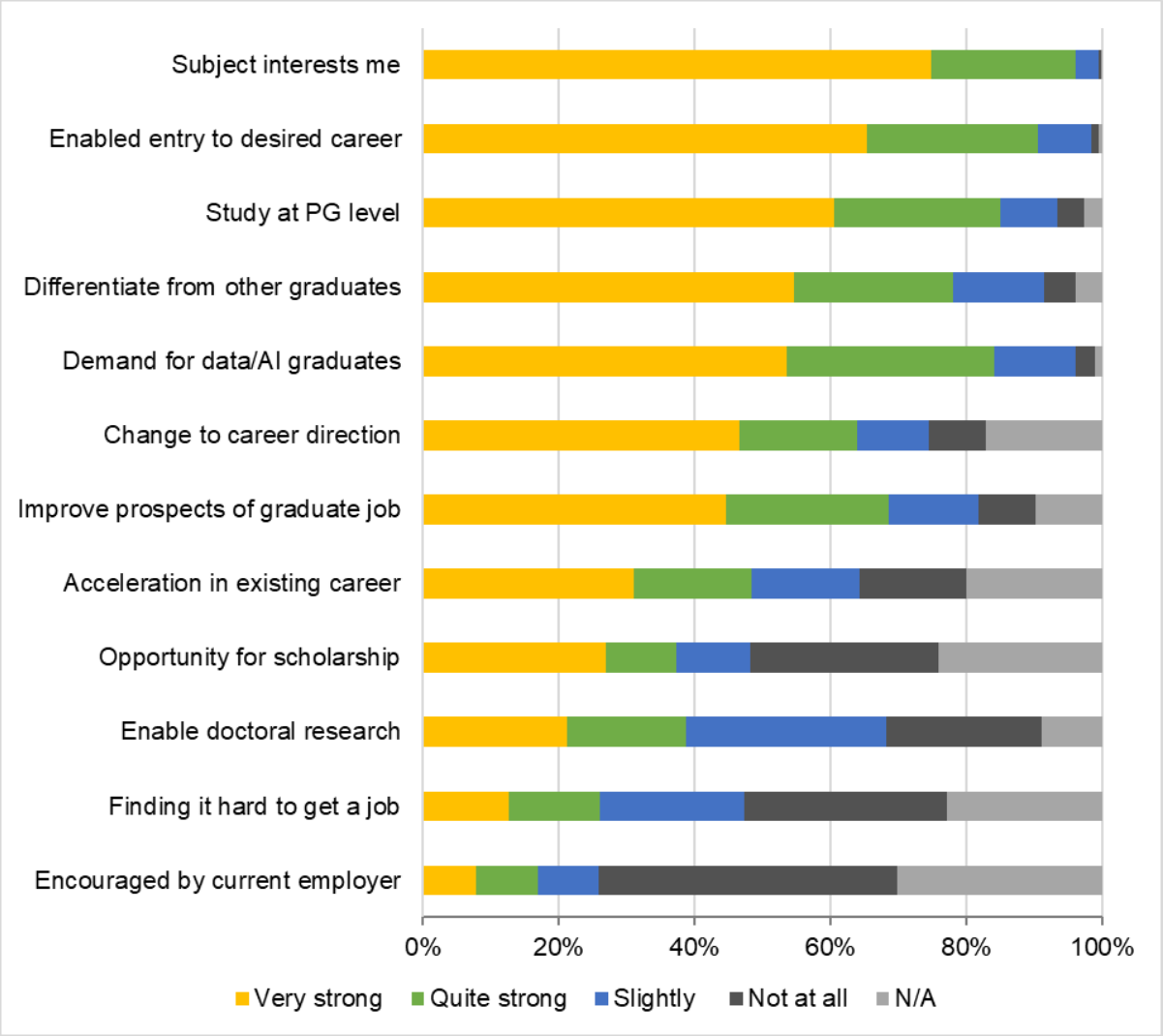
Although only 80 student survey responses were obtained from part-time students, three quarters of these reported that they were continuing to work in an existing job while studying, although only a handful had obtained either financial support or time off from their employer to do so.

5.4 Student motivations for study

Achievement of the long-term programme aims – enhanced entry to the UK AI and data science workforces – pre-supposes that students who study the courses either have that motivation in mind or are open to that possibility. Questions in the student surveys sought the motivations for study, and results revealed a wide variety of motivations or rationales for taking a conversion course. Figure 5.6 shows that the top three career- or subject-related motivations in terms of popularity were: interest in the subject; to enable entry to a career they desired in this area; and recognition of strong demand for graduates of this type. These were rated as strong motivations by half or more of respondents (and were of some importance to all but a very small minority).

Over 40 per cent said they were strongly motivated by the opportunity the course offered for a change in career direction, while just over one quarter were motivated strongly by the thought that it could accelerate progress in their existing direction. These two commonly held strong motivations reflected the large number of students who had been working prior to the course. However, only a quarter said they had been influenced at all by their employer, so for the vast majority these motivations appeared to be personal rather than employer-driven.

Figure 5.6 Reported strength of potential motivations for taking a conversion course, for student survey respondents (Ns = 910-940)



Other motivations were also present to varying extents, including the course's potential to differentiate a graduate in a competitive graduate labour market and improvement of job prospects. These two motivations were more strongly associated with respondents who had newly or recently gained their first degree.

Almost all these results suggest that career-related motivations for studying the new courses have been strong and that many of the students would be open to entering the workforce that the programme was aimed to support.

The survey results also revealed that 52 per cent of respondents had also applied for other PG study opportunities, and 38 per cent had applied for at least one other PG conversion course in a similar subject area (many of which will have been in this programme). This latter proportion rose with time, reaching 46 per cent of respondents on courses in Year 3, which we infer to reflect increasing awareness of these courses. Overall, a higher proportion of international students had applied for multiple courses (43 per cent) than UK students (27 per cent). There were also anecdotal reports from providers that some of their international

students had made multiple applications to courses in the programme in the hope of increasing their chances of obtaining a scholarship.

Those who had applied for more than one course were asked the reasons for selecting their particular course and provider. These included, most commonly, its particular content (52 per cent), the university's reputation (also 52 per cent, but higher amongst international students) and convenience of location (almost half for UK respondents). Around one third (34 per cent) stated that lower fees were a rationale for selection, although few of these had previously studied at the same institution (which could have entitled them to a discount).

5.5 Funding of study

Insights into how students funded their studies were felt important in order to understand conversion course provision better, hence sought in the student survey. However, these results are presented with the caveat that students with scholarships were over-represented in survey responses. Of survey respondents, 40 per cent had obtained a scholarship, while a further 29 per cent had applied for one unsuccessfully (confirming that there was competition for scholarships).

One third (33 per cent) of those who obtained a scholarship stated that they would not have enrolled on the course without it, and a further 24 per cent were unsure. While this was some evidence of impact of the scholarship, it was interesting to note that over 40 per cent of these respondents might have enrolled on their course even without the scholarship. Further analysis suggested these results were broadly similar for female, Black and other scholarship awardees.

However, there was some difference between UK and international respondents. Half of the UK-domiciled respondents indicated that without the scholarship they would not have enrolled, whereas this was the case only for one quarter of the international respondents. This appeared to suggest that the role of the scholarship was more influential for UK students in enabling them to study a course.

Analysis of UK-domiciled student survey respondents suggested 48 per cent of those with a programme scholarship had also taken out a PG/Master's loan to help them pay their fees and/or living costs. Almost all the remainder (of scholarship awardees) depended solely on their own funds and/or financial support from their family to pay costs beyond those covered by the £10,000 scholarship. Fewer than five scholarship awardees (who responded to the survey) reported that their employer was providing financial support.

Amongst UK-domiciled respondents without a scholarship, 63 per cent had taken out a PG/Master's loan to fund their study, and all were drawing to some extent on their own or family funds to cover living costs. Again, only a very low number (10 respondents, which was under eight per cent) of these non-scholarship respondents were receiving any financial support from their employer.

5.6 Course completion

Data about completion status were obtained for around 1100 students who commenced courses in 2020/21 and in certain intakes in autumn 2021. These data suggested at least 850 of the 1100 students had successfully completed their courses by late autumn 2021 or March 2022, respectively, i.e. 14 months after course start. At around 78 per cent, this

appears lower than the overall completion statistics for full-time students on UK PGT courses (around 94 per cent), but the latter are assessed four years after course start (rather than 14 months for the students in this programme), so this should not be seen as a direct comparison.

Amongst those who had not completed at the time of reporting, the numbers of students reported as having withdrawn (45) or unsuccessfully completed (another 45) were smaller than the number who were recorded as suspensions or deferrals. Amongst the latter there were students deferring specific projects, re-sitting assessments and, in a few cases, deferring to a later intake/cohort.

These data led us to estimate an overall completion rate of around 90 per cent would be achieved within two years, which aligned with the views reported by course leaders. Two providers reported completion rates of 80-85 per cent,[28] and more widely the project final reports suggested that the vast majority of students, overall, did complete their courses successfully, albeit with a substantial minority taking longer to complete than the original schedule. However, an extended period of study is not unusual in taught PG programmes and, anecdotally, some course leaders suggested the rate of completion for their conversion course was not substantially different from their other PGT courses. Some explicitly fed back to us that, overall, conversion students were as successful as cognate students in this respect, partly helped by the high levels of enthusiasm and drive they brought to PG study.

A more robust and systematic review of completions may be available from DDB Student Record data provided that the courses within the programme can be identified within it.

[28] Recorded less than two years after course start.

6 Graduate outcomes

This chapter considers evidence for outcomes achieved by graduates of the courses and whether these demonstrate progress towards achievement of the long-term aims of the programme (to increase the number of graduates entering the UK AI and data science workforce and to enhance the diversity of that workforce).

Results in brief

The career aspirations stated by course students in our surveys revealed that 79 per cent would like work directly using data or AI and 63 per cent in a related technical role. 83 per cent would like to work for an employer/sector where they could apply their data or AI skills, and 73 per cent in a specialist data/AI organisation. These aspirations align well with intended programme outcomes.

Systematic evidence for the employment outcomes of graduates did not (and was not expected to) emerge during the timeframe of the evaluation.

Graduate survey data from course intakes early in the programme suggest nearly half had obtained a new job and eight per cent started a doctorate within two months of graduation.

Amongst those graduates who obtained a new job, for 88 per cent this was new employment directly relating to their course and in a role that was strongly AI- or data-focused, although located across a wide range of sectors.

Only eight per cent remained in or returned to their pre-existing job and were not seeking new employment (noting that this response sample under-represented part-time students, for whom this outcome might be expected to be more common).

Almost all the new jobs or offers were in the UK, irrespective of student domicile, although there was some evidence that UK-domiciled graduates were transitioning into industry more quickly.

As such a high proportion of programme course graduates are achieving outcomes that align with programme aims. This is evidence for progress towards the longer-term programme aims and is further supported by very limited data from a survey a year after graduation.

6.1 Sources of evidence for graduate outcomes

Two of the ultimate aims of the programme were to increase the number of appropriately-qualified graduates entering the UK AI and data science workforce and to enhance the diversity of the AI and data science workforce. It was not possible to assess the employment outcomes for all programme graduates using the Graduate Outcomes survey, because of the time it takes for those systematic data to emerge (even if programme graduates could be identified within the survey). Insights into the employment of programme graduates – and especially whether they entered the relevant labour force – at this stage were therefore largely reliant on our programme-wide surveys of graduates who had completed courses. This chapter provides the insights that were available through these methods.

A few providers shared anecdotal knowledge about the employment destinations of their students, such as that particular students had obtained ‘good jobs’ in the AI or data science

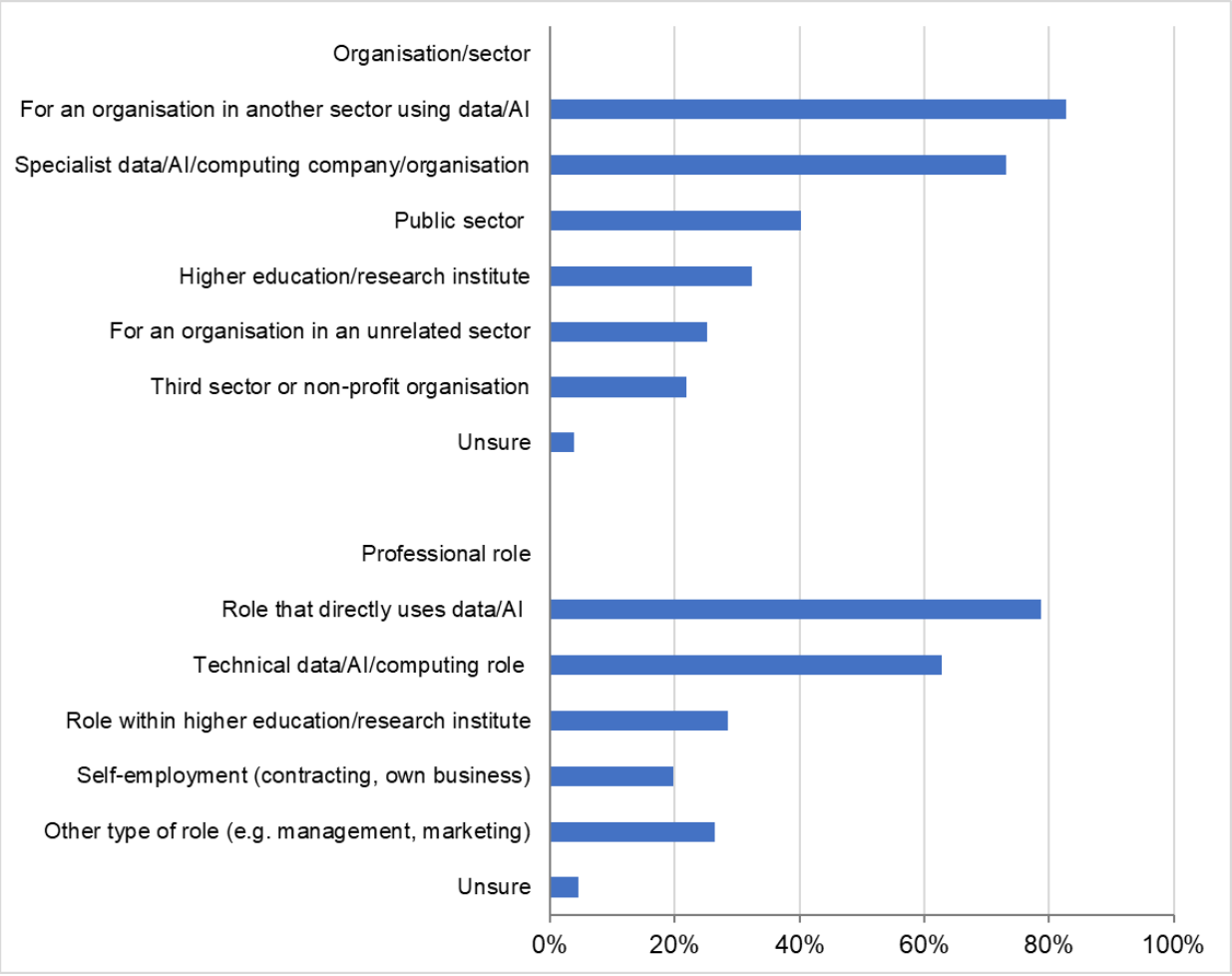
industries. Keele University obtained destinations information from 10 students from its 2020 and 2021 intakes, recording that seven of them were employed in work directly relating to the course. Although anecdotal, personal stories from graduates (such as this example from the University of Wolverhampton) make powerful testimony:

> *"Amazing to think that such a short time ago I had zero knowledge of programming and not much of a clue what data science really was, and now I'm working for the civil service using the skills I've learned on this course. It may have been a rollercoaster, but you delivered what you set out to do. Skills gap bridged and employment in a new profession secured. Thank you!"*
>
> Conversion course graduate,
> now statistician for Department of Levelling-Up, Housing & Communities

6.2 Prior career aspirations

The impact of any intervention on a career trajectory – such as whether it resulted in entry to a particular occupation – is more fully understood with knowledge of the context of the student. Career intentions and trajectory prior to any intervention (in this case, the conversion course) can strongly affect post-intervention outcomes. If they align with the aims of the intervention, its desired outcomes are more likely to be achieved.

Figure 6.1 Medium- to long-term career aspirations of respondents at start of course, in terms of role and organisation/sector (N=899; multiple responses allowed)



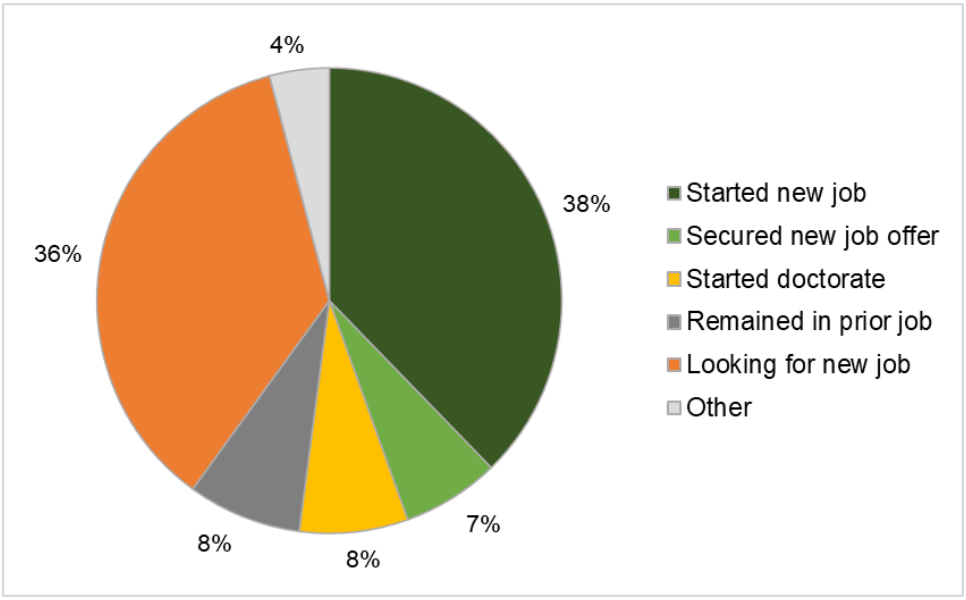
Students in our survey indicated their medium- to long-term career aspirations, in terms of potential roles and sectors. Over three quarters (79 per cent) said they would like to work in a role that directly uses data or AI, and 63 per cent a technical role working on data or AI (Figure 6.1). 83 per cent would like that work to be in an employer/sector in which they could apply their data or AI skills, and 73 per cent in a specialist data/AI organisation (69 per cent).[29] Work in HE or a research setting was also seen as attractive (by 28 per cent).

Asked about their ideal next step after the course, 71 per cent hoped to enter long-term employment of the type they had indicated, while 10 per cent hoped to continue study at a higher level. Only two per cent said they would like to return to their previous or current job. These results seem to reflect the strong career-related motivations many expressed (section 5.4) and that most when entering their course were aspiring to the sorts of subsequent employment outcome that the programme sought to achieve.

6.3 Graduate outcomes

In the completion survey, undertaken a few months after the end of the course, we asked more detailed questions about current career thinking and next steps either taken or planned. Those responses revealed that 38 per cent had already started a new job and seven per cent had obtained a new job offer, while eight per cent had started a doctorate. 36 per cent were currently looking for a new job at that time. Only eight per cent had remained in or returned to a pre-existing job and were not seeking other employment. These proportions are illustrated in Figure 6.2.

Figure 6.2 Chart showing graduates' current employment position, post-course (from completion survey responses, N=*265)*



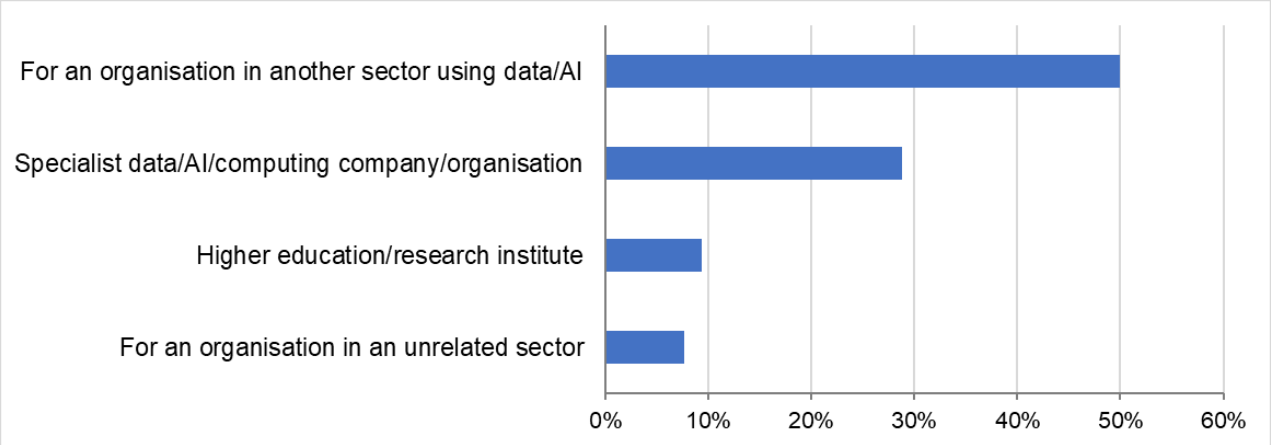
It is worth noting that only five per cent of completion survey respondents had studied part-time, as most students studying part-time had not yet completed their course. Amongst this small sample of part-time students who had completed, half were remaining in their existing job. In fact these respondents comprised a quarter of all those who were not seeking (or had

[29] Multiple responses were permitted to this question.

not gained) a new position. This suggests fewer of those who had studied part-time sought new positions, so the survey results to date may slightly over-represent the overall proportion of graduates who will seek employment change (compared with upcoming results once a more balanced sample of intakes emerges).

Amongst the graduates who reported a new job, a new job offer or a pre-existing job, half of the roles were in a sector/employer using data science or AI, 29 per cent in a specialist data/AI organisation and nine per cent in an HE or research institute (i.e. 88 per cent in total were in employment directly related to the course). Figure 6.3 illustrates these proportions.

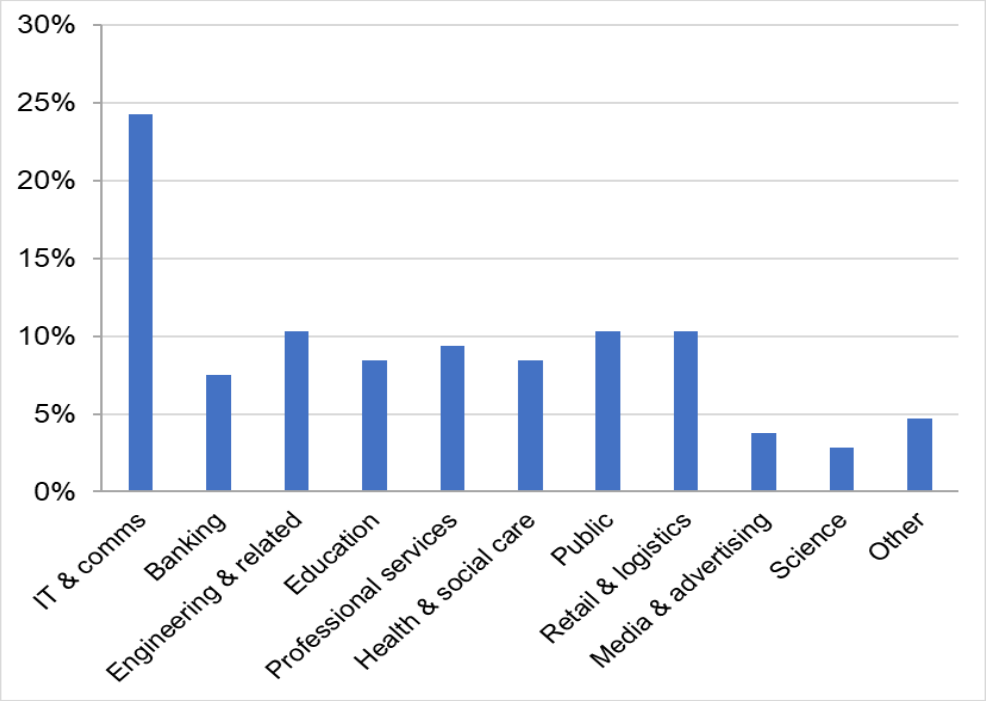
Figure 6.3 Chart showing post-course career destinations for employed graduates (from completion survey responses, N=*118)*



This pattern of employment outcomes is quite similar to the pattern of career aspirations prior to course study (in Figure 6.1) reported by student survey respondents. If those who had started a new doctorate are included, the proportion in a post-course occupation closely related to their course subject was over 90 per cent.

Analysis of the sectors in which these jobs were located, shown in Figure 6.4, indicated they were widely spread, including in engineering and manufacturing, health, the public sector, professional services and banking, and retail and logistics, as well as in the IT and communications sector (which was the most common).

Figure 6.4 Industrial sector of employment obtained by course graduates (completion survey respondents, N=*108)*



The job titles that graduate respondents gave confirmed that almost every new role achieved was quite strongly data-focused; Figure 6.5 is a simple word cloud of the job titles of respondents in employment, demonstrating that focus.

*Figure 6.5 Word cloud of job titles of employed completion survey respondents (*N=*118)*

It is also important to note that 95 per cent of these graduate respondents in employment were working in the UK, despite 44 per cent of them being non-UK domiciles. This suggests that the courses have enabled the transition of international students into the UK workforce.

Amongst the respondents who were looking for a job (*N*=95), almost all said they were seeking a role either as a specialist in data/AI or in an organisation in another sector where they would use their data/AI skills, and almost all expected that role would be in the UK. The very small number in this sample (*N*=6) who were working outside the UK were all international students.

Although the number of responses to date in the completion survey was too small for robust analysis of results for different sub-groups of graduates, preliminary evidence suggested that female graduates had been somewhat quicker to achieve firm outcomes, with 59 per cent either in or having secured a new job or doctorate programme admission, compared with 47 per cent of male graduates. A higher proportion of the male graduates was still looking for a new job (45 per cent) than of female graduates (29 per cent). However, the pattern of roles and sectors of the jobs being secured appeared not to vary with gender, on the basis of the results so far.

Analysis by broad domicile suggested slightly more differences, however. More of the UK-domiciled graduate respondents than of other domiciles reported achievement of firm post-course outcomes by the time of survey. 73 per cent of the UK-domiciled respondents had secured or started a new job or doctorate, compared with 42 per cent of their international counterparts. Consequently, a higher proportion of the international graduates (48 per cent) were still seeking a new position at this point (17 per cent). Again, however, there was no evidence to suggest that the types of job being secured by UK-domiciled and international graduates were different.

Unfortunately the sample size was not sufficient to enable comparison of the outcomes for graduates in the other key priority groups, i.e. identification of UK-domiciled Black graduates compared with white UK-domiciled graduates, for graduates who as students had declared a disability. It would be valuable to investigate results for these groups should sufficient evidence become available in future.

Responses to open-ended comments in the completion survey reinforced, on a qualitative basis, the view that course graduates had achieved employment in the AI and data science workforce, as intended in the programme:

> *“I really, thoroughly enjoyed it and it gave me my only ever true academic passion; I also got a well paid and enjoyable job out if it.”*
>
> *“It allowed me to get a full time job straight after I finished my course.”*
>
> *“It equipped me with the skills and confidence to make a career change.”*
>
> *“Allowed me to learn vital components of data science and analytics that I am currently using. I got a job before even completing the course thus achieving my goal to 'switch career path'.”*
>
> *“I am very satisfied with the course as I gave it my all and I am glad to have made a distinction and have secured a job as a Tech Analyst in a fortune 500 company in the UK.”*

"It was the best decision of my life, I'm more confident in myself and am on a great trajectory in a career I love!"

6.4 Insights from alumni

As mentioned in section 3.3, very few responses were obtained during the evaluation period to the follow-up 'alumni' survey (implemented around 15 months after course completion). This suggests that robust evidence about more established career next steps would require a different data collection methodology and a longer evaluation window. Nonetheless, 25 of the 34 respondents reporting a specific outcome were in a new job (i.e. almost double the proportion seen in the completion survey) and several of the others had a new job offer. In total, 30 of the 34 respondents were either in a new job, waiting to start one or had entered further study. Interestingly, none of them reported that they were in the same job that they had been in prior to the course. While this sample was extremely small, and entirely comprised respondents who had studied full-time, it was preliminary evidence of stronger outcomes than evidenced in the completion survey (as might be expected, as not all outcomes will emerge immediately upon course completion).

Analysis of these data also confirmed the trends in type of employment reported above from completion survey responses. For almost all those with new jobs or a new job offer, the employment was in the UK and in roles as either AI/data specialists or using data/AI. The job titles they gave again indicated that all were specialising in data and/or analysis across a variety of sectors.

For the 28 graduates with a known outcome who responded to a question about how helpful the course and qualification had been in securing that outcome, eight said their new data/AI course/qualification was a requirement to get the job and a further 13 that it was very helpful in doing so, with five responding that it was somewhat helpful (i.e. it was stated as at least helpful in all but two cases).

"It has given me the necessary skills to advance my career in data and analytics."

"Enjoyed the content, learned a lot, equipped me for my current job."

"Great content, great lecturers, incredibly interesting course and it got me my first data science job, getting my foot in the door."

Reflecting back on their course, 27 out of 33 (82 per cent) felt very satisfied or satisfied with their experience, similar to perceptions amongst Year 1 intake students in the completion survey, i.e. the same cohort. 22 said they would positively recommend their course to somebody who had not studied data or AI before, although five said they would not (again, similar proportions to sentiments expressed by those in comparable intakes in the completion survey).

These emerging results, both from the completion and 'alumni' survey, provide growing evidence that, overall, most who have completed a conversion course have secured (or are trying to secure) an employment position of the type that the programme was aiming to facilitate.

7 Programme design and operational issues

The third aim of the evaluation was to provide the OfS with reflections on the design and operation of the programme and of the evaluation itself ('process evaluation'). The observations in this chapter are provided in the hope that they may assist future programme designs and evaluation strategies. They also provide some useful context to the evaluative judgements we make about this programme.

The focus here is on some key issues which impacted on observable outcomes for the programme and to suggest potential future improvements. However, we also want to record our belief that the supportive environment and culture fostered by the OfS during the programme was positive and helpful in relation to achieving several programme and evaluation aims. Many providers reported to us that they appreciated that open environment and the opportunity it offered to share challenges and experiences with others, and learn from them, set within a culture of experimentation and flexibility. The programme workshops, in particular, were very widely appreciated by funded project teams. We believe that environment also contributed to the effectiveness of the evaluation, not least in securing substantial reporting efforts by the project teams.

7.1 Student profile data collection

In this evaluation we asked providers to collect and collate a range of characteristics of every student enrolled in the programme, including those awarded scholarships. In hindsight, this proved to be a substantial burden on providers, one aspect of which was that some of the characteristics we sought (such as first degree subject) were not captured in admissions systems and hence such data were not systematically available to course teams, leading to a requirement for bespoke efforts to capture those data.

While most providers did collect, collate and present student-level data which was complete and systematic for all students, and included all the key dimensions we sought, a number of providers reported they were not able to collect systematic data on the characteristics of the under-represented groups targeted for scholarships other than female, Black and disabled status. As a result, profile data about those other characteristics were less complete. Should future programmes target these groups of students in particular, further consideration as to how to identify students with these backgrounds will be needed.

While the data collected this way were mostly complete and provided a robust basis for analysis of the profile of enrolled students and scholarship awardees, as the programme progressed a minority of providers presented student data which lacked some of the more critical features, such as first degree subject and domicile. Looking forward, we question whether placing such a data collection burden on providers is sustainable.

We also make two related observations. In relation to ethnicity, a priority scholarship criterion was Black background and many international students were allocated a scholarship on the basis of that characteristic. However, DDB conventions on reporting student data limit the reporting and publication of data about ethnicity of students to those of UK domicile only. While we managed to obtain ethnicity data from providers about all domiciles, including international students, we have only been able to report here on the ethnicity of UK students, which limits our insights into scholarship use and impact.

Second, we were only able to obtain partial data about completion of courses, because to provide data at individual student level would be further substantial effort for provider teams. We elected not to request such completion data separately (to reduce reporting burden) but sought it at the same time as reporting of enrolments to new intakes. In retrospect, this was troublesome as, for example, the point at which autumn enrolments were reported was not the ideal time to report completions to courses started a year earlier, as a significant minority of students took longer to complete their course than intended. We suggest that collecting completion statistics another way – ideally through data on qualifiers in the DDB Student Record – would provide more robust data which could be compared for cognate and conversion students.

We were able to discuss these issues with the OfS team as the programme evolved, resulting in adjustment of some monitoring and data collection and reporting aspects of the successor programme, which will change how its evaluation will take place.

7.2 Outcomes data and alumni

The primary aims of the funding programme were to foster increases in entry of graduates to the UK AI and data science workforce and their diversity. However, as described in our evaluation approach, in practice most of the evaluation focus was on course provision and participating students (including those who obtained scholarships), as these were the outputs and outcomes that were practically measurable in the timeframe of the evaluation. It was always clear that not all post-course career or employment outcomes would be observable, not least as many students had not completed a course during the evaluation period (including all students in Year 3 intakes and students on many earlier courses of more than a year in duration such as part-time students). Thus, most evidence was accrued for Year 1 intakes, with progressively less for subsequent intakes. These Year 1 student experiences have to be considered in the context of the restrictions at that time due to the Covid pandemic. Given the potential interest (in the programme aims) in how well courses cater for mature students who enter from employment, it is unfortunate, for example, that no students are expected yet to have completed the part-time course at the University of Bath, which was a course specifically positioned for such students. Arguably, a longer timeframe for evaluation could have provided additional insights of this kind.

As our evidence about employment outcomes for course graduates was almost entirely dependent on responses to surveys implemented after students had completed a course, the extent of that evidence was strongly dependent upon how many could be engaged. Providers could not share contact details of students with us for data protection reasons. Thus, the surveys were implemented by providers forwarding our invitations to their students, which was reasonably successful amongst current students, as course teams had their email contact details. However, once students had completed a course, course leaders reported that they were not permitted systematically to retain those contact details, as responsibility to engage with them shifted to their ‘alumni’ team. From other research projects with alumni, and direct reports here from project leads, we know that many alumni units are very restrictive of the third-party emails that they will send to alumni, either as a policy and/or in practice. This reduces potential engagement with alumni, while any contact data and consents gathered directly by us from students tends to suffer the practical issue that some providers use internal email addresses for students which no longer function once the student has left.

As a result, our ability to engage graduates following completion of a course was, as expected, far more limited than for current students. Given the focus of the programme on post-course employment impacts, this was a serious but essentially unavoidable limitation on the assessment of these long-term impacts in practice. Again, this is something we discussed with the OfS and that has informed the programme and evaluation designs for the successor scholarships programme. However, as in numerous other evaluations of career-related interventions, these two issues – a weak ability to access and engage alumni and the timing or duration of the evaluation preventing observation of some of the desired outcomes – combine to limit the assessment of longer-term impacts.

8 Overall findings and recommendations

8.1 Progress against programme aims

As noted in Chapter 2, and depicted as desired impacts in our theory of change in Chapter 3, the aims of this funding programme were to:

(1) Accelerate the number of highly skilled workers entering the UK AI and data science workforce by 2500 by autumn 2023 [through provision of conversion courses];
(2) Increase the diversity of the AI and data science workforce, through the funding of 1000 scholarships for those conversion courses [targeted at key under-represented groups];
(3) To increase the knowledge base about conversion course provision.

In practice, the OfS acknowledged that the extent of achievement of the first two aims would not directly be measurable within the evaluation period, as not all the students in the programme would by then have completed their course and post-course employment entry or change may not be immediate. Thus, for this evaluation, the first two programme aims were replaced by two specific measurable intermediate and graduate outcomes given in the theory of change:

(1) Achievement of 2500 highly skilled AI and data science graduates by spring 2023;
(2) Achievement of increased diversity of those AI and data science graduates.

This section now assesses progress against these two outcomes, while the next summarises overall findings and provides a variety of insights and lessons learned from activities within the programme (essentially the formative aim of the programme).

Outcome 1: 2500 additional graduates in AI and data science

The data presented in Chapter 4 show that the courses in the programme enrolled just over 7600 students in total. Even with a cautious estimate of 80 per cent completion, this should lead to at least 6000 new graduates in time (of whom up to 5000 are likely to have completed their course at the time of this report). These estimates are substantially in excess of the target of 2500 graduates by spring 2023.

Here we attempt to assess the impact of such an increase upon the total UK pipeline of PG graduates in AI and data science. Our judgement is that there is strong evidence that the programme's funding for the development of conversion courses has substantially enlarged the pipeline of PGT students in these disciplines.

OfS analysis of DDB Student Record data (see Appendix 3) shows 3905 entrants to UK PGT courses in AI and data science[30] in 2019/20, the year before this programme. In 2020/21 the total number of entrants doubled to 7885, among which our own data suggests 1393 were on conversion courses in this programme (roughly 18 per cent). In 2020/21, the programme courses comprised 26 per cent of all UK-domiciled students and 13 per cent of all international students on UK AI and data science PGT courses. The 1393 students on programme courses constituted roughly 35 per cent of the 3980 increase in student numbers between 2019/20 and 2020/21.

[30] Identified by the presence of 'Artificial Intelligence' or 'Data Science' in course titles

The following year, the 2555 programme course students we recorded comprised 24 per cent of all UK PGT course students in these areas (including 28 per cent of the UK-domiciled students), and 87 per cent of the total growth in students compared with 2020/21.

A smaller-scale, independent but complementary piece of evidence also emerged from our student survey. Half of the UK-domiciled respondents with a scholarship indicated that without their scholarship they would not have enrolled on the course. This is further evidence that the programme and its scholarships have expanded the total cohort studying these AI and data science courses.

Overall, we believe there is clear evidence to support the view that the development and provision of the conversion courses in this programme has contributed substantially to the total number of PGT students in the UK in these subjects.

The evaluation has not produced such quantitative evidence about the number of programme course graduates that have entered the AI and data workforce, as to date this has relied upon survey responses from graduates whom it is decreasingly feasible to engage over time once they have graduated (quite aside from the fact that not all will undertake employment or career changes immediately post-course). Equally, the footprint of the 'AI and data science workforce' may not systematically map to employment outcomes described by survey respondents. Nonetheless, evidence from survey results suggests that around half of the graduates gained an employment outcome aligned with the programme aim within a few months of graduation. There is preliminary evidence to suggest that this increases to around three quarters by a year later.

Outcome 2: Increased diversity of AI and data science graduates

We have presented a variety of data demonstrating that the cohorts of students undertaking programme conversion courses have had enhanced diversity as a result of the targeted scholarships, with much higher proportions (around double) of scholarship awardees being female and/or Black and/or disabled than amongst other enrolled students (see Figure 5.1).

Comparison of the profile of students on courses in the programme with that of potential benchmarks is another way to assess whether these cohorts are more diverse. For example, for 2020/21, the proportion of female students on programme courses was 38 per cent, which was higher than amongst all students on UK PGT computing courses that year (29 per cent), and more than double the proportion amongst first degree qualifiers in computing that year (17 per cent). Similarly, the proportion of programme course students declaring a disability was nearly double the proportion amongst PGT computing students in the same year, although the difference is likely to have decreased since 2020/21 as international student numbers have risen dramatically (far fewer of whom report a disability).

Amongst UK-domiciled students, 52 per cent of students on programme courses in 2020/21 were of ethnic minority background, far higher than amongst all UK-domiciled PGT computing students (32 per cent) that year. A directly comparable benchmark for Black PGT students was not available to us, but the proportion of Black students on programme courses at 23 per cent was far higher than the seven per cent of all students (or of first degree qualifiers) at a comparable time who were Black.

Robust evidence did not emerge about the effect of scholarships in relation to the other under-represented groups targeted (albeit these had a lesser focus), as data was much

more limited. However, 37 scholarships were awarded to students on the basis of being in one of these groups and not in one of the three priority focused groups.

In our judgement, these comparisons provide considerable weight in suggesting that the cohorts on programme courses have been more diverse than on broadly equivalent UK PGT courses in relation to the key priority characteristics, at least partly due to the presence of the scholarships. The cohorts also comprise students with a wider range of first-degree backgrounds than overall, due to their design as conversion courses. Although there is much more limited evidence about the profile of course graduates who specifically enter the UK AI and data science workforce after the programme at this time, there is equally no evidence to suggest that the more diverse student/graduate cohort will not in time progress into the workforce and thereby result in an enhanced diversity of those entering the workforce.

8.2 Emerging knowledge and lessons learned

Taking a broader view than in the previous section, we offer some overall findings from the programme and also observations about provision of postgraduate conversion courses based on experiences within the programme.

Course development and participation. More than 30 new conversion courses in data science and AI were successfully developed, approved and launched, and continue to be delivered, in line with funded providers' proposals. A number of pre-existing courses were refined by introducing new content or options and/or opened up to a wider range of students. The vast majority were launched, with the backdrop and challenges of the Covid-19 pandemic, in Year 1 of the programme.

These courses have, in total, admitted a very large number of students (over 7600 to date). Demand has been very strong, leading to many providers offering multiple intakes per year (for 15 of the courses to date), far more than originally proposed. Cohort sizes have in all cases been sustainable to date and in some cases have become very large (cohorts of over 100 students have become relatively common). The 'success' of these new courses in terms of enrolments and fee income have led to several cases of awards or other recognition by their institutions, and in other cases have underpinned development of new facilities or buildings. We estimate the total fee income from enrolments in the programme to have been around £100 million.

Course intakes have comprised students with a wide range of domiciles and first-degree backgrounds (with the majority being 'conversion' students, as intended, rather than cognate), as well as other personal characteristics targeted by scholarship awards. The proportion of international students has risen strongly, reaching 86 per cent in Year 3 of the programme (which mimics the position for many STEM PGT courses). There is evidence that the courses are appealing to students with a wide range of ages (nearly half were over 30 years of age), including mature students returning to PG study as well as recent graduates. Survey evidence suggests that over half have been in long-term employment prior to the course (and three quarters some kind of work), with only a minority progressing immediately from a prior degree.

While not quantitative with the same robustness, there is evidence that the majority of students (at least 80 per cent) have completed or are expected to complete their courses successfully, a rate of completion which is not thought to be markedly different from students on other types of PGT courses.

Design, content and delivery. Many courses featured an initial bootcamp or introductory module, most commonly focused on programming and/or mathematics, at the start of the formal course timetable or beforehand. Positioning such a bootcamp prior to formal enrolment (and commitment to fees) enabled some providers to assess students' aptitude to succeed on the course, or to offer this as a 'taster', through which they could develop a pool of motivated and suitable candidates. One project took this concept further back in the pipeline and offered pre-course taster bootcamps to current undergraduates and other prospective students, to introduce the idea of a conversion course.

Once beyond Covid-19 restrictions, when courses had to be online, most courses were offered in hybrid format, with blocks of learning each comprising a few fixed teaching days per week (on campus or in some cases online) and the remainder of the week dedicated to self-paced and/or online study. Some amount of asynchronous online study was felt to offer maximum flexibility to students. Inclusive designs were attempted to account for both the non-cognate background of many students and a diversity of personal circumstances, including the many who remained employed while studying. Following student feedback, many revisions were made to design and/or delivery, including the content of modules, to cater better for conversion students and the flexible delivery needed in practice. Graduate feedback from Year 1 intake entrants also supported the need for improved organisation of courses, in terms of delivery and content in different modules, recognising that they had experienced the first delivery of new courses. In the later stages of the programme when many intakes increased in size, a few commented adversely on large class sizes.

There was also some evidence from course graduates that more focus on industry examples and applications, and for more of the courses to introduce students to a wider range of contemporary software and technologies used in industry practice, would be welcome (at least compared with experience on courses in the first half of the programme).

Personal support. Providers' proposals for the courses highlighted the additional support that conversion students might require and that delivery could prove challenging as intakes became large and high numbers of students had to be supported. In addition to providing access to additional support in areas such as mathematics and programming, often delivered by other parts of the institution, and the regular range of pastoral and study support services, some providers introduced new self-paced online courses to support areas such as mathematics and programming. Others utilised additional resources such as doctoral students to mentor conversion course students needing extra support. Beyond this, academic and teaching staff themselves provided vast amounts of personal support to students, although a reported benefit of mixed cohorts (of conversion and cognate students) was enhanced opportunities for peer-to-peer support. Feedback from course graduates provides confirmation of the practical challenges of teaching and supporting cohorts of students with such a wide range of backgrounds and prior knowledge (i.e. cognate and conversion). Some providers introduced streaming in certain modules, recognising that cognate and conversion students had different needs.

Industry experience and career learning. While some courses offered variants with an integrated or mandatory placement, very many more offered the opportunity of an optional industry placement; our (somewhat limited) evidence suggested up to one third of students may have undertaken one. Feedback on such experiences was generally very positive, but demand outstripped supply, particularly during Year 1 when the Covid-19 pandemic limited opportunities.

Other methods of offering industry-related learning included, in a few cases, an industry mentoring scheme for students, while others ran formalised industry interactions rather than placements or internships. Industry-focused projects were also commonplace, as were guest lectures by industry partners. A minority of providers offered additional career-related support, positioned to help conversion students engage with the AI or data science industries. Feedback from graduates suggests that courses could beneficially augment this aspect of provision, to help conversion course students to transition into the AI and data industries. As courses mature, more providers will be able to engage course alumni in activities to promote courses or support current students.

8.3 Recommendations

For funders and the HE sector, in relation to programme aims

- There is evidence that PG conversion courses do increase the pipeline of AI and data science graduates, so we recommend that such provision should continue;
- Targeted scholarships have enhanced the diversity of the pipeline of graduate talent so, again, we recommend that Government continues to support such scholarships targeted towards under-represented groups (acknowledging that a successor programme is underway to support 2023/24 and 2024/25 intakes);
- We recommend that conversion courses are considered more widely as a response to desired enhancement of other skills pipelines.

For the OfS in relation to operating conversion course scholarship programmes

- We recommend that attention is given to ensuring greater consistency in providers' interpretation and implementation of scholarship eligibility criteria, where such awards aim to enhance participation by under-represented groups;
- Within the successor PG conversion course scholarships programme, we highlight the need to monitor and review scholarship demand and allocation, given its more restrictive criteria in relation to domicile, and recommend retaining the potential to adjust criteria without too long a lead time (i.e. guidance should not be fixed for too long).

For the OfS in relation to evaluating conversion course scholarship programmes

- We recommend close cooperation between the external evaluator and the OfS in designing monitoring requirements for funded providers, to avoid duplication of reporting effort;
- The use of administrative data, and sufficient evaluation duration to analyse such data, would be beneficial to obtain more robust data on rates of completion of students on conversion courses;
- Given the aspiration of this programme to enhance the number and diversity of those entering the AI and data science workforce (rather than graduates with that potential), we recommend any future evaluative activity is of sufficient duration to observe transitions into that workforce and that there is a clearer definition of the footprint of occupations in that workforce;

- We recommend continued assessment of programme outcomes for international students, to assess whether they should be included within targeted scholarships.

For HE providers in relation to conversion course provision

- As there is some evidence that very large class sizes are impacting on the experiences of students, continued monitoring of delivery and student experiences is needed and providers should ensure sufficient resourcing for teaching and support of such large numbers of students with a wide range of backgrounds and needs;
- We recommend that providers actively obtain feedback from students to continue to optimise design, content and delivery of new provision developed in this programme, including the extent to which it reflects contemporary industry needs for skills;
- Given evidence of the multiple benefits of student interactions with industry, the range of options for industry engagement should be reviewed and enhanced (and not restricted to placement and project opportunities);
- We recommend that alumni from the conversion courses are engaged by providers in order to (1) generate positive personal testimonies (including employment outcomes and career changes enabled) that will support course marketing and (2) offer additional support for students in relation to achieving their post-course career aspirations;
- Although not specific to this programme, we urge providers (and/or the HE sector more widely) to increase their ability to engage with programme alumni as they can provide critical evidence for assessing programmes' long-term outcomes and impacts.

Appendix 1. Courses in the programme

Table A1.1 PG conversion courses and intakes within the programme

Provider	Course title	Within programme	
		First intake	Cumulative no. of intakes
Birmingham City University	Artificial intelligence	Oct 2020	3
Brunel University London	Artificial intelligence	Oct 2020	3
	Data science and analytics (revised)	Oct 2020	3
Keele University	Artificial intelligence and data science	Oct 2020	4
Loughborough University	Data science	Oct 2020	3
Nottingham Trent University	Data science	Oct 2020	3
Sheffield Hallam University	Healthcare analytics and artificial intelligence	Jan 2021	3
Solent University Southampton	Applied artificial intelligence and data science	Jan 2021	5
Teesside University	Applied artificial intelligence	Oct 2020	3
	Applied data science	Oct 2020	3
University of Birmingham	Responsible data science	Oct 2021	2
University of Bradford	Applied AI and data analytics	Oct 2020	6
University of Essex	Applied data science	Jan 2021	5
	Artificial intelligence and its applications	Jan 2021	5
	Data science and its applications	Jan 2021	5

Provider	Course title	Within programme	
		First intake	Cumulative no. of intakes
University of Hull	Artificial intelligence and data science	Oct 2020	4
University of Liverpool	Data science and artificial intelligence	Oct 2020	3
University of Newcastle-upon-Tyne	Data science (2 new specialisations)	Oct 2020	3
University of Suffolk	Data science and artificial intelligence	Jan 2021	3
University of Sussex	Data science	Oct 2020	3
	Human and social data science	Oct 2020	3
	Artificial intelligence and adaptive systems	Oct 2020	3
University of Wolverhampton	Artificial intelligence	Oct 2020	10
	Data science	Oct 2020	10
Institute of Coding consortium			
Aston University	Applied artificial intelligence	Oct 2020	3
Birkbeck College London	Applied data science	Jan 2021	3
Coventry University	Data science	Oct 2020	6
Lancaster University	Health data science	Oct 2021	2
Manchester Metropolitan University	Artificial intelligence	Oct 2020	2
	Data science	Oct 2020	2
Queen Mary University of London	Data science and artificial intelligence	Oct 2020	4
University of Bath	Artificial intelligence online	Oct 2020	9

Provider	Course title	Within programme	
		First intake	Cumulative no. of intakes
University of Exeter	Data science with artificial intelligence	Oct 2020	3
	Cybersecurity analytics	Oct 2020	3
University of Gloucestershire	Data science	Jan 2021	4
University of Sunderland	Applied data science	Oct 2020	5
University of the West of England	Data science	Jan 2021	5

Appendix 2. Participation and student profile

Table A2.1 Enrolments and scholarships to 30 June 2023, based on providers' data.

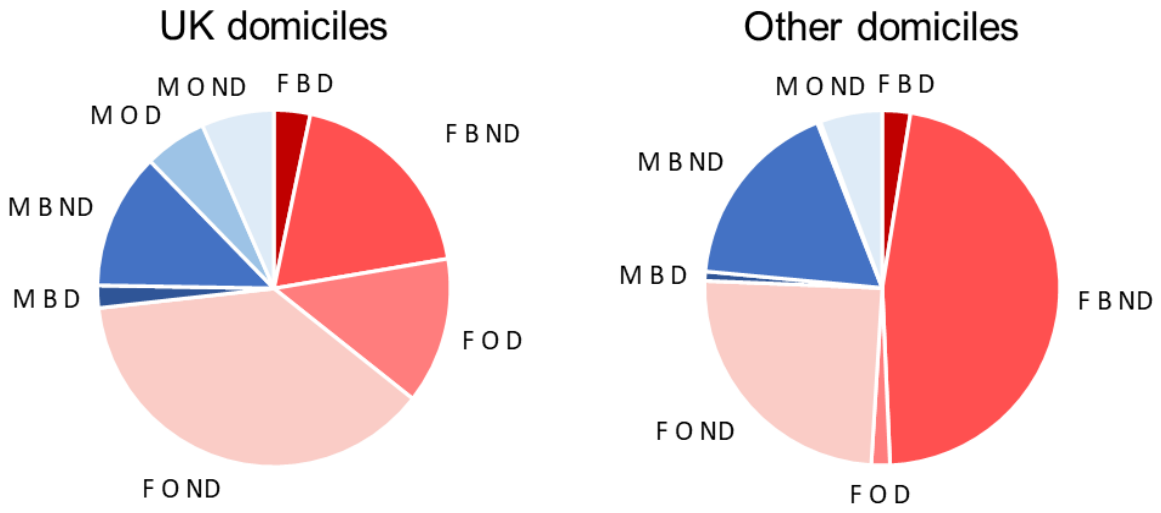
Launch period	All enrolments			All scholarships		
	Target	Total	Per cent of UK domicile	Target	Total	Per cent of UK domicile
Autumn 2020	605	784	61	220	139	88
January 2021		535	52		71	70
Spring 2021		74	49		8	100
Total Year 1		**1393**	**56**		**218**	**82**
Autumn 2021	835	1792	37	350	258	71
January 2022		688	12		34	35
Spring 2022		75	23		1	0
Total Year 2		**2555**	**30**		**293**	**67**
Autumn 2022	1060	2394	20	430	377	54
January 2023		1144	5		63	29
Spring 2023		118	16		1	0
Total Year 3		**3656**	**14**		**441**	**47**
Cumulative total	**2500**	**7604**	**28**	**1000**	**952**	**61**

Table A2.2 Key characteristics of UK-domiciled students awarded scholarships, based on providers' data

Intake	UK-domiciled scholarship students (per cent)				Number
	Female	Black	Total ethnic minority	Declared disability	
Autumn 2020	74	40	56	30	124
January 2021	80	40	56	26	50
Spring 2021	-	-	-	-	-
Total Year 1	**77**	**40**	**56**	**29**	**179**

Intake	UK-domiciled scholarship students (per cent)				
Autumn 2021	69	34	56	23	183
January 2022	92	33	58	33	12
Spring 2022	-	-	-	-	-
Total Year 2	**71**	**34**	**56**	**24**	**196**
Autumn 2022	64	33	57	25	188
January 2023	83	33	33	17	18
Spring 2023	-	-	-	-	-
Total Year 3	**67**	**33**	**55**	**22**	**206**
Cumulative total	**72**	**35**	**56**	**25**	**581**

Figure A2.1 Scholarship awardees by key eligibility group for UK domiciles and other domiciles, respectively. F – female; M – male; B – Black; O – Other ethnic background; D – disabled; ND – not disabled. Ns *= 542 (UK) and 353 (non-UK)*[31]



[31] Complete data was not provided for every scholarship awardee, hence totals sum to less than reported in Table A2.2.

Student profile and intersections

Table A2.3 Profile of total enrolled students for various sub-groups (from provider data)

Grouping	Enrolled students (per cent)				
	Women	Declared disability	Black	All ethnic minority	*Total*
UK-domiciled					
Scholarship	72	25	35	56	*581*
Non-scholarship	28	15	17	47	*1548*
Total	41	17	23	51	*2129*
International					
Scholarship	72	6	-	-	*371*
Non-scholarship	34	2	-	-	*5104*
Total	37	2	-	-	*5475*
All domiciles					
Scholarship	72	16	-	-	*952*
Non-scholarship	32	5	-	-	*6652*
Total	38	6	-	-	*7604*

From Table A2.3 it can be seen that the proportion of female students amongst scholarship awardees (72 per cent) was much higher than amongst other students (i.e. non-scholarship, 32 per cent). This was as hoped given that female students were a priority group based on the scholarship eligibility criteria. Slightly more of the UK-domiciled students were female (41 per cent) than of other domiciles (37 per cent). The proportion of female students on data science courses was slightly higher than on AI courses (Figure A2.2).

Much stronger variances in declared disability were observed in different sub-groups. As intended, with disability a priority eligibility criterion, the proportion of scholarship awardees declaring a disability (16 per cent) was higher than for other students (five per cent). Other intersections included a higher rate of declared disability amongst female students (eight per cent) than male (five per cent), and higher amongst UK-domiciled white students (22 per cent) than ethnic minority (14 per cent), see Figure A2.3.

Finally, a much higher proportion of UK-domiciled scholarship students was Black (35 per cent), than of other UK-domiciled students (17 per cent), as intended through the scholarship eligibility criteria. The total proportion of those from an ethnic minority background was highest amongst scholarship awardees at 56 per cent but was also high compared with potential benchmark populations at 47 per cent amongst other UK-domiciled students.

There was also some evidence for an intersection between ethnicity and gender, with a slightly higher proportion of UK-domiciled female students being Black compared with amongst UK-domiciled male students (and the reverse for UK-domiciled white students), although these variances were not seen for other ethnic minority backgrounds. There was

also some intersection with broad course discipline, with higher proportions of UK-domiciled Black students on data science courses than AI, whereas for UK-domiciled students of Asian background the reverse was the case.

Figure A2.2 Proportion of enrolled students reported as female, from provider data for all programme intakes (female students: N=2754). AI & data sci refers to courses containing both disciplines in their title/scope

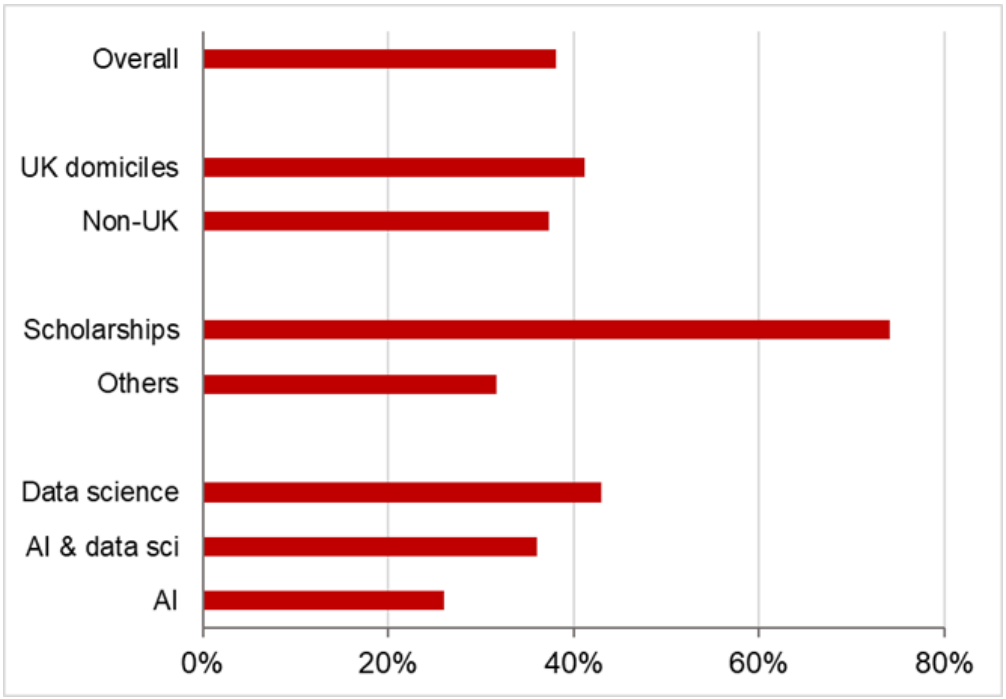


Figure A2.3 Proportion of enrolled students reported to have declared a disability, from provider data for all intakes (disabled students: N=448)

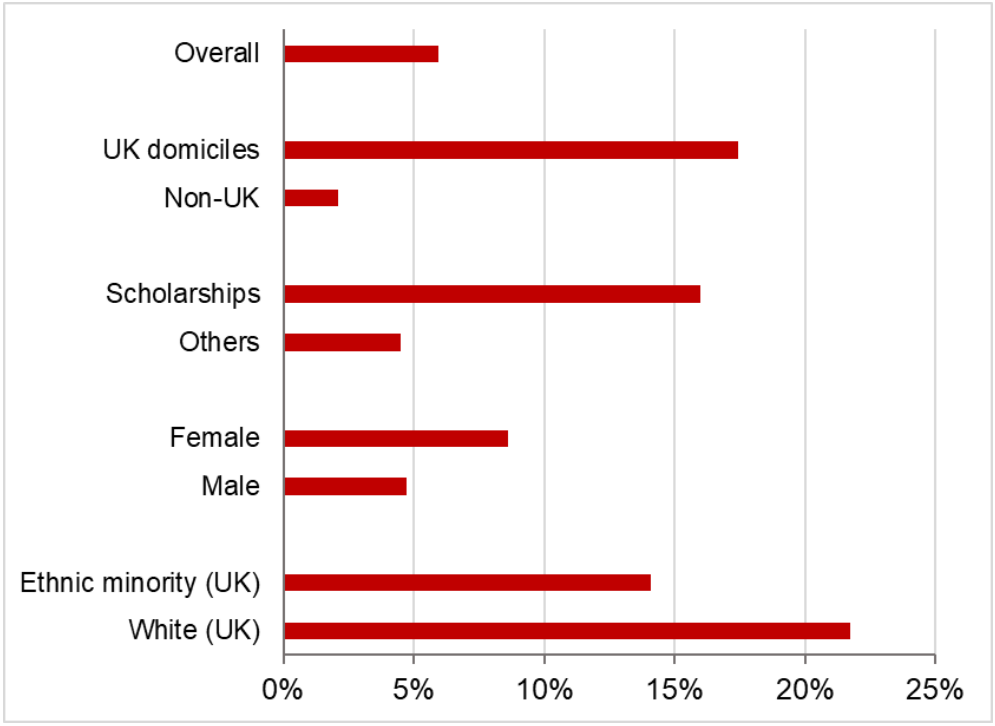


Figure A2.4 All enrolled UK-domiciled students by ethnicity, from provider data for all intakes (UK-domiciled students of known ethnicity: N=1892)

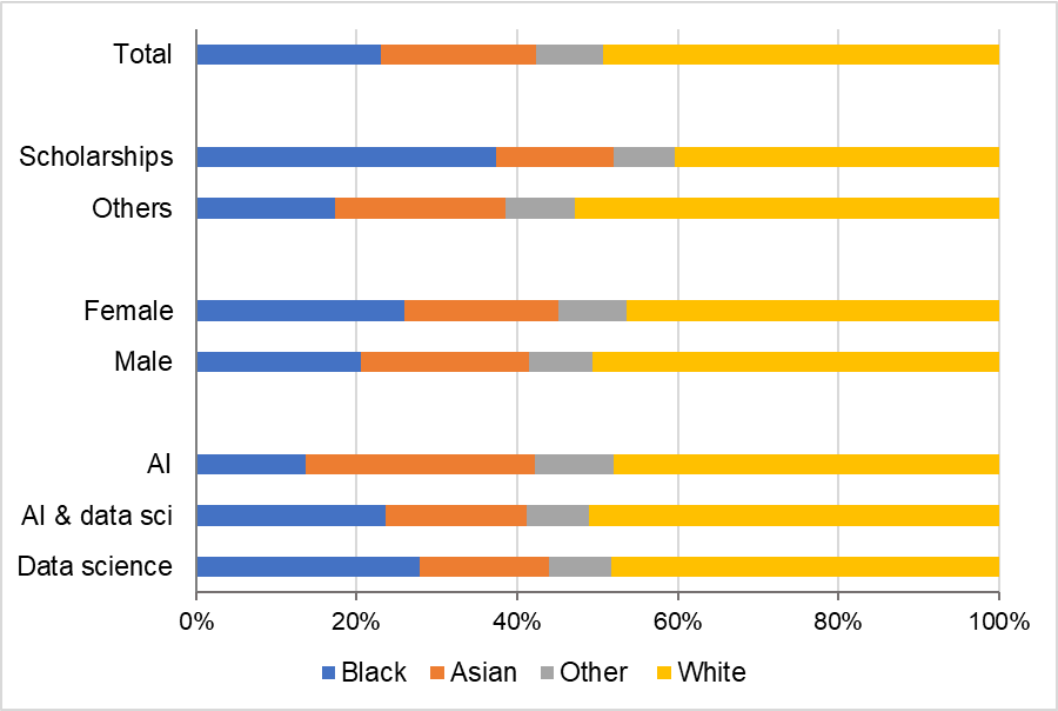
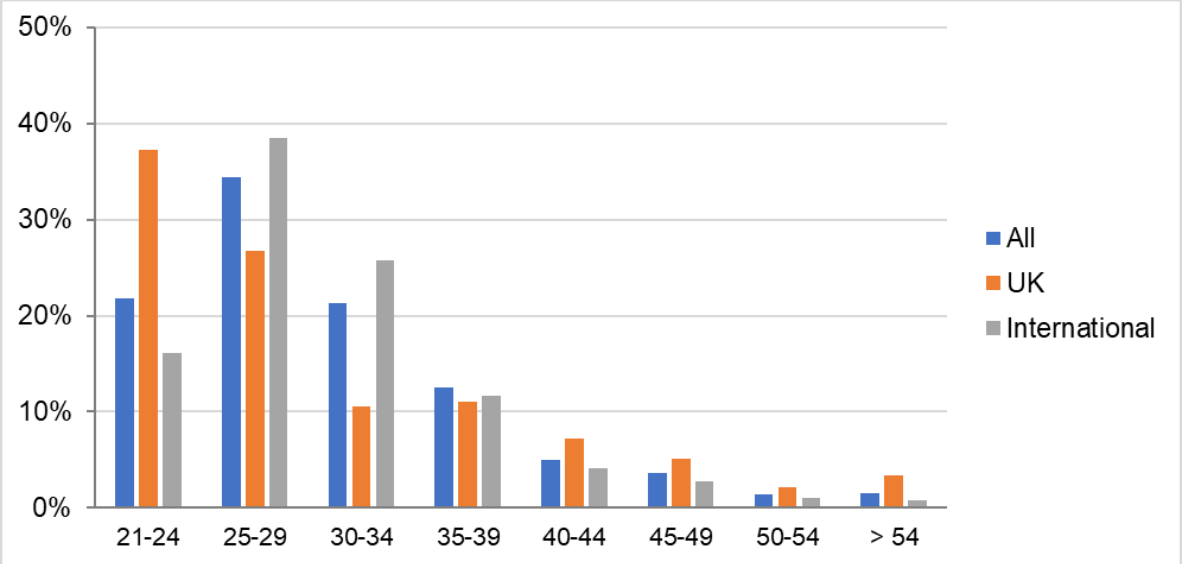


Figure A2.5 Age profile of student survey respondents, shown as age in years, with nationality (Ns: UK=244; International=607)



Appendix 3. Entrants to UK PGT courses in AI and data science

Table A3.1 Entrants to AI and data science PGT courses by domicile

	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Change 2019-20 to 2020-21	Change 2020-21 to 2021-22
Numbers of entrants:								
UK domiciles	500	715	895	1,220	3,030	2,745	1,810	-285
Non-UK domiciles	555	915	1,545	2,690	4,855	8,085	2,170	3,225
Total all domiciles	**1,055**	**1,630**	**2,440**	**3,905**	**7,885**	**10,825**	**3,980**	**2,940**
Percentage of entrants:								
UK-domiciled	47.4%	43.7%	36.7%	31.2%	38.4%	25.3%		

Student Record data from the Designated Data Body (DDB) has been used to examine trends in entrants to AI and data science PGT courses between 2016-17 and 2021-22.

AI and data science PGT courses have been identified via the presence of either “Artificial Intelligence” or “Data Science” in their course titles. As such, any courses that have been spelt incorrectly may not have been recognised.

Entrant numbers are rounded to the nearest five and percentages to one decimal place. Due to rounding, totals might not equal the sum of individual numbers. Percentages were calculated using unrounded numbers and then rounded.