RESEARCH ARTICLE

Career and portfolio development in data science apprentices

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Abstract

Traditional mathematics programmes have often emphasised subject knowledge over employability and soft skills, despite growing recognition from employers and professional bodies of the importance of these competencies, especially considering rapid workplace changes driven by AI. This paper explores the use of authentic assessment to support such skills through real-world tasks, focusing on a teaching block within the Data Scientist Degree Apprenticeship at the University of Nottingham. Designed to prepare final-year apprentices for their careers and the End Point Assessment (EPA), the block emphasised skills development, portfolio building, and readiness for a professional discussion. Survey data from two cohorts revealed that while the teaching block was positively received initially, confidence in EPA preparedness declined over time, particularly among apprentices earlier in their careers. These findings suggest a need for sustained support and have broader implications for embedding employability-focused, authentic assessment strategies in both degree apprenticeships and traditional mathematics curricula.

Keywords: Apprenticeships, assessment, portfolio, employability skills.

1. Introduction

Employers and professional bodies increasingly highlight gaps in graduates' employability and soft skills, particularly in STEM subjects were rapid technological change demands adaptability. In mathematics, the Institute of Mathematics and its Applications (IMA) emphasises the need for transferable skills such as teamwork, self-management, and communication (IMA, 2021)

This study focuses on career development within the Level 6 Data Scientist Degree Apprenticeship at the University of Nottingham. Unlike traditional undergraduates, apprentices are working in a workplace and studying for 20% of their time over 3.5 years in a hybrid fashion. Their final assessment, the End Point Assessment (EPA), requires them to demonstrate knowledge, skills and behaviours through a knowledge test, a work-based project report, and a professional discussion informed by a portfolio of six-eight workplace evidence.

To support EPA and career readiness post-apprenticeship, the university developed a bespoke six-week teaching block, 'Becoming a Professional Data Scientist', delivered in the third year. It combines weekly online activities (interactive slides, guest speakers from data science, and applied activities such as CV writing) with an in-person block halfway through the teaching block featuring an in-person guest speaker, mock professional discussion and a CV feedback exercise. The teaching block commenced in September 2023, with the second cohort starting in September 2024.

Prior to completing the portfolio in year 3, apprentices undertake authentic assessments in prior years of the apprenticeship, which can be later used in the portfolio as an evidence piece. In the context of the Data Scientist Degree Apprenticeship, we define authentic assessments to be assessments that use work data to solve a work problem.

Degree apprenticeships remain underrepresented in UK higher education with only 13.9% of new apprentices in England enrolled at degree level in 2022/23 (Bolton & Lewis, 2024). Limited literature

exists on career and portfolio development in this context, and the upcoming apprenticeship levy cut (Chowen, 2025) may further impact uptake of degree apprenticeships.

This study evaluates the impact of the teaching block on EPA and career preparedness, addressing three research questions:

1. To what extent did the dedicated teaching block influence apprentices' perceived preparedness for the EPA?
2. How did the teaching block contribute to apprentices' sense of preparedness for their future careers as data scientists?
3. Is there a difference between the two cohorts in terms of perceived preparedness for the EPA and future careers?

2. Rationale and relevant literature

Employers report that graduates lack key soft skills such as communication, collaboration, critical thinking and building relationships, and that these skills are increasingly critical for success in the workplace (Robinson, 2024; Succi & Canovi, 2020). This has been highlighted as a particular issue in STEM disciplines, where rapid changes in technology can render some knowledge and skills obsolete within a few years (Smith & White, 2019). As a result, Universities need to provide courses that foster adaptability and professional competencies.

The recent rise of generative AI has further shifted employers' expectations of graduates, placing greater emphasis on soft skills, over traditional knowledge (Walker, 2024). For degree apprenticeships these skills are especially important, as they must demonstrate both subject knowledge and workplace behaviours and skills through the EPA. Authentic assessment – using real-world tasks to develop and evidence skills – offers a valuable approach to bridging this gap (Symonds & Mott, 2024).

To address these needs, we designed a dedicated teaching block within the Data Scientist Degree Apprenticeship which aligns with broader calls to embed employability and soft skills development within mathematics curricula, including traditional undergraduate programmes (Institute of Mathematics and its Applications, 2021).

3. Methodology

The study evaluates the impact of the 'Becoming a Professional Data Scientist' teaching block on apprentices' preparedness for the EPA and their post-apprenticeship careers and addresses the three research questions that are defined in the Introduction.

3.1. Survey analysis

Four surveys were sent to all apprentices enrolled on the programme.

- Cohort 1 (started 2021/22): Surveyed in November 2023 and July 2024, with response rates of 37.5% (6/16) and 81.3% (13/16);
- Cohort 2 (started 2022/23): Surveyed in November 2024 and July 2025, with response rates of 58.3% (7/12) and 75% (9/12).

Each survey used Likert-scale questions and apprentices were encouraged to give reasons for their responses. Respondents were also encouraged to give any other constructive comments regarding the preparation for the EPA and future careers. Quantitative results were analysed graphically. Due to the small cohort size, findings are not statistically significant.

4. Results

Four surveys were conducted across two cohorts of apprentices (Cohort 1: 2021/22 start; Cohort 2: 2022/23 start) at two time points: immediately after the conclusion of the third-year teaching block (November) and approximately eight months later (July). Response rates ranged from 37.5% to 81.3%. Cohort 1 primarily comprised experienced professionals, while Cohort 2 was mainly made up of recent school leavers.

4.1. To what extent did the dedicated teaching block influence apprentices' perceived preparedness for the EPA?

Survey responses indicated that the teaching block was positively received, with 100% of respondents initially agreeing it supported their EPA preparedness (Figure 1). Confidence declined slightly by July, particularly among less experienced apprentices in Cohort 2.

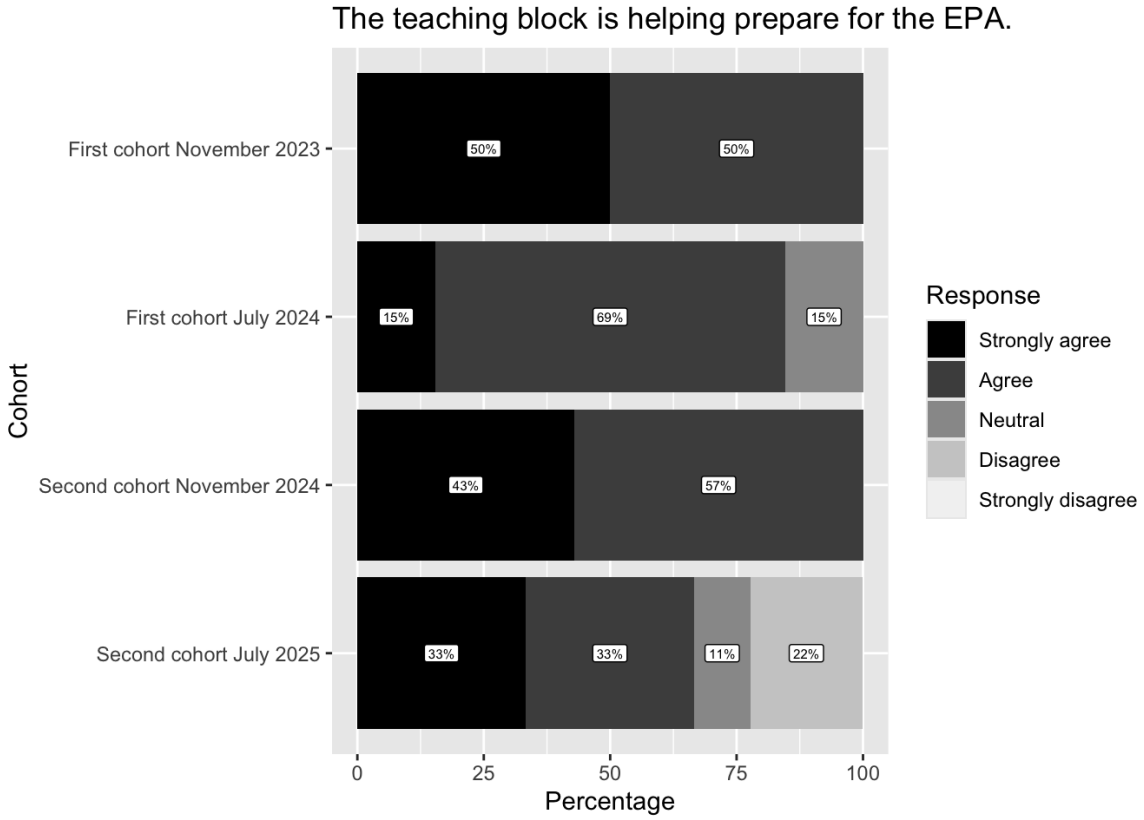


Figure 1. A Likert plot showing the responses of apprentices. They were asked whether they agree or disagree with the statement "The teaching block is helping me to prepare for the portfolio and professional discussion", for the 'Becoming a Professional Data Scientist' teaching block they completed.

Apprentice comments suggested that they valued the structured guidance and mock professional discussions:

> *"Having some support and guidance from the University in preparing for the portfolio/professional discussion is really helpful, so I don't have to guess about what is required."* (Cohort 1, November)

> *"The block release was really useful for understanding the professional discussion. I felt I knew a good amount about the portfolio but there were opportunities to ask questions informally as we went along throughout the day which I liked."* (Cohort 2, November)

Cohort 1 generally appeared more confident:

> *"I am pretty good in an interview and know my projects well, just got to get that last one done."* (Cohort 1, July)
>
> "*I just don't have much experience with vivas."* (Cohort 2, July).

These differences were not surprising due to the general differences of previous work experiences in the two cohorts.

4.2. How did the teaching block contribute to apprentices' sense of preparedness for the future careers as data scientists?

Apprentices found the teaching block beneficial for career readiness, especially the data science guest speaker sessions (Figure 2). However, perceived usefulness declined over time.

> "*Hearing from current Data Scientists was extremely insightful*." (Cohort 2, November)
>
> "*The guest speakers were incredible and I would really like more. I think this should have been implemented in our first year."* (Cohort 1, November)

This suggests that there is some appetite for seeing real data scientists from other work contexts earlier on in the apprenticeship and not just when they are preparing to finish the apprenticeship.

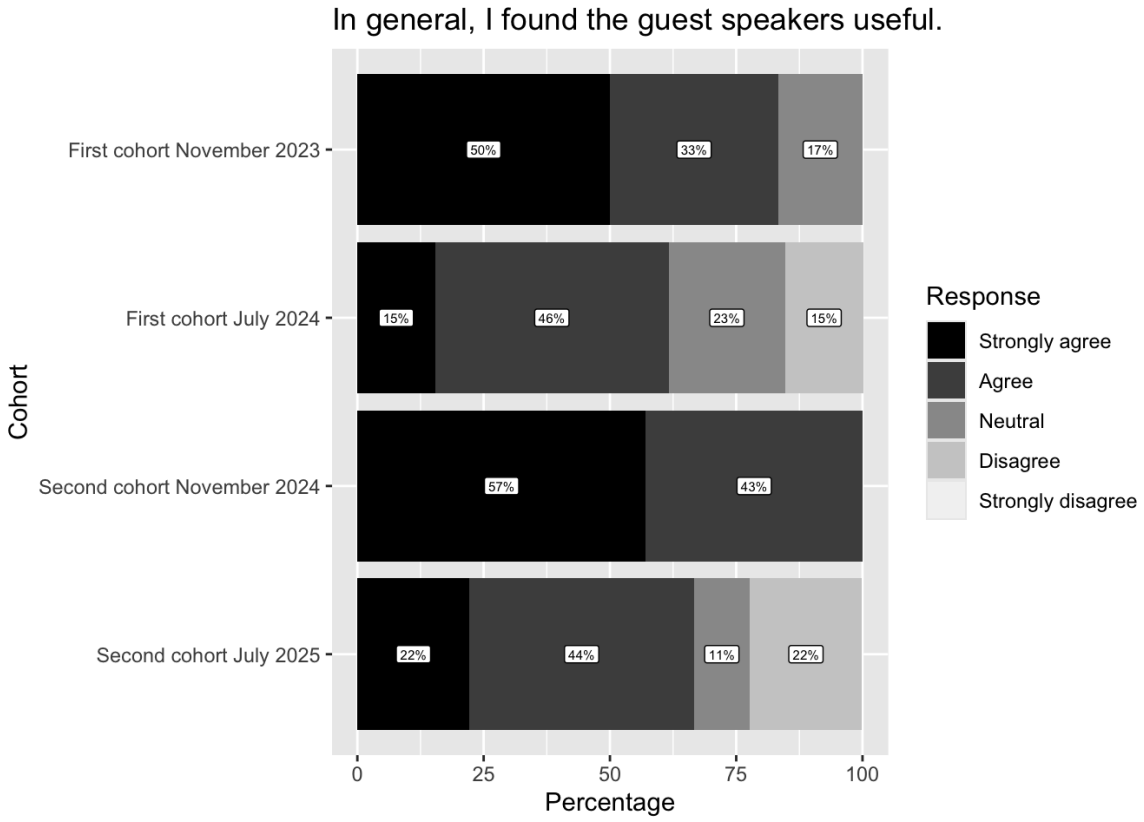


Figure 2. A Likert plot showing the responses of apprentices. They were asked whether they agree or disagree with the statement "In general, I found the guest speakers useful", in the 'Becoming a Professional Data Scientist' teaching block they completed.

There was also strong appreciation for the in-person block release and CV feedback task (Figure 3), though one apprentice suggested improvements, which were implemented in 2025:

> "*I felt that for the block release session where we provided feedback on each others' CVs, it was difficult to understand how I should improve the CV based on the feedback and I couldn't ask the person who provided the feedback for more clarification as it was anonymous. I felt this task would have been better if it were done in small groups of about 3, where the groups look through the CVs together and discuss how to improve them."* (Cohort 2, November)

However, there were some apprentices in Cohort 1 who commented that rather than a teaching block that prepared them for the workplace they would have preferred a teaching block that taught them more technical knowledge:

> "*I think some of the exercises and talks were useful but at the same time I think the study hours could have been spent better teaching us technical knowledge instead. If I had an option between this module and for example another coding module, I would choose the latter*." (Cohort 1, November)

However, others valued the non-technical content:

> "*I think it would have been good to have more non-technical learning like 'Becoming a Professional Data Scientist' throughout the three years."* (Cohort 1, July)

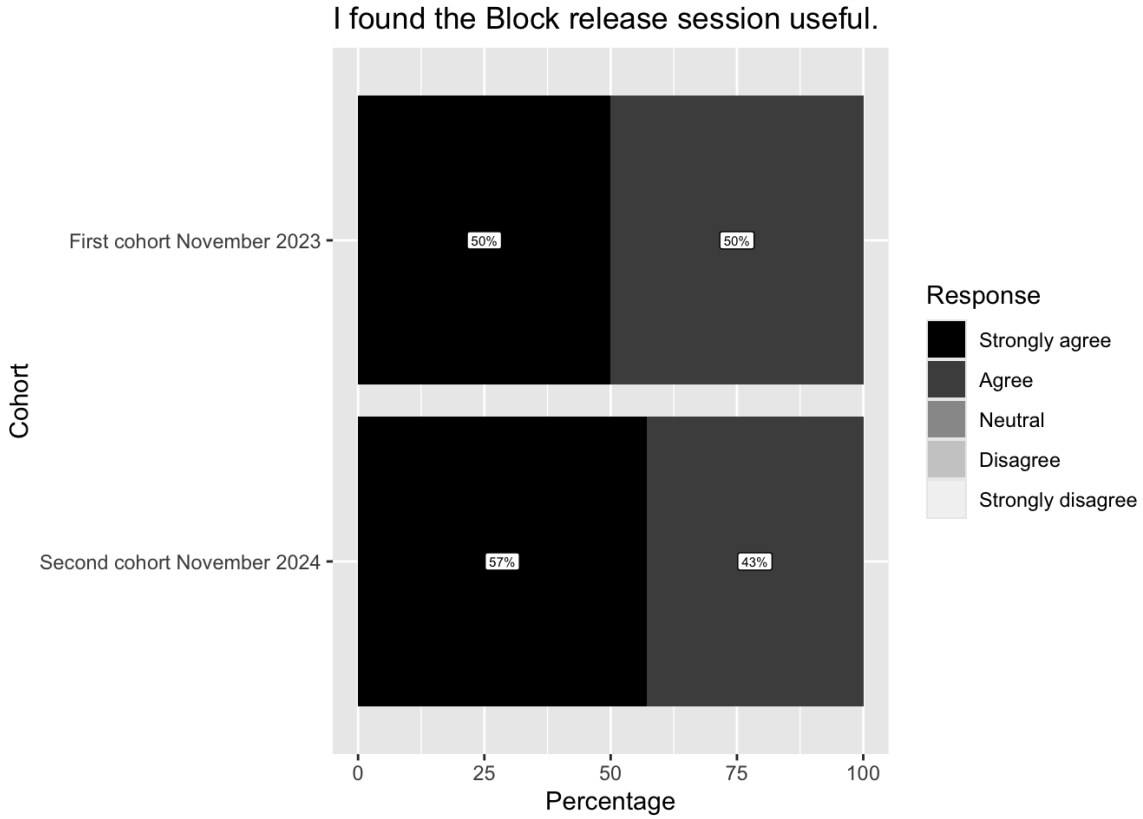


Figure 3. A Likert plot showing the responses of apprentices. They were asked whether they agree or disagree with the statement "In general, I found the Block release session useful", in the 'Becoming a Professional Data Scientist' teaching block they completed.

4.3. Is there a difference between the two cohorts in terms of perceived preparedness for the EPA and future careers?

Cohort 2 were generally more positive immediately after the completion of the teaching block (Figures 2-5), except regarding EPA preparedness (Figure 1), likely due to less workplace experience. Cohort 1, while more confident, sometimes found the content less relevant:

> "*As someone who is not doing their first degree, some of the project support and portfolio teaching blocks were not particularly valuable, although I can see how they may be for others.*" (Cohort 1, July)

In contrast:

> "*I thoroughly enjoyed this learning block as it allowed me to dedicate some time to my personal growth as a data scientist.*" (Cohort 2, November).

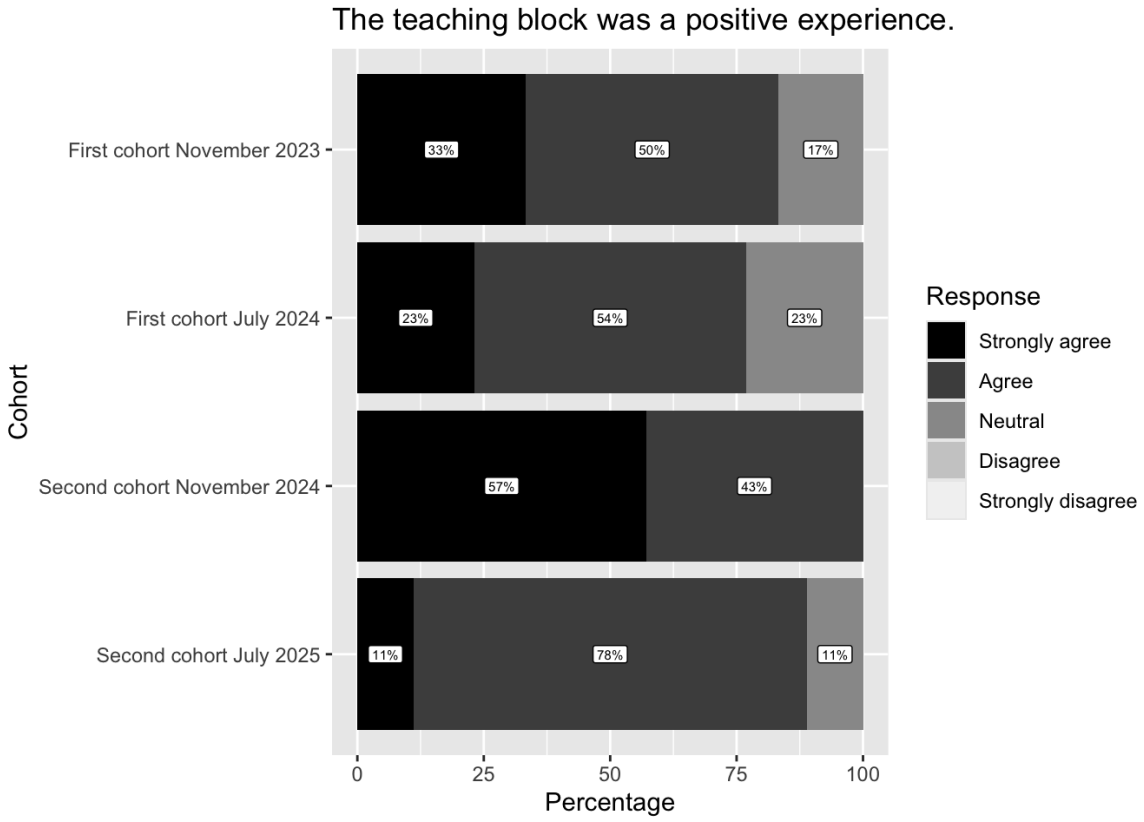


Figure 4. A Likert plot showing the responses of apprentices. They were asked whether they agree or disagree with the statement "The teaching block was a positive experience", for the 'Becoming a Professional Data Scientist' teaching block they completed.

In both cohorts we found that responses around the teaching block, guest speakers and EPA preparedness declined over time (Figures 1, 2 and 4), particularly in Cohort 2, suggesting a need for ongoing support.

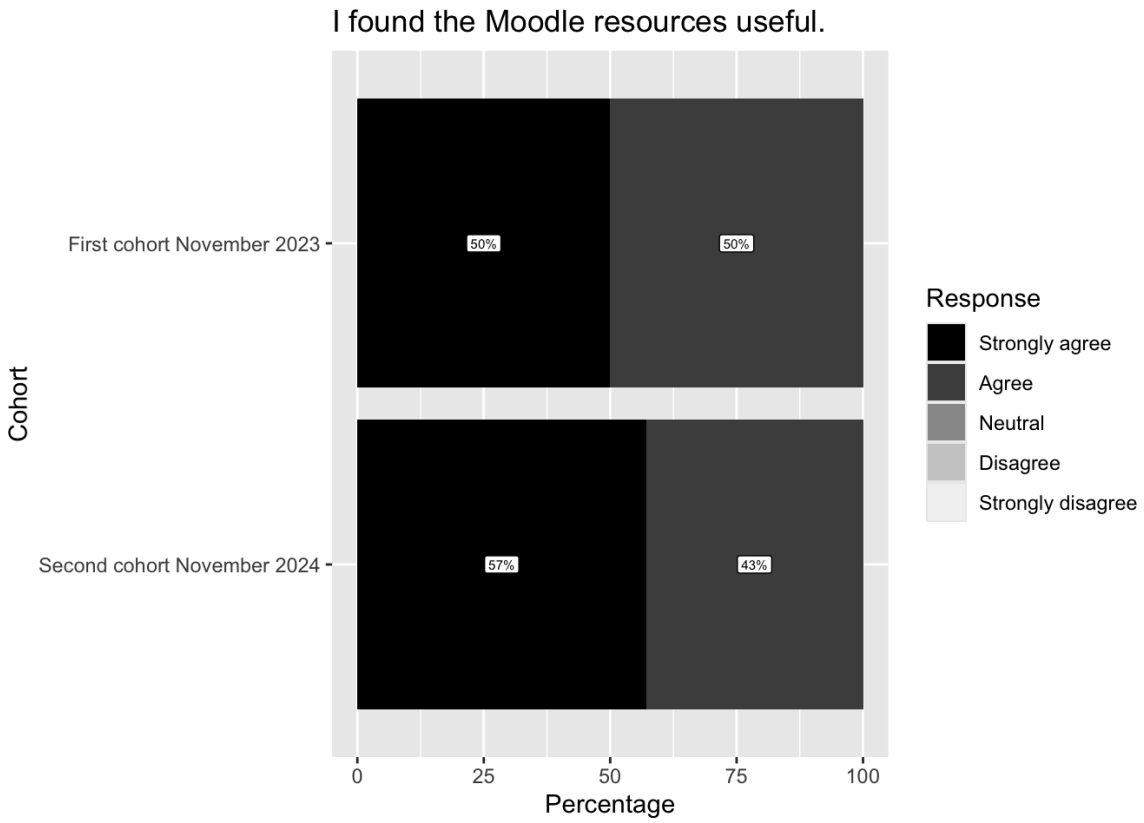


Figure 5. A Likert plot showing the responses of apprentices. They were asked whether they agree or disagree with the statement “In general, I found the Moodle resources useful”, in the ‘Becoming a Professional Data Scientist’ teaching block they completed.

5. Discussion and conclusions

Our analysis set out to evaluate the impact of a dedicated teaching block on apprentices’ preparedness for the EPA and their future careers, and to explore differences between two cohorts. Overall, the findings suggests that the teaching block was effective at preparing apprentices for both the EPA and future careers in the short term. However, the analysis also suggests that there is a slight decline in confidence eight months after the teaching block, particularly in relation to EPA preparation. Perceptions of the teaching block varied with prior workplace experience.

Apprentices found guest speakers from data science helpful for understanding where they are going after the apprenticeship and to see insights from industries that they are not in. In the long term, this exposure may support career progression, especially if apprentices consider changing employers. In-person activities were particularly valued, especially mock professional discussions and evaluating each other’s CVs. However, one consideration in future cohorts has to be diversifying the teaching block so that it is also suitable for more mature apprentices, who are upskilling but have been in the workplace for many years. The second cohort were more positive around the range of activities, but careful evaluation of future cohorts would be required to determine whether this difference is because the teaching block has evolved after feedback, or whether the makeup of workplace experience and age of apprentices is also important in how useful apprentices find the preparation.

The limitation of this analysis is that the sample size is small, although uptake of the survey was very good, particularly in the July surveys. Further investigations with larger, future cohorts, combined

with interviews or focus groups to delve deeper into apprentices' responses would allow for more robust conclusions to be made.

The first cohort of apprentices started in 2021/22 with the fifth cohort of apprentices starting in 2025/26. There has been a significant increase in the number of apprentices in each cohort, with the third cohort to take 'Becoming a Professional Data Scientist' having more than four times the number of apprentices as the second cohort. The teaching block will make use of Power Automate to automate tasks that were done manually before, and will increasingly make more use of tutor feedback, rather than lecturer feedback, with the aim of maintaining the same quality and support as in smaller cohorts. An analysis of student feedback will take place in November 2025 and July 2026 to make sure that students still feel prepared despite the larger cohort sizes.

Although this paper focuses on apprentices already in employment, the teaching block could be adapted for traditional mathematics undergraduate. In fact, this type of learning and development is more important for students without workplace experience, as soft skills are becoming increasingly essential, particularly in the age of AI. (Institute of Mathematics and its Applications, 2021; Robinson, 2024; Walker, 2024).

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