



PAPER

How do Physics students navigate their career development?

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ABSTRACT

Balancing employability skills development with core content is challenging for content-heavy degrees like Physics but can be supported through adapted teaching methods and structured employability activities such as careers fairs, societies, and industrial placements. This study draws on quantitative and open-text analysis of survey responses from 185 physics students across five UK universities to evaluate the collaborative initiative called the White Rose Industrial Physics Academy (WRIPA).

Many students believed a Physics degree would enhance their career prospects and could clearly identify skills gained, particularly in problem-solving, programming, and data analysis. Those completing industrial placements or internships reported fewer concerns about their preparedness for employment, suggesting both academic progression and work experience strengthen confidence in future careers. Nonetheless, students continued to face barriers when engaging with employers, frequently citing limited time, lack of feedback, and frustration during job applications.

KEYWORDS: employability, Physics, careers, skills, curriculum, decision-making.

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Introduction

Employers expect graduates to have a range of flexible, transferrable skills (Wickramasinghe & Perera, 2010). Consequently, universities are expected to equip students with a range of transferrable skills while simultaneously teaching relevant subject-specific content (Boden &

Nedeva, 2010). This appears to be internalised by students in recent times, even under uncertain economic environments (Jackson & Tomlinson, 2020). Overall, we take an approach like Wiedner (2024) in our assessment of the situation in Physics, wherein universities have a dual focus on improving employability skills and developing subject-specific knowledge, to sufficiently prepare students for their futures.

The state of Physics education at university-level

Enhancing employability skills is imperative across all academic disciplines, including traditionally content-rich degrees such as Physics. This is necessary to align with career aspirations and potential trajectories of Physics graduates, which in conjuncture with the massification of the sector has meant that not all students take up science-related jobs. Indeed, recent data shows that 15 months after graduation only 18.3% of physics graduates completed further study, compared to 51.3% in full-time employment, of which only 9.8% were 'science professionals' (Greaves, 2024, p. 82). This implies that degree subject knowledge is further under pressure to create links with the labour market with a stress on transferrable skills, while maintaining the rigour of degree-level material. Balancing these two essential tenants of a modern Physics degree is undoubtedly challenging, a notion elegantly captured by McNeil and Heron (2017). They suggest increased development of employability skills is achievable through changes in Physics course content, such as introducing internships and providing opportunities to acquire non-Physics specific scientific/technical skills.

The impact of these changes has resulted in the re-structuring of programmes beyond disciplinary variations. The Institute of Physics recently changed their degree accreditation framework to account for this needed change in teaching methodology, which further outlines the importance of providing students with a combination of the translational and technical skills valued by graduate employers across a wide range of careers (Benson et al., 2023; Institute of Physics, 2022). Hirst (2018) suggested three changes to Physics education to promote employability: emphasising application of knowledge as opposed to factual knowledge, implementing curriculum-based learning experiences with industry partners, and aligning graduate skills with regional innovation and opportunities. Employer involvement in course design and delivery has been shown to improve student career prospects by both improving employability skills and improving the quality of graduate employment (Mason et al., 2009). While minor changes to teaching methodologies may lead to enhanced



employability, completely alternative teaching approaches such as Project Based Learning (PBL) have also been suggested. Such an approach could lead to improvements in interpersonal skills, such as teamworking, project-management, and report writing (Benson et al., 2023). Along with employability skills development, universities promote and enable 'employability activities' which include careers fairs, internships, conferences, student union societies, and volunteering. These activities can further improve interpersonal skills and allow students to pursue a wide range of interests, which can serve as valuable evidence for prospective employers.

Student decision-making and career trajectories

Improving the employability skills of Physics students is only worthwhile if students can outline them and employers can appreciate these skills. D'Silva (2019) argues that (lack of) confidence in employability skills is often not a deterrent for Physics students when considering their career futures. When engaging with the world of work, Physics students may believe that their course content and degree make them highly employable, with employers often re-enforcing such notions regarding a hierarchy of degrees, and therefore knowledge, valued. This is described by D'Silva (2019, iv) as 'science ego', in which the current economic structure assigns higher value to the natural sciences on the premise of such disciplines being 'objective', thus supporting a technologically driven world. Inadvertently, it ignores the need to consider human behaviour, which may translate to disconnections between student and employer perceptions of Physics graduates' skills (D'Silva & Pugh, 2020).

However, while enhancing employability skills is important, students on the same degree programme may have vastly different career aspirations including general graduate jobs, academia, or technical industries. It is hard for universities to account for these differences, so a 'one size fits all' approach is often used to enhance employability. This has been criticised, with studies suggesting that universities need to do more for under-represented groups and that panels discussing HE policy need increased inclusion of young people from diverse backgrounds into these conversations (Benson et al., 2023; D'Silva, 2019). The linear trajectory based on industry demands and the employability provision of universities is not always a priority for students. Many young people have an emotional attachment to their hometown (D'Silva & Pugh, 2021), with 82% of all students living in their home region a year after graduating and 65% still based there a decade later (Hirst & Benson, 2019, para. 8). With the



UK's geographically unbalanced labour market, students from areas lacking a high concentration of graduate jobs are at a major disadvantage (D'Silva & Pugh, 2021). Hirst and Benson (2019) suggest this can be countered by increasing engagement with local employers and encouraging employability activities throughout a degree. Other research suggests that employer input into course delivery could lead to better matches between students and employers (Mason et al., 2009).

Industrial placements have been shown to have a myriad of other benefits. Students undertaking industrial placements have been shown to attain higher academic performance compared to peers without a placement (Gomez et al, 2004; Gracia & Jenkins, 2003; Rawlings et al., 2005; Reddy & Moores, 2006). Studies suggest this is because students return to university with more maturity and higher commitment to their studies (Gracia & Jenkins, 2003; Rawlings et al., 2005). Conversely, Surridge (2009) argues this effect is exaggerated as academically stronger students are more likely to seek and attain a placement year. Jones et al. (2017) acknowledged this self-selection but determined that placements still have a positive impact on student performance. In addition to strictly academic benefits, placement years have been shown to improve transferrable skills and improve students' ideas about future careers (Reddy & Moores, 2006). These effects combine to give placement students a higher chance of graduate employment in a saturated job market where employers equally value academic performance and experience (Tomlinson, 2008), and lead to placement students experiencing greater success at gaining graduate employment six months after leaving university (Mason et al., 2009). However, the substantial evidence proving the value of placements may negatively affect students without such experience, who may lack confidence if they failed to attain a placement, consequently believing that their degree alone is insufficient to compete with more experienced graduates (Brooks, 2012).

Student career success is also inevitably related to their personal experience of employment. Studies have shown that 58% of students feel 'doing something they really enjoy' was the most important factor in their future careers (Quinlan & Renninger, 2022, p. 865). Guiding students to find fulfilling career paths is therefore another important focus for universities.

In short, the situation is one that is difficult to control without collaborative endeavours. In this paper, we present an initiative that drew five major Northern English universities together on the shared principle of supporting students to achieve a career future that supports them



and the local economy, and through which career trajectories into STEM education could be supported in a meaningful way.

Methodology

The White Rose Industrial Physics Academy (WRIPA) is a collaboration between the Physics departments of five universities in northern England. WRIPA's mission is 'to bring students and businesses together to foster innovation and retain talent' (n.d., para. 1), which involves many of the aforementioned methods, such as embedding employability skills within the curriculum and increasing engagement with regional employers through employability activities.

Data collection

An online survey was carried out between May and October of 2022 with responses from 185 students across the five WRIPA universities, with an aim to understand decision-making in relation to engagement with their career futures. This included perceptions of employment through reflections on students' decisions to undertake a degree, various activities they participate in, their engagement with the job market including finding information and applying, and perceptions and concerns about future employment. The survey consisted of a combination of closed and open response questions.

Data analysis

This paper uses a mixed-methods evaluation of the survey data. The data was cleaned and coded for the purposes of analysis. This included thematic coding of open-ended responses. Demographic characteristics of class, gender, and race were left open. In the case of class, the responses generally reflected terms in social discourse—i.e., using categories of middle class and working class. In the case of gender, the proportion of respondents who identified beyond the gender binary was small. Similarly for race, the respondents were mainly white. Other than for gender, identifying the specific characteristics would have implied issues around statistical significance, reducing meaningful engagement with these responses. Before completing analysis, it was important to get a general overview of participant demographics so that deviations in descriptive statistics for groups with small sample sizes could be quickly identified.



Responses were summarised using SPSS descriptive statistics in crosstabs tables and later translated to graphs. For 'select all that apply' questions, the 'group by' function was used to increase efficiency. For the statistical-focused approach, hypothesis tests were run if descriptive statistics were noticeably different among demographic categories, but only if these differences could be logically explained to reduce the chance of type 1 error. Only three statistical tests were used: Chi-squared tests and loglinear analysis for categorical data, and Mann-Whitney U tests for Likert scale data (Field, 2018).

Discussion

WRIPA intended to directly address some of the issues highlighted in the Introduction. The region itself has inequalities and instability in the economy. The universities formed a community of practice; through meetings and various conversations, challenges could be discussed, an ethical level of transparency was adhered to, and a focus on collaboration, pooling of knowledge and networks to support all universities was undertaken. The impact included sharing information about best practices in each university as well as any barriers experienced. Through the mobilising of resources, a Physics-focused careers fair was initiated over 10 years ago in the region. A day trip was organised for all students, with a free coach (bus) service for travel to the venue from respective universities, slotted within their timetable. Other collaboration included the presence of a website through which students could view the profiles of recent graduates to find out about potential careers and employers related to Physics. Beyond this, each participating department had to make decisions within the constraints and opportunities of their own university. Tailored approaches to delivering employability development were thus a simultaneous feature. Within this context, it is important to note that responses to the survey might reflect differences in demography and regional inequalities as well as respective corresponding university culture—all of which are arguably inter-related.

General overview of respondents

There were 185 total respondents. The survey and each of the questions were optional. As a result, the data do not always represent 100% of the total submitted surveys. There was over-representation of some universities in this response set due primarily to differences in cohort numbers; all institutes have a minimum population response rate of 5%, and some having



over 15%. Regarding the demography of respondents, there were 88.4% UK respondents, 7.2% European nationals, and 4.4% were International. Participants ranged between the ages of 18 and 26. With regards to gender, 38.1% identified as cis-women, 55.8% as cis-men, 4.4% as either non-binary or genderfluid, and 1.7% as trans-women. 16% of participants entered through Widening Participation routes. With regards to Ethnicity, the question was open-ended. Overall, 11% did not respond, around 71% identified as ethnicities related to White, while around 16% identified as ethnicities that are racialised.

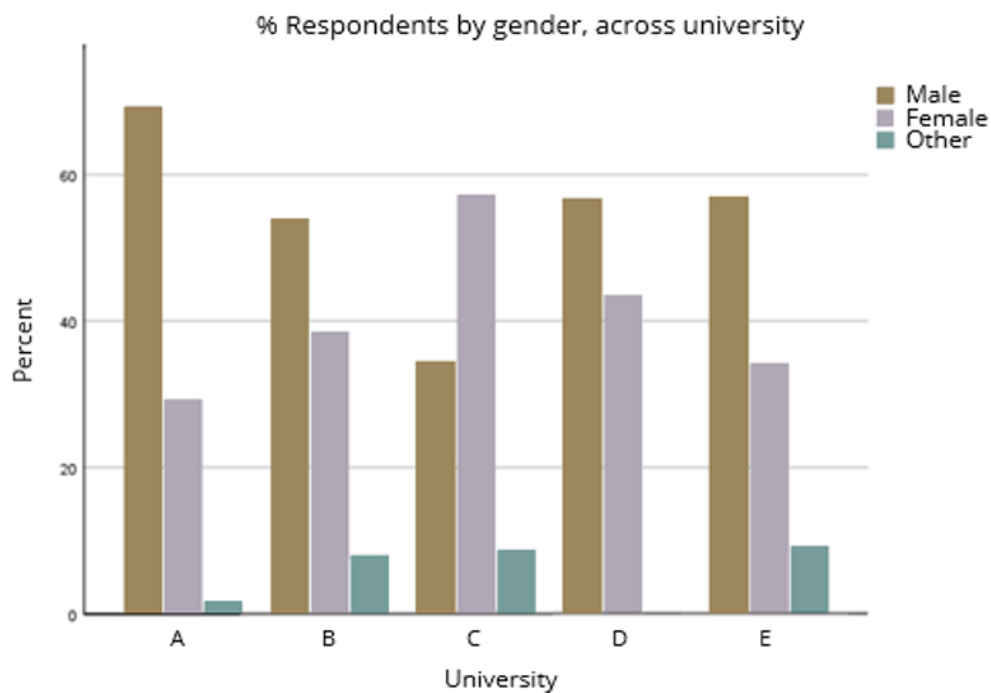
Table 1. Missing responses for demographics questions (n = 185).

Demographic category	Missing responses
University	0
Gender	5
Class	29
Ethnic group	25
Year group/type	12

Associations between demographics

Survey respondents are not a representative sample and so the results cannot be generalised. In Figure 1, we can observe that Female and Other students (which included Non-binary, Trans-woman/Trans-man and gender fluid) together made up a higher proportion of respondents than the average proportion of Female/Other students completing a Physics degree, which is typically around 24%/0%, respectively (Institute of Physics, 2021). While females may simply be more responsive to surveys than males (Smith, 2008), they may also feel a greater responsibility to share their opinions due to their relatively small proportion within the Physics student population (Crilly, 2021). Aside from increasing chances of type 1 error, small sample sizes for certain demographic groups could prevent chi-square tests from running accurately (Field, 2018). Due to the quantitative analysis methods used for this project, research was limited for groups with small sample sizes, as even if descriptive statistics showed noticeable differences, no further analysis could be undertaken. As such, the only demographic factor that will be presented in this paper is gender.



Figure 1. Split of genders within each university.

Degree motivations and postgraduate aspirations

The survey reflected a range of options regarding motivation and included a text box to list others. To alleviate the potential for students to provide 'correct' responses to staff members, varied options as listed below (alongside percentage of respondents) were provided as multiple choice. The responses reflect that many WRIPA physics students undertake a degree with the belief that it will improve their career prospects (Table 2), which is consistent with previous findings from larger surveys (Ball, 2023) and reinforces the notion that development of employability skills within the curriculum is essential. Learning more about Physics was also a common reason for studying Physics. Integrated master's students (i.e., those on a combined graduate and post-graduate programme) were significantly more likely than bachelor's student to undertake a degree for this reason.

Table 2. Common reasons for studying physics (select all that apply question).

Reason for undertaking a degree	Count	% of respondents
Improve future career prospects	138	75.4
I really want to know more about Physics	126	68.9
Natural progression, it's what most people at my school/college do	114	62.3



I just didn't want to start full-time work so soon	58	31.7
My school/college expected me to go to university	55	30.1
Parents expected me to go to university	46	25.1
All my friends were going to university	40	21.9

When asked about post-graduate aspirations (single selection question), the highest percentage response indicated graduate jobs or further study (Table 3), with no difference in aspirations between bachelor's and master's students.

Table 3. Postgraduate aspirations.

Postgraduate aspiration	% of respondents
A graduate job	43.8
Further study	32.4
I don't know, that's too far ahead	4.3
Return to my hometown and find something	3.2
Stay in my university city and find a job	6.5
Take some time off to travel	4.9
Whatever job helps me get by (including bar and restaurant work)	1.1
Something else	3.8

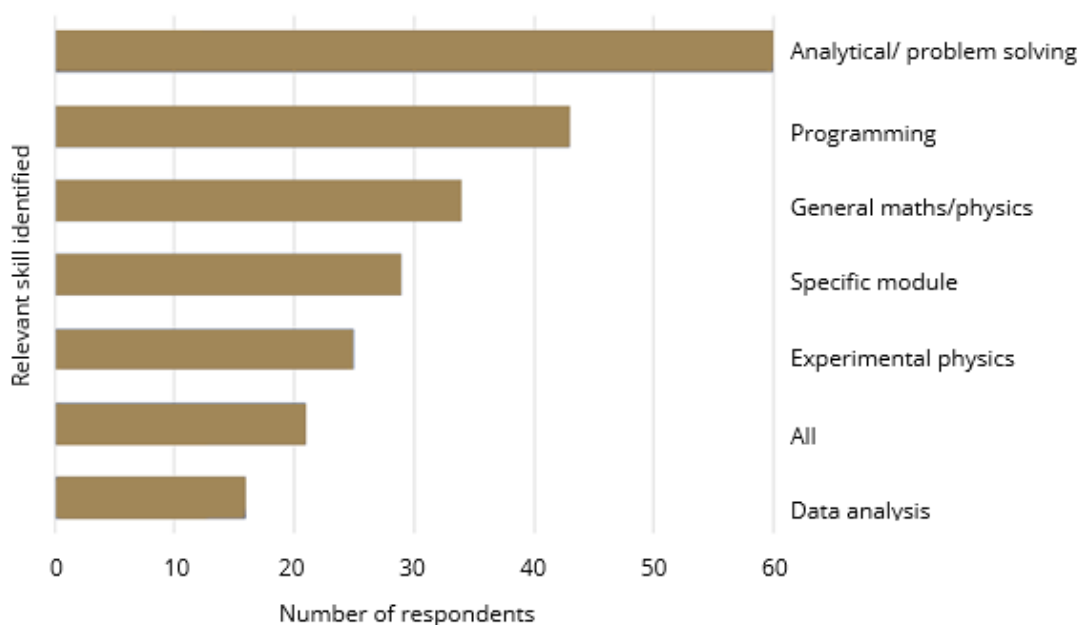
The link between university and work necessitates a balance between enhancing employability and teaching Physics content to ensure the needs of all students are met. As postgraduate aspirations are similar between respondents of different year groups and degree types, yet different for finalists and non-finalists, it is evident that the unique aspirations of every student are likely to develop while at university, regardless of initial motivations for undertaking a degree. The quote below demonstrates the ways in which some of these motivators are intertwined and relate to career futures:

I specifically picked Physics because I was very indecisive about what I wanted to do as a career. Physics has a strong base in all things STEM so it gave me adequate time to look into careers while gaining stem related skills. Also, it's the best degree by far.



The quote once again echoes the literature presented previously regarding Physics students' perceptions about how employable they are by virtue of a social perception of the science-specific knowledge and discipline-specific skills of a Physics degree.

Figure 2. Frequency identified of useful degree aspects.



Of the 150 student respondents, 94 identified multiple useful aspects of their degree, as opposed to just one aspect. These were overwhelmingly related to technical employability skills, including analytical, problem-solving, programming, maths, and data analysis (Figure 2). This is positive, as these are essential for working environments across a range of STEM-related industries. However, equally essential interpersonal skills such as teamwork, communication, and time-management were only sporadically identified. Perhaps a greater focus on these skills is necessary to ensure students have a more well-rounded skillset, possibly through the implementation of new teaching methods, such as PBL (Benson et al., 2023) or through reflective practice to enable students to surface the skills they have developed (Veine et al., 2019).

Interest in specific modules was often linked to career goals. For example, those interested in careers in Medical Physics identified some specific aspects of their degree as useful, while a vast majority identified all their degree, or a specific relevant module, as useful. Physics degrees are often pre-requisites for careers in these specific, complex industries, so it is



positive that interested students feel confident that their degrees are sufficiently preparing them for these careers.

Some participants felt it important to specify modules they felt would contribute greatly to their future, often relating it to the skills they develop that can be transferrable or useful, exemplified through the following quotes. Participant 1 said, 'Modules related to Subatomic Physics, Material Science or Electromagnetism. These areas should assist in providing a background for energy related fields however more hands on/practical application of these ideas in the real world would better prepare me'. Participant 2 commented that 'course work (including computer skills), research experience gained from my year in industry, and scientific communication through outreach are the three biggest things I can think of that will help me'. Other areas of study were identified by participant 3: 'I think the Matters at Extremes module will be helpful as it's the only module that involved nuclear elements. Also, obviously experimental skills from lab work will be useful in industry'.

These quotes also indicate a range of applications of Physics. Many participants focused on the content of their courses and the skills with which they would be equipped by virtue of doing a Physics degree and were able to easily articulate their preference in relation to what might be desirable in the job market:

Problem solving, having resilience in the face of things not working, and having to work with others in labs will all be very useful because they are life skills. Plus, the Physics knowledge will probably be useful, because I will probably get a job that forces me to use my Physics (Participant 4).

Alongside this are some other work ethic related skills, which demonstrates students consider what employers might look for in an applicant, including the bias that employers may have towards merely seeing the mention of Physics and its related skills. This is also revealed regarding what aspect of their choice in degree related to employability where most said the degree programme itself would support their prospects. Participant 5 said, 'Physics heavily develops problem solving and information-gathering skills through the content itself and interpersonal skills through group work. For any career in science these are the main skills I imagine employers would be looking for'. Participant 6 identified the following skills: 'Communication: ability to communicate complex issues in simple ways; Problem solving: day to day Physics degree challenges in things like projects and tutorials; Analytical mindset:



competency in data analysis, reporting and evaluation'. Participant 7 commented, 'Physics looks great on a CV, excellent problem-solving skills, and great at maths'.

These sentiments demonstrate that the currency of a Physics degree in the market is understood by students.

Job applications

In this research, we thus aimed to record student engagement with job applications.

Unsurprisingly, respondents with Industrial Work Experience (IWE) were significantly more likely to have started applications than those without. Students with IWE may possess greater confidence due to prior successful applications and additional experience, thus more readily make job applications. In contrast, students without IWE may feel unprepared, so delay starting applications. However, students who more readily make applications may have a higher chance of successfully attaining IWE, thus the direction of this effect cannot be determined from this data alone.

The survey hoped to elicit a better understanding of the emotional impact of this process of applying. Of the 119 respondents that had started making job applications, many (n = 108) had multiple concerns. Most of these respondents had concerns about feeling frustrated or disappointed, having insufficient time, and receiving no feedback from employers (Table 4). Concerns may be reduced if students believed their applications were fairly treated.

Table 4. Job application concerns by all students, pre-application.

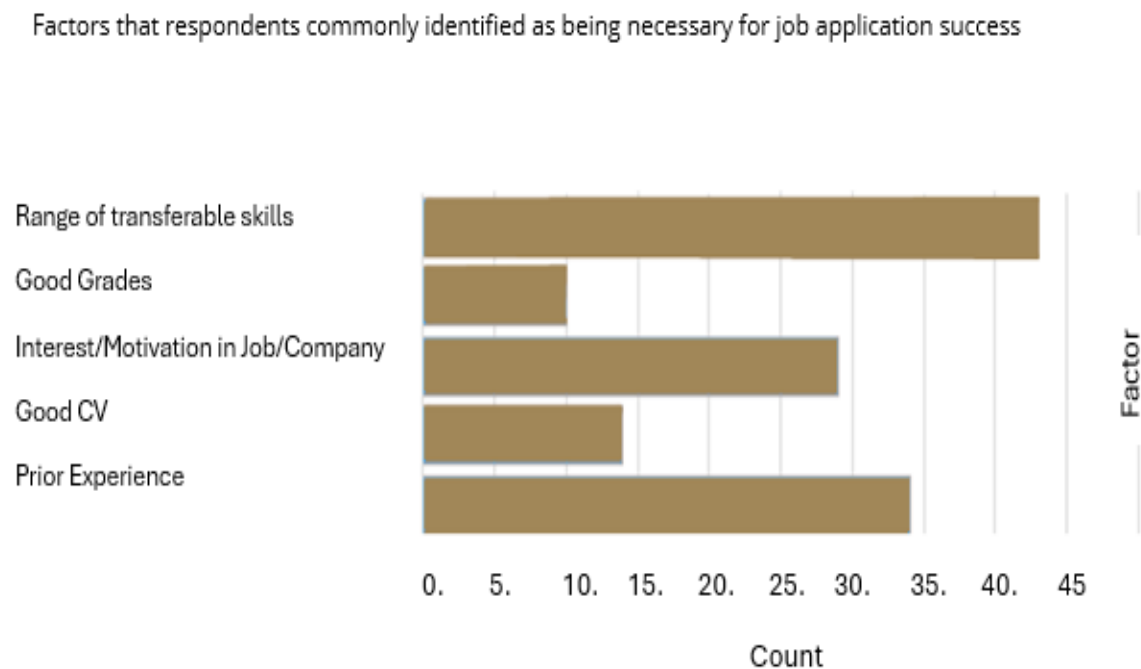
Concern	Count
Frustration while waiting	79
Not enough time to apply	78
I expect some feedback	61
Might lose motivation to more applications	53
I won't fit their profile	49
Don't have any idea what I want to do	40
Haven't seen anything that interests me	32
Accept rejection as part of the process	19
Being too good for them/overqualified	3



While students inclined to have fewer concerns may be more likely to initially apply for IWE opportunities, it is likely that the experience itself may reduce these concerns, which agrees with previous findings that work experience, summer placements, and industrial placements improve students' ideas about future careers (Reddy & Moores, 2006).

Simultaneously, students were asked what they felt were enablers for successful applications. Despite this question being open-text, many respondents identified similar factors (Figure 3). A 'range of transferrable skills' was the most identified factor, which suggests that WRIPA Physics departments have sufficiently impressed the importance of employability skills on students.

Figure 3. Common factors respondents think they need for application success.



Prior experience was also commonly identified as important, showing students have a good understanding of employer expectations. With this understanding, students without experience may feel underqualified for jobs, thus delaying their applications, which compounds the previous evidence that students with IWE are more likely to make job applications earlier than those without.

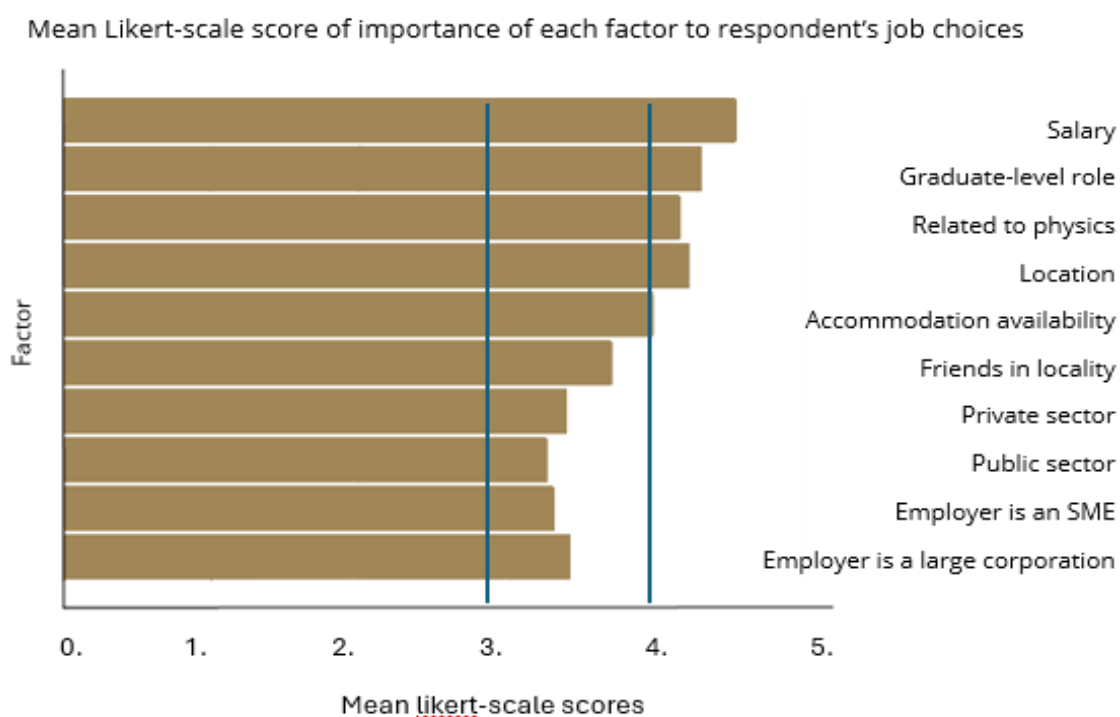
As 'interest/motivation in job/company' was another common important factor for job applications (Figure 3), it was useful to understand what factors determine student interest in



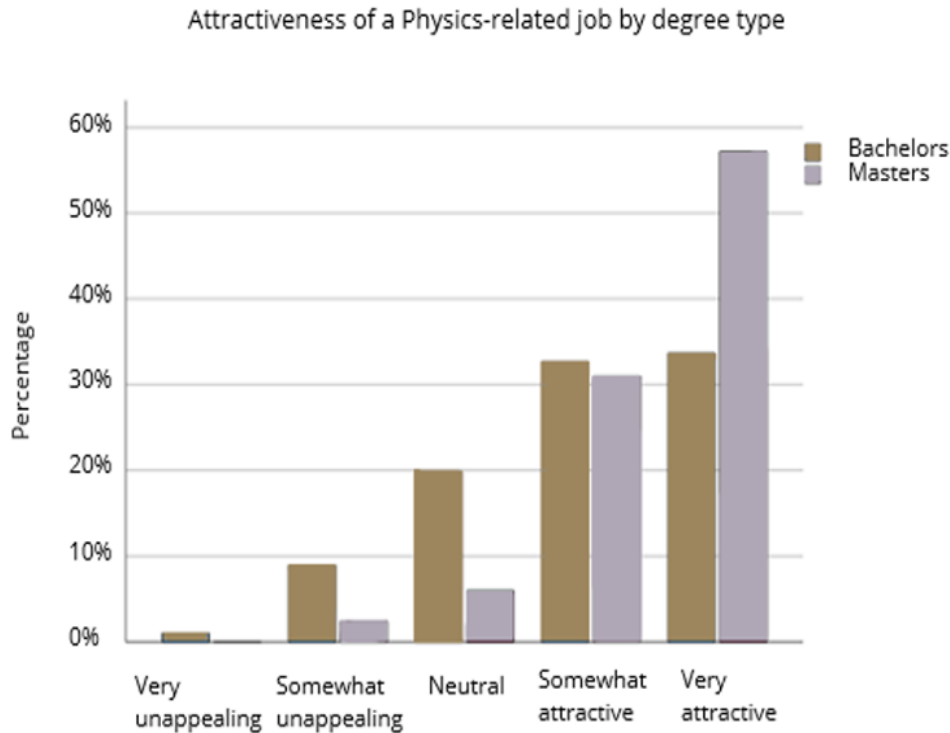
jobs (Figure 4). While recognising Likert-scale data is ordinal, the mean score was used to visualise the relative importance of each factor.

The highest mean scores were for salary, role-type (Physics/graduate roles), and location, with lower scores for sector and employer size (Figure 4), indicating that students are more concerned with the benefits and opportunities available in each job than the employer itself. Perhaps the benefits of applying to SMEs (small/medium enterprises) should be emphasised to students, as their potentially lower application volume could help relieve many of the job application concerns identified by respondents (Table 4).

Figure 4. Factors affecting job choices (very unappealing=1, neutral=3, very attractive=5).



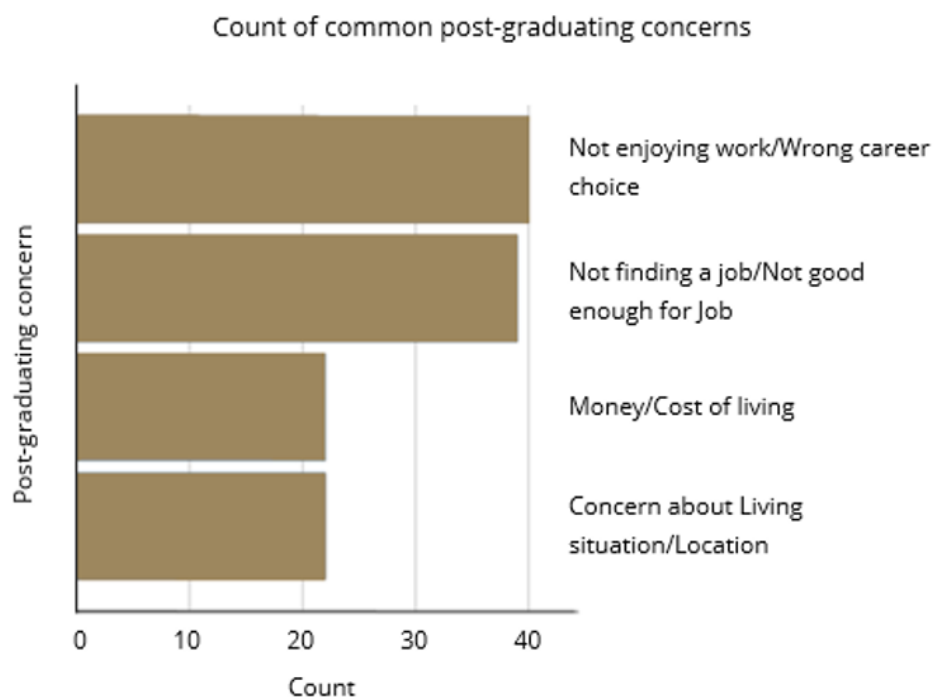
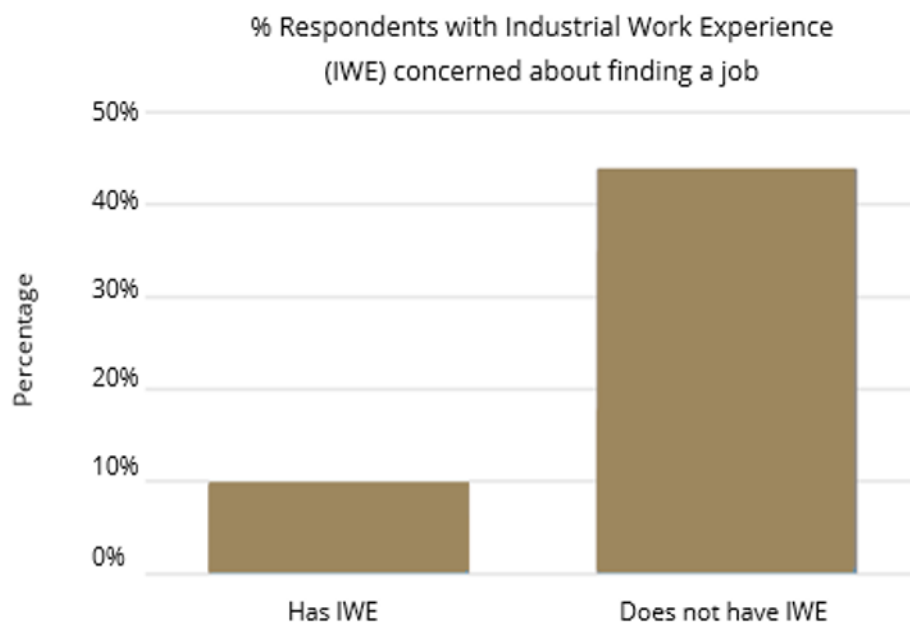
Interestingly, master's and bachelor's students showed significantly different distributions in their rating of 'Physics-related' as an attractive factor (Figure 5). While the increased proportion of master's students undertaking a degree due to interest in Physics previously appeared unrelated to post-graduate aspirations, this data suggests that the relation pertains to specific career paths, not simply wanting graduate work/further study.

Figure 5. Attractiveness of 'Physics-related' job by degree type.

Post-graduation concerns

Students were asked about their thoughts on their future trajectories, specifically with regards to any concerns they may have. A wide range of responses were recorded, but the most common were employment-related (Figure 6).

Despite their previously seen ability to identify employability skills, many students were concerned about not attaining employment or being inadequate for employment. Respondents with IWE were significantly less likely to hold these concerns (Figure 7), indicating that it may be lack of experience that causes students to feel inadequate for future employment, not a lack of employability skills. Respondents with confidence they could find a job were instead frequently concerned about not enjoying work or making the wrong career choice (Figure 6), which strengthens the evidence that 'doing something they really enjoy' is the most important factor for student careers (Quinlan & Renninger, 2022 p. 865). Very few respondents felt too good/overqualified for jobs (Table 4), indicating that even confident students are aware of the high competition they face.

Figure 6. Common post-graduation concerns.**Figure 7: Respondents concerned about not finding a job.**

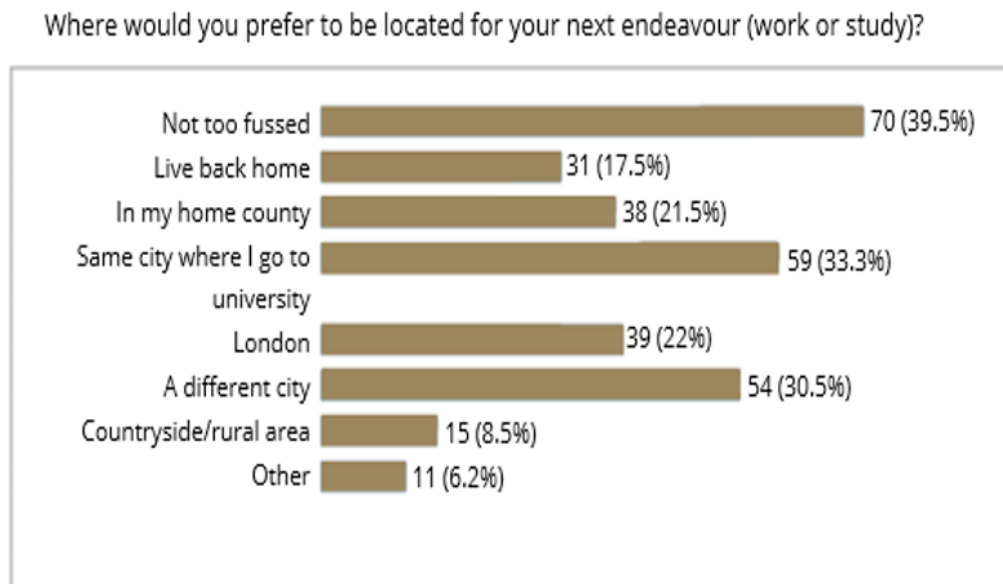
Furthermore, many respondents were concerned about their living situation/employment location, which shows similarities to the relatively high importance given to location-related factors (D'Silva & Pugh, 2021). For WRIPA universities, this could also help retain talent in local

areas; this benefits both employers and students and aligns with the UK government's 'levelling up' agenda in recent years (HM Government, 2022).

Location

A final question worth considering within the remit of this report relates to the future living locations participants consider for themselves when considering life after a degree (Figure 8). There is variation in perceptions of future locations and almost 40% say they are 'not too fussed' about location.

Figure 8. Student preferences for where they would like to live post-graduation.



On closer attention through a follow-up question, a variety of thoughts were presented by participants. Participant 7 said, 'I would relocate for the right job, and I understand that this is likely necessary, for example, Airbus operate out of Bristol, and I live in [Yorkshire town], so it would make sense to move there for the job'. Participant 8 responded, 'It's hard enough getting a decent job, I can't limit myself through location'. Another participant (9) said, 'I don't have any particular place that I would like to live although I would want to move away from England at least for a while'. Finally, participant 10 commented:

I think it's healthy for me to move on from this phase of my life and changing location is a good way to mentally and physically do this. I don't have a specific

location in mind but, realistically, think that job opportunities are likely to be in and around cities, although I do love the countryside.

Overall, they were open to the idea of moving or rather were aware that it might be required for their preferred sector, even if some may prefer to stay in their hometowns, university towns, or try out a new location. The other options that were popular were respondents wanting to stay back in their university city or relocate to a different city. For example:

There are limited graduate jobs in my hometown and none that I personally would want to do, and I'm bored of living there anyway. I enjoy [University town's] mix of countryside and city which is why I chose to study here and would be happy to continue living here. I'd probably be even more excited for a new adventure in another UK city though, but London is too expensive. (Participant 11)

Whereas participant 12 said, 'I like it here and most my family and friends are in Yorkshire. I wouldn't move down South unless the salaries were higher than here', and participant 13 said, 'I don't want to be stuck in London, but I need to live in a city, it would be nice to stay in the city I went to university in, but I know that grad job opportunities are limited here'.

Location does seem to feature as something participants considered, even if it were to say that they could not prioritise a certain location because of the nature of work. Perhaps for this reason, it is important that WRIPA has attempted to develop a stronger link with regional employers.

Conclusion

Through this paper we have attempted to build a narrative that demonstrates the process through which Physics students find themselves engaging with employability skills development experiences and activities, while detailing how WRIPA has attempted to support this process of graduate transitions. The findings from this research have provided an excellent insight into student opinion on a range of careers-related topics and enabled successful answering of the initial project research questions. We can suggest that the attempts made by WRIPA to support students through a collaborative endeavour has contributed to enabling an equal access to opportunities for students.



Most respondents identified employability skills as a useful aspect of their degree, including analytical/problem-solving, coding, experimental, and data-analysis skills, although interpersonal skills were sporadically identified. Respondents most identified employability skills as a key factor for job applications, indicating that students appreciate the benefits of employability skills development. Most students interested in scientific careers identified specific modules from their degree as useful; highlighting the importance of these modules to increase certain students' careers prospects and emphasising that employability skills development and Physics content is not mutually exclusive.

IWE was the only employability activity proven to make students have fewer concerns about being prepared for their careers. While previous findings suggested industrial placements improve student ideas about their careers (Reddy & Moores, 2006), this did not apply to summer internships and does not specifically relate to the other positive benefits, although it is logical that experience could reduce job application and post-graduation concerns.

Forging connections with smaller, regional employers with university-exclusive opportunities could address concerns over location (as students can remain in their university city), regional skill deficits, and uncertainty while waiting for applications (as application volume is reduced), as well as helping students find enjoyable careers (Mason et al., 2009). Organising these collaborations between companies and Physics students is already a major focus for WRIPA (WRIPA, 2023) and these results are simply evidence of the effectiveness of these methods in addressing the primary concerns held by students.

Disclosure statement

The authors used the following generative AI tool in the development of this manuscript: Microsoft Enterprise Copilot (ChatGPT 5.2 LLM). Microsoft Enterprise Copilot was used to aid in editing the abstract to achieve the required word count only.

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