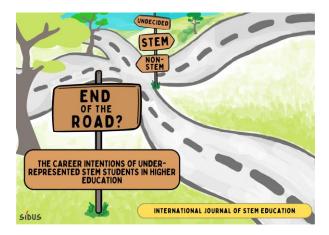# End of the Road? The career intentions of underrepresented STEM undergraduate students

Background: the *leaky pipeline* in STEM education

Our goals and aspirations tend to develop or transform over time. Our perspectives broaden with experience, and new opportunities or obstacles can arise. Sometimes, these can push us off course or present us with diversions. Other times, they can bring completely new challenges or adventures. When a student enters higher education, they may be highly interested in their discipline and keen to pursue a career in that field. But, over the course of their study, their interests and expectations of success might change, and alternative routes and pathways may start to look more appealing or viable.

Analogies can be an effective way to describe this journey. In the education context, the analogy of the 'leaky pipeline' is often used by researchers to explain how students participate in Science, Technology, Engineering & Mathematics (STEM) subjects. The leaky pipeline illustrates how different student groups – often those whose identities and backgrounds are underrepresented – tend to leave STEM education to pursue other opportunities or courses of study. We feel this analogy is helpful because it highlights the loss of talents in STEM as students move through different stages of their education and career trajectories. It also highlights the general lack of diversity in many areas of the STEM workforce.

Underrepresented students in STEM higher education

In the UK, undergraduate STEM programmes tend to be dominated by white British men who make up most of the student and staff populations, especially in the physical sciences. There is plenty of research to suggest that students who are underrepresented in STEM higher education can experience multiple inequalities and structural barriers due to being marginalised. Yet very few research studies have explored the career intentions of these students. We are interested in whether these students can see themselves pursuing a career in STEM, and if not, why not? What alternative routes are they considering? These questions motivated us to find out more about the aspirations and career intentions of underrepresented students in STEM higher education.

The SIDUS Project (Supporting the Identity Development of Underrepresented Students) is an education research project based at Imperial College London, which aims to better understand the

experiences and identities of underrepresented students in STEM higher education. Between the Summer and Autumn of 2020, we interviewed 110 STEM undergraduate students who were enrolled at one of two medium-sized universities in England, and who self-identified as being underrepresented – by gender, ethnicity, social class, sexuality, disability, neurodiversity and/or a specific learning difficulty. We asked students about their experiences of their degree programmes and how they felt about their future pathways, including their post-degree plans and how their experiences of being an underrepresented STEM student might have shaped their career choices.

Navigating the STEM road: where are underrepresented students heading next?

In short, we identified three future career pathways of underrepresented STEM students: a STEM future, a non-STEM future and an undecided future. Here, we use the analogy of a 'STEM road'. We found that around two-fifths of students (45/110, or 41%) had clear intentions to pursue a career in STEM and drive into a STEM future. Almost one in four students (26/110, or 24%) stated no aspirations to pursue a career in or from STEM, reaching the end of the STEM road or in some cases, being forced off the STEM road. And over a third (39/110, or 35%) of students were undecided about their future pathways, sometimes considering multiple careers in or from STEM, or being totally unsure about where to turn next, thus reaching a STEM crossroads.

Driving into a STEM future

For the 45 STEM-career-oriented students in our study, their intentions to pursue a STEM future are rarely in question. We found these students could see themselves working in STEM and had high expectations of success and future outcomes. Just over a quarter of these students (12/45) had a career intention to work in academia, whilst the rest (33/45) suggested they wanted to enter the STEM workforce. These students acknowledged the impact of social inequalities on their experiences and future pathways. However, they were driven by their interest and commitment to their discipline.

For instance, Lakshani (British South Asian working-class woman) reflected: "[social inequalities] will completely not stop me from getting where I need to be... [even if it] might take me longer". Similarly, Michael (Black British working-class man) said: "I don't let [racisms] define me ... I know how to navigate those things... I try not to let them hinder my choices". We could then draw from this that whilst minoritised students experience multiple social inequalities, they can confidently identify as 'a STEM person' and can see themselves pursuing a future career in STEM. However, we should interpret these findings with caution. The excessive work needed to manage social inequalities can be complex, exhausting, harmful and linked to burnout, especially if the achievements of these students are not properly recognised or supported.

End of the STEM road

Out of the 26 students who stated no career intentions in STEM, we found that half of those students are opting for pathways in finance, whilst the others expressed interest in consultancy work, the creative industries, the education sector, general office work and entrepreneurship. Students suggested that their main reasons for choosing alternative career plans was the better financial reward that is on offer in some non-STEM sectors, especially in finance and business. Furthermore, these students suggested that finance-related careers offered opportunities that were

more secure and accessible compared to the STEM sector, especially in academia, where STEM careers are said to have heavy workloads but limited career opportunities.

Others reflected that negative experiences of social inequalities on their degree programmes made them consider other career pathways. Francesca (Black British working-class woman), for instance, recalled the impact of racism on her experience as an underrepresented STEM student:

> *I had friends but I was alone… I spent a lot of lunch times sitting by myself… A lot of people found friends quickly, and I didn't know why I didn't find friends that quickly… maybe it is the added pressure of being the only black girl… I felt like people didn't know how to approach me.*

Whilst it is already difficult for underrepresented students to enrol in STEM degree programmes in the first place, their experiences of inequalities at university can ultimately force them off the STEM road. Like many others who are opting for non-STEM careers, Francesca intends to work in finance and consultancy, for reasons of financial security as well as the hope that finance industries will be more inclusive. For these students, concerns about pay, job security and working conditions are important. Of course, some students will inevitably leave STEM, but we must be critical and sensitive about who stays and who goes, and how inequalities can limit certain groups from aspiring towards STEM careers.

A crossroads in STEM
For those 39 students who were undecided about their future pathways, we found that many are still exploring or have various ideas about their future, including careers in, from and outside of STEM.

Heather (British East Asian working-class woman), for example, had many options, such as working in technology and software engineering, the finance sector, as a consultant, a patent attorney, and participating in an 'NHS scientist training programme'. John (White British working-class man), on the other hand, had no ideas, and recognised that:

> *Coming from the background I come from, I've not really been exposed to a lot of people who work in degree environments… I don't really know what people with degrees do all the time.*

Undecided students such as Heather and John are not short of talent or passion for their discipline but would benefit from a broader range of career advice and opportunities. Their undecidedness therefore presents an opportunity for educators and different stakeholders in STEM to respond to these students. We have provided some suggestions about what this might look like in practice in the next section.

Supporting the career intentions of underrepresented STEM students
Here, we provide some suggestions about how stakeholders of STEM can better support the career intentions of undergraduate students who identify as being underrepresented in higher education.

- As we have found, some students' career pathways are not straightforward because they must consider how to navigate different barriers and inequalities. We suggest closer

collaboration between university career services and STEM departments would be beneficial for these students.

- Students may benefit from having access to additional resources and contacts that can advise them about their future pathways. Advisors should be sensitive of any challenges or inequalities as experienced by underrepresented students, and help these students to manage their expectations and anxieties when they are unsure.
- It is important for students to feel a sense of belonging and identity in the STEM sector. We note in our paper that STEM career options should be broadened to be more inclusive of the experiences and values of underrepresented students. Greater recognition of these students is needed.
- We suggest employers provide more paid internships and graduate scheme opportunities that provide clear pathways and are financially rewarded. We suggest these are targeted towards students who are underrepresented in STEM higher education to support them in gaining relevant professional experience.
- Furthermore, recruiters and employers should be aware of their biases and ensure their recruitment strategies are inclusive. A diversity of candidates should have access to these opportunities.
- Finally, we suggest more work and critical research is needed to disrupt long established practices in STEM. Whilst representation is important, and short-term suggestions can be useful, they by no means solve the bigger issue. We must acknowledge that a long-term cultural shift is needed in STEM industries and STEM education.

Conclusion

Our research suggests that the STEM pipeline is far from secure or equitable. A diverse, inclusive and supportive learning environment is needed to better support the potentials of students, especially those who are underrepresented. However, inequalities do not necessarily determine students' futures. As we have found, many underrepresented students stay committed to the STEM road. However, more work needs to be done to address these inequalities and break down the barriers to STEM entry and progression.

The full research paper is free to read (see reference and link below).

Full reference:

Wong, B., Chiu, Y.L.T., Murray, O.M., & Horsburgh, J. (2022). [End of the road? The career intentions of underrepresented STEM students in higher education](). *International Journal of STEM Education, 9(51),* 1-12.

Infographic and image designed by Meggie Copsey Blake