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Research article

A framework for investigating immigrant students' attitudes towards science, exemplified with data from Turkish families

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Abstract

In this article, we draw on sociocultural, cognitive and affective perspectives to investigate the factors lying behind immigrant school students' attitudes and aspirations towards science. We combine Deci and Ryan's self-determination theory and Bourdieu's theory of cultural and social capital to produce a new theoretical framework for understanding how these factors operate. One part of our framework focuses on students' cognitive and affective resources, such as enjoyment, self-efficacy, engagement and intrinsic motivation. Another relates to students' sociocultural resources, such as gender, class, home language, parental expectations and perceived teacher encouragement, which are filtered through notions of field and students' immigrant status. We then exemplify this framework by exploring the attitudes towards science of two Turkish immigrant secondary school students in England, as revealed by questionnaires that they completed

and interviews with them and their parent(s). Our tentative conclusion is that our theoretical framework, in its combination of a Bourdieusian perspective and Deci and Ryan's self-determination theory, may help make sense of why some immigrant school students continue with science and others do not.

Keywords immigrant students; science attitudes; self-determination theory; Bourdieu; capital; Türkiye

Introduction

In many countries, there is the widespread perception that too few school students are choosing to continue with science once its study is no longer mandatory. Continuing with school science is often seen as necessary if there are to be sufficient scientists to meet future needs. In addition, it is widely thought that it is desirable for a high proportion of the citizens in a country to be 'scientifically literate', and so able to make informed judgements about a wide range of science-related issues, for example, whether to have their children vaccinated, and whether some supplies of energy are better for the environment and human health than others (Li and Guo, 2021).

Reasons why many school students choose not to continue to study science have been actively investigated. A range of personal factors, both cognitive and affective, alongside political and sociocultural influences, have been found to intertwine to shape students' attitudes towards, and engagement with, science (Avraamidou, 2020; Toma, 2021). The experiences of immigrant students introduce an additional layer of complexity. Despite the recognised significance of ethnicity and cultural background in shaping science aspirations (for example, Archer et al., 2012; Moote et al., 2020), there remains a deficiency of research specifically using a cultural perspective to explore immigrant students' study of school science in their host country.

Drawing on results from the Programme for International Student Assessment (PISA) 2018 (Sizmur et al., 2019), students with an immigrant background in England showed lower academic performance compared to students without an immigrant background, which aligns with the global pattern. However, Sikora and Pokropek (2021) show that regardless of their linguistic skills immigrant students tend to hold science lessons in higher regard than their non-immigrant peers because of their perception of science as a gateway to improved career prospects and a promising future.

In England, research that has been undertaken on the impact of ethnicity on students' attitudes towards science has primarily focused on students from Asian, African or Caribbean communities (for example, Mujtaba et al., 2018; Strand, 2011). Despite the existence in England of a substantial Turkish community, limited attention has been paid to understanding how their distinctive cultural background influences Turkish school students' perception of, and engagement with, science education.

More generally, it is known that the attitudes of immigrant students towards science are closely connected to their families' socio-economic and cultural backgrounds as well as to the social expectations that they experience, particularly from their family and in the local community (Gabrielli et al., 2021; Hu et al., 2018). These various factors play a significant role in shaping students' educational aspirations, which highlights the importance of understanding how cultural backgrounds influence student interest and involvement in science. This study proposes a general framework (a model) for investigating immigrant students' attitudes towards science from sociocultural, cognitive and affective perspectives. It then exemplifies the framework by examining the attitudes towards science of two Turkish immigrant students and their parents in England. This research therefore aims to provide initial insights into the role of sociocultural, cognitive and affective factors on Turkish immigrant students' attitudes towards science and a framework suitable for application to other immigrant communities.

Literature review

Attitudes towards science

An attitude is an individual's stance or reaction to an object or situation, gained from experiences, learned through intellectual and natural processes, and which can impact behaviours (Allport, 1935; Fishbein and Ajzen, 1975). In the science education context, Osborne et al. (2003: 1053) define attitudes towards science as 'feelings, beliefs and values held about an object that may be the enterprise of science, school science, the impact of science on society or scientists themselves'. Reid (2006) divides attitudes towards science into three main components: behavioural, cognitive and affective. In a systematic review, Potvin and Hasni (2014) elaborate these three main components and add more subcategories, including enjoyment, self-efficacy, motivation, engagement with science and sociological variables. In terms of sociological variables, there are numerous studies investigating the influence of students' social backgrounds on their attitudes towards science. Gender (for example, Homer et al., 2013), socio-economic background (for example, OECD, 2019), ethnicity (for example, Archer et al., 2014), immigrant status (for example, Chiu, 2007), home language (for example, Taboada, 2012), parental expectations (for example, Sheldrake and Mujtaba, 2020) and perceived teacher support (for example, Mujtaba and Reiss, 2013) are all sociological variables that affect students' attitudes towards science. Taken together, all these factors suggest that attitude towards science is a multifaceted term that likely needs to be examined in a comprehensive way that considers a multiplicity of factors.

Immigrant Turkish students in England

Immigrants are individuals who have moved from one country to at least one other. First-generation immigrants are those who were born in one country and have relocated to another. They are often the pioneers in their families, having experienced life in their country of origin before settling in the new one. Second-generation immigrants are the children of these first-generation immigrants, and unlike their parents they were born in the destination country. They represent the first native-born generation and have parents who were immigrants.

In recent decades, the UK has experienced one of the greatest increases in the percentage of immigrant students among countries in the Organisation for Economic Co-operation and Development (OECD) (Cerna et al., 2021). As recently as between 2021 and 2022, long-term immigration to the UK increased significantly, from 942,000 to 1.2 million. The majority of newcomers in 2022 were non-European Union nationals, totalling 925,000, arriving for work, study and humanitarian reasons (ONS, 2023). The Turkish community in the UK is a significant ethnic minority group, but it has been understudied in respect of immigration issues. Therefore, in the context of our study, the term 'Turkish community' refers to a heterogeneous group of individuals who have immigrated from Türkiye to England and includes people of various ethnic minority backgrounds, such as Kurds, Alevis, Laz and Turks. The number of people of Turkish origin living in England is unclear. Some e-newspapers and Wikipedia articles claim that the number of Turkish immigrants in England is as high as half a million (for example, Travis, 2011). However, this figure has been challenged by experts in the field. Sirkeci (2017) argues that the half-million number is not credible and that it is merely the result of a careless comment made during a parliamentary commission hearing. Sirkeci (2017) suggests that the actual population of Turkish immigrants in England is unlikely to exceed 250,000. According to the 2021 Census results, the number of Turkish-born people living in England and Wales is 127,641, with the highest concentration living in the Enfield area in London (17,053).

In England, the educational attainment of Turkish-origin students is under-researched (Kolancı and Melhuish, 2023). Nevertheless, the Greater London Authority reported their achievement levels as 'a cause for concern' (Issa, 2008: 19). What seems to be the most recent available evidence (from reports commissioned by the then Department of Health and Social Care [Tas et al., 2008] and the Department for Children, Schools and Families [Strand, 2011]) highlights that Turkish children face significant vulnerabilities, leading to a greater likelihood of low academic achievement, mental health problems and exposure to violence.

Motivation of immigrant students

Salikutluk (2016) claims that immigrant students can have stronger aspirations and more positive attitudes towards success and education than their native peers. Among ninth and tenth graders in Germany, Turkish immigrant students show higher aspiration than their native counterparts because of Turkish students' ambition for improvements in their status (Salikutluk, 2016). Likewise, regardless of their linguistic skills (for example, bilingual or monolingual), in the UK, immigrant students typically value science lessons more compared to their non-immigrant peers, because they see science as an area of study that will bring them better career options and a brighter future (Sikora and Pokropek, 2021).

Several putative reasons have been advanced to attempt to explain immigrant students' higher aspirations for success in science education. The first, named 'immigrant optimism', argues that immigrants typically manifest a willingness and ambition in the host country to construct a better life and enhance their socio-economic status (Kao and Tienda, 1995). This motivation and ambition for success can also be passed on from foreign-born parents to their children because the younger generation experiences high parental expectations for them to be successful in the host country, although the first generation may not have managed to be (Feliciano and Lanuza, 2016). The second, named 'blocked opportunities', maintains that students from ethnic minority backgrounds can have higher aspirations and motivation for education than their native peers because these students believe that gaining academic success and qualifications is the only way to overcome the discrimination to which they have been exposed, or to which they anticipate being exposed, in the labour market and in society more generally (Kao and Tienda, 1995). A third suggestion, named 'status attainment' (Alexander et al., 1975), suggests that the socio-economic and cultural background of the family and the expectations of their social environment play an important role in influencing the educational aspirations of students (Van den Broeck et al., 2019). For example, from a Bourdieusian perspective, Scandone (2018) proposed that Bangladeshi girls in England have higher aspirations than their English peers because they are surrounded by those who expect them to do well; thus, they are brought up to believe that to succeed is 'what people like us do'.

Theoretical framework

This study draws on sociocultural, cognitive and affective perspectives to investigate the factors lying behind immigrant students' attitudes towards science, exploring the complex interrelationships between students' motivations and their cultural contexts. Aiming to construct a theoretical framework that enables us to examine students' attitudes towards science from these multiple perspectives, we combine, for reasons we now discuss, Deci and Ryan's self-determination theory and Bourdieu's work on capital.

Self-determination theory

Deci and Ryan put forward their self-determination theory by scrutinising the factors affecting people's social integration, motivation and well-being (Gagné and Deci, 2014; Ryan and Deci, 2017). Self-determination theory proposes that students' intrinsically motivated tendencies are key to making decisions, pursuing challenges, extending their capabilities, exploring new concepts, and learning (Reeve, 2012). Self-determination theory postulates the sense of belonging (*relatedness*), feeling effective in an environment (*competence*) and being wholeheartedly committed to that which an individual is doing by their own will (*autonomy*) as the three main factors that produce motivation and engagement with a particular domain (Deci and Ryan, 2012).

- Relatedness is described as 'the need to feel belongingness and connectedness with others' (Ryan and Deci, 2000: 73). This conceptualisation includes the feeling of being in a secure association or harmony with others. According to self-determination theory, the need for relatedness plays an important part in the internalisation of motivation (Ryan, 1993). Therefore, it is crucial, particularly for immigrant students, to feel themselves as belonging to the classroom environment and as establishing meaningful relationships with their teachers and peers to develop intrinsic motivation towards science and associated self-efficacy (D'Lima et al., 2014; Zhang et al., 2022).
- Competence refers to the eagerness to fulfil one's capacity, and so become a master in a certain topic or skill (Reeve, 2012). For example, when a student completes a given assignment, despite

its challenges, it makes this student feel competent. According to self-determination theory, the need for competence is one of the essential components that maintains intrinsic motivation for learning. However, it is not held to be sufficient by itself, and this is a difference from what Bandura's self-efficacy theory claims (Bandura, 1997; Niemiec and Ryan, 2009).

- Autonomy denotes 'being self-initiating and self-regulating of one's own action' (Deci et al., 1991: 327) and therefore helps maintain intrinsic motivation for learning. For example, if a student attends a science club voluntarily, or willingly devotes time and effort to a scientific activity in a mandatory lesson, this is a manifestation of the student's autonomy.

To sum up, self-determination theory looks to have the potential to help researchers understand immigrant students' attitudes towards science and their aspirations through a lens of social integration, motivation and well-being. A theoretical framework that includes self-determination theory should allow us to investigate immigrant students' intrinsic motivations and goals to study science, and the cognitive and affective factors influencing their science-related decision-making processes. However, the concept of attitude is multifaceted and affected by a range of factors (Allport, 1935; Fishbein and Ajzen, 1975; Osborne et al., 2003). Therefore, to identify patterns in students' science aspirations, and to create a more comprehensive framework for understanding these, by examining their households, cultures and socio-economic backgrounds in addition to their motivations and interactions at school and in their social life, Bourdieu's ideas are used to enable us to explore immigrant students' attitudes and motivations towards science through the lens of their social and cultural capitals.

Bourdieu's theory of capital, habitus and field

Pierre Bourdieu put forward the concepts of capital, habitus and field to help understand people's practices in certain situations, influenced by their social surroundings and cultural inheritance. In the wider social sciences, Bourdieu's concepts have been used to investigate such apparently disparate issues as social classification (Savage et al., 2005), the role of gender in the transformation of home life (Silva, 2005), immigration (Erel, 2010) and inequalities in education (Archer et al., 2012). In the present study, Bourdieu's notions of capital, habitus and field are used to elucidate the status and cultural practices regarding immigrant students' science aspirations.

According to Bourdieu, in contradistinction to Karl Marx, *capital* does not only consist of economic factors (income, accumulated wealth), but also society and culture. Bourdieu (1986: 15) defines capital as 'the accumulated labour which, when appropriated on a private, i.e., exclusive, basis by agents or groups of agents, enables them to appropriate social energy in the form of reified or living labour'. Capital determines one's status in society, and that status changes as a result of changes in four different forms of capital: economic, social, cultural and symbolic. Economic capital refers to the financial resources, such as money or property, that an individual has. Social capital is about whom a person knows and the networks on which they can draw. Cultural capital encapsulates symbolic elements inherited from the culture in which an individual grew up, such as tastes (for example, likes and dislikes about music, one's attitudes towards different animals), clothing and credentials that are acquired through being part of a particular social class. Finally, symbolic capital means the legitimately perceived and recognised types of capitals in different fields. In this study, our emphasis is on the cultural capital of immigrant students as related to their science-related culture, which they carry with them wherever they go, but which changes over time as a result of influences from their family, peers and others.

- Cultural capital therefore encompasses the knowledge, skills, values and experiences that an individual has (Bhugra et al., 2021). Bourdieu (1984) scrutinises cultural capital from three different sources: 'objective' sources, such as books, art and other cultural goods; 'embodied sources', including language, gestures and choices; and 'institutionalised sources', referring to qualifications, certificates and diplomas. Bourdieu argues that cultural capital causes inequality in education because education systems are dominated by the majority's culture and designed for students who are assumed to have a certain cultural level. This situation results in inequality, with lower class students being substantially less likely to succeed in education systems (Elliot Major and Briant, 2023; Sullivan, 2001).
- Habitus is related to how a person perceives their position in life through their experiences or the society in which they grow up (Bourdieu, 1986). Habitus therefore encompasses childhood experiences, cultural inheritance and family norms, as these contribute to individuals' dispositions,

and to beliefs that in turn generate social practices (Nash, 1999). One's habitus can change over time. Moreover, it shapes one's desires and aspirations, and reflects attitudes, including students' attitudes towards science classes (Archer et al., 2012).

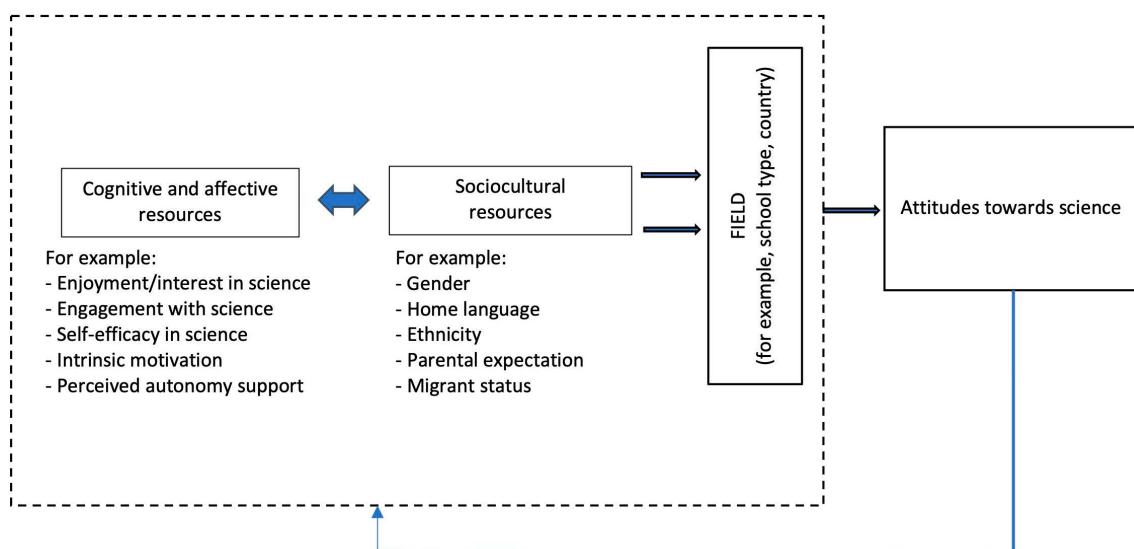
- Field refers to the environment or place that a person (with their attendant capital and habitus) occupies, such as a school, country, business life or a family home. People take positions and act depending on where they are. From a Bourdieusian perspective, various capitals can emerge in different fields, and this can lead individuals with similar habitus to practise in different ways in various fields (Bourdieu, 1986).

In summary, for the purposes of this study, Bourdieu's notions of cultural and social capital, habitus and field are included in our theoretical framework to reflect immigrant students' cultural context, science aspirations and daily life. From such a perspective, we examine the influence of ethnicity, home language, socio-economic background, parental expectation and migrant status on students' science aspirations, and explore the relationship between cultural backgrounds and science-related motivations.

Combining Deci and Ryan's self-determination theory and Bourdieu's theory of cultural and social capital

In this model, we combine Deci and Ryan's self-determination theory and Bourdieu's theory of cultural and social capital. Our model has two elements, as shown in Figure 1. One element focuses on students' cognitive and affective resources, such as enjoyment, self-efficacy, engagement and intrinsic motivation. The other element is related to students' sociocultural resources, such as gender, class, home language, parental expectations and perceived teacher encouragement. These sociocultural resources are filtered through Bourdieu's notion of field and students' immigrant status. By virtue of this model, students' attitudes towards science will be examined through their cognitive, affective and social resources.

Figure 1. Combining Deci and Ryan's self-determination theory and Bourdieu's theory of cultural and social capital to better understand immigrant students' attitudes towards science



Some other studies have combined self-determination theory with Bourdieu's work. Mitchall (2015) makes use of this combination to explore low-income, first-generation young immigrants' motivation to go to college in the USA. According to Mitchall (2015), such a combination provides powerful lenses to explore the quality of information in an individual's social network and a more nuanced approach to establish the factors influencing students' motivation. Brittain et al. (2020) use this combination to explore why disabled people are less likely to access or participate in sport and physical activities. By outlining the linkages between ableism, social practice and self-determination, Brittain et al. (2020)

propose a theoretical framework to indicate the reasons that limit disabled people's participation in these activities.

While Mitchall's (2015) focus is on higher education access and Brittain et al.'s (2020) is on disabled people's participation in sport and physical activity, ours is on immigrant school students' attitudes and aspirations towards science. Our presumption is that combining elements of Deci and Ryan's self-determination theory with Bourdieu's theory of cultural and social capital should allow a more nuanced picture to emerge of the factors that help shape young Turkish immigrants' perceptions about science, and allow us to better understand the role that their cultural heritage plays in this. In particular, it is hoped that our framework will allow light to be shed on the importance of these factors in affecting attitudes and aspirations towards science. This represents a relatively novel approach to examining a cohort of young people who have not received much research attention (Kolançali and Melhuish, 2023).

We now exemplify the theoretical framework outlined in Figure 1, which combines Deci and Ryan's self-determination theory and Bourdieu's cultural and social capital approach, by exploring the science attitudes of two Turkish immigrant students in England.

Methodology and methods

To obtain rich data on the science attitudes of Turkish immigrant students in England, a mixed-methods methodology was used in which students completed questionnaires and they and their parents(s) were interviewed by the first author in their homes, with the interviews being audio-recorded and transcribed. It is now generally agreed that a particularly important time for the formation of student attitudes and aspirations towards science is early in their secondary schooling (DeWitt and Archer, 2015). Accordingly, we focus here on one Year 7 student, Alya, and one Year 8 student, Senem. The questionnaires and interview schedules (available from the first author on reasonable request) were designed to capture data on each student's attitudes towards science and their science aspirations, and data relevant both to Deci and Ryan's self-determination theory and to Bourdieu's cultural and social capital approach.

Recruitment was undertaken opportunistically, using snowballing sampling. Interviews were semi-structured, and therefore allow for a number of approaches to analysis. In this article, we use narrative analysis, as this allows for a rich account to be built up for each student (Andrews et al., 2013; Clandinin and Connelly, 2000). It is also an appropriate approach given that we see the analysis presented here as exploratory in nature. The first author is in the middle of data collection for her PhD, and we do not yet know which type of data analysis will be most suitable once the full data set is available. At this stage, an in-depth examination of two children is likely to prove useful for seeing the extent to which our theoretical framework is of value.

Findings

As is standard in narrative analysis, we present our findings by student, drawing in each case on the student questionnaire, the student interview and the parental interview. For reasons that will become clear, we start with Senem, the older student.

Senem

Senem and her brother (who is four years younger than her) came to England from Türkiye with their mother when Senem was four years old. Senem's mother explained that her husband was already living in England, and that, initially, she found it hard living in England, but that she felt, for the sake of the children's education, that they had made the right decision. Senem's extended family, to whom she feels 'very close', is still in Türkiye, but Senem feels more comfortable living in England, with going to Türkiye feeling like a holiday. She feels 'equally comfortable' speaking either Turkish or English. Her main understanding of Turkish culture is 'Turkish cuisine', but she also associates 'religion' with Turkish culture. In response to the question, 'So in your science classroom, let's say, if there are a couple of Turkish people like you, which group would you prefer to study together with – the group that includes Turkish students or the group with diverse backgrounds?', she replied, 'I think it depends on who the people are. If they are my friends, no matter what background they have.'

Senem says that there is no one in her family who has a science-related job. Her father works in a cafe and her mother, who is principally a housewife, sometimes helps him. Her mother left education after secondary schooling in Türkiye, at which point, she said, 'I could not read much.' Senem wrote on her questionnaire that there were between 26 and 100 books at home.

Senem's mother explained that they chose where to live 'because the schools were very good'. Nevertheless, she said that:

children need to take extra lessons because the education provided by the schools is not enough for me ... I learned from my friends that education was not enough at first, but an extra lesson should be taken. I think my daughter was going to the third grade. We talked to her teacher; she said, 'If you hire a teacher, of course, you will see a lot of benefits.' We hired a private teacher. She was coming for an hour a week, but it continued for a year. Then we sent her to another course. She took extra math and English lessons there. But she missed by very few points to enter a grammar school.

Senem's parents' commitment to her education is indicated by her mother saying, 'Part of the reason we didn't go back to Turkey is because her lessons are so good. We look forward to it with high hopes. I am sure she will do well.'

In response to being asked whether Senem 'ever experience[d] anything negative at school?', her mother replied: 'Frankly, she didn't experience any negativity at school. She had minor problems with her friends, but there were no problems like racism. We did not see any kind of racist approach. Overall, never had a problem.'

Senem said that whether or not she likes her science lessons depends on which of her two science teachers is teaching them. The one she prefers is quite strict but 'makes lessons fun'. Her other science teacher has problems with classroom management: 'he can't really handle it that well, so the students just speak over him and, like, disrespect him'. She said that her favourite science subject was 'probably biology', on the grounds that 'it's just fun learning, learning about like, how your body works'. Her favourite school subject is English because she has 'a good teacher'. On her questionnaire, Senem agreed with the statements 'I am happy working on science topics', 'I am interested in learning about science', 'I learn interesting things in science lessons' and 'I look forward to my science lessons', and she strongly agreed with the statement 'I am good at science'. However, she disagreed with the statements 'I enjoy learning new things in the field of science', 'When I am doing science, I always know what I am doing', 'I would like to or do belong to a science club' and 'I enjoy watching TV shows that deal with science', and she strongly disagreed with the statements 'Science is one of my favourite subjects', 'My science teachers are interested in me as a person', 'I would like to have a job that uses science' and 'I would like to become a scientist'.

When asked if she gets help from her parents when she does her science homework, Senem replied, 'No, I do it by myself. I don't think I need any help.' In response to a question about how Senem was getting on with her science lessons, her mother replied, 'Frankly, we always look at her grades and works, we always look at her scores, but I don't know, she sometimes tells us about science lessons at home, but now I have no idea.'

Senem had visited the Natural History Museum with her parents, an experience she twice described as 'quite fun', but her mother said that they had 'never been to science fairs or science centres', even though 'I really want to go.'

With regard to the future, Senem said, 'I would like to be a lawyer when I grow up.' She said that she had talked about this with her parents, and that they had both said that they 'would support me'. While her mother has lawyers in her family, she is keen on Senem becoming an engineer:

I have a friend at Ford with her engineer husband. They do engineering. They said that if Senem's courses are very good when she starts university, [they] will arrange an internship for her at Ford, and Ford will sponsor her for her university. I don't know if she wants something like that, so we talked, but she says she wants to be a lawyer, so she wasn't very interested, but I want Senem to be an engineer.

When asked, 'What kind of expectations do you have about Senem's future?', her mother replied, 'I think that she should stand on her own feet, read and get somewhere.' When asked, 'What kind of profession do you think would be the most suitable for Senem?', her mother responded:

Frankly, she thinks about being a lawyer or something, but around me they always say it's very difficult. I would like [her] to have a profession that is not difficult, that a woman can also do, that she can take time for herself and travel. For example, there are engineers around me; my friends are doctors – they work very hard. Engineers work more comfortably – they only go to and from the complaints during working hours. Some days they can also [work] from home.

When asked, at the very end of the interview, 'Would you like her to work on science?', Senem's mother replied, 'Yes, I would love to, but it seems like my children are not very interested in science.'

Alya

Alya came to England with her parents and younger sister seven years ago, her father arriving on a Tier 2, skilled worker visa. They have remained here because of the children's schooling, although, having found out about grammar schools, her father said:

We think that it would be better for Alya to go to grammar school because of her academic success in primary school. She always got the highest grade on the tests, she is one of the best students, and she aims at university, or we think she will. Those schools are very successful. Actually, it's not because the schools are very good. The success of those schools is very high thanks to the selected students' academic successes. Since there are always such selected students around, students in those schools are successful.

When Alya was asked if she would prefer to be interviewed in English or Turkish, she replied, 'English, please', adding, 'I prefer English.' She also said that she felt more comfortable with English, despite the fact that when asked, 'But do you speak English with your parents?', she replied, 'No, I speak to all my family in Turkish.' When asked whether she felt more at home in England or in Türkiye, she replied, 'England', adding, 'because I study here. I have friends here.' She went on to say that she has 'relatives in Turkey, but not many friends'. Alya associated Turkish culture with religion, saying, 'Most of my family are Muslims, which is why I know their traditions and stuff like Ramadan or the other things', and then went on to talk about Turkish food. She was clear, however, that she herself was not Muslim, stating in response to a question about her liking of Ramadan, 'I'm not Muslim. I don't do Ramadan.' Alya wrote on her questionnaire that there were between 100 and 200 books at home.

In her interview, Alya said, 'my school's all right. My teachers are great.' On her questionnaire, she strongly agreed with the large majority of the statements about science, for example, 'I like reading about science', 'I am happy working on science topics', 'I am interested in learning about science', 'I learn interesting things in science lessons', 'I look forward to my science lessons', 'Science lessons are exciting' and 'Science is one of my favourite subjects'. She also strongly agreed with 'I am good at science', 'I am certain I can figure out how to do the most difficult science tasks in classes' and 'My science teachers are good at explaining science'. Interestingly, however, she only agreed (rather than strongly agreed) with the statement 'I think I could be a good scientist'.

Alya's favourite school subject is 'English ... Because it's writing. I like writing.' On being asked why she likes writing, she said, 'I just like writing fiction because it let me express myself and stuff.'

Alya knows that her father is a computer engineer, and her favourite science subject is computing, but she does not know of anyone else working in a science-related job within her family. Her father said of Alya that:

[She] is a child who is constantly doing computing at home and is interested in software. Maybe I directed her, but I saw that Alya was engrossed in the world of coding. There is a program called Scratch or Microsoft Code Composer. She made maybe hundreds of software using these programs. I've never helped her afterwards. I saw that she has done hundreds of projects and established a lot of communities.

At primary school, Alya had been a STEM (science, technology, engineering and mathematics) Ambassador and had assisted in the school's after-school coding class.

When asked, 'Do you have any person you particularly look up to? It can be in your family or beyond it', Alya replied: 'Most authors, well, as a group of all those who go by the name Erin Hunter. They wrote to a 72, yeah, it's 84, book series now, and I really look up to them because I love their book series, and I want to be an author when I grow up.'

On her questionnaire, Alya had strongly agreed with the statements 'I would like to study science at university' and 'I would like to become a scientist'. However, when asked in the interview 'As I remember in the questionnaire, you also said that you really want to study science in the future. Right?', she replied, 'Oh, I was answering that with my Dad. I don't want to study like science, biology, chemistry in the future. I want to like more on writing and stuff.' On then being asked 'So why don't you want to study science in the future?', she replied, 'I don't know. It's just that writing kind of gets my attention more.' When asked if she ever talked about her career intention with her parents, Alya replied: 'I used to think I always wanted to be a software engineer like my Dad. But now, I don't really think so. I want to be an illustrator or something, or an author.' When asked, 'What changed your mind?', she replied, 'reading, just reading books'. When then asked, 'So, did you talk about your intention with your parents?', she replied, 'I don't. If I have then I don't remember doing it, but I don't think I have.' When then asked, 'Do you think they will be happy that you would like to be an author?', Alya replied: 'I don't know. My Mom would be happy. She has kind of always wanted me to show more interest in writing and studying than doing computing. But I don't think my Dad will be as happy, because he's more of a computing side of things.'

When her father was asked 'What are your expectations for the future of Alya', he replied:

It is very important for Alya to discover her talents. She has a talent for computing and for reading. She also has an interest in sports. She loved swimming. She loved chess. She loved scouting. We try to find the things she likes and move on ... We say let time decide what to do. But, for example, if she decides to be a good software developer or engineer, or something like an architect, I think it would be nice and I would be happy.

On then being asked 'What is the most suitable job for Alya in your opinion?', he replied, 'Since she is similar with me in her characteristics, an IT software job could be suitable for Alya, since she does not like one-on-one relationships very much with people, but mostly because it is a job that one works on her own.'

When asked, 'Do you get some help from your parents when you are working on your science homework or in science projects?', Alya somewhat surprisingly replied, 'We don't really have science homework.' On being asked as a follow-up question 'You don't? Don't you make any science projects like anything about science?', she replied, 'No, not yet.'

When asked, 'Have you ever been to a science museum then?', Alya replied, somewhat uncertainly, 'Yeah, I think so I have'. On then being asked 'Do you remember that day?', she replied, 'I don't remember a lot', even though she thought the visit 'was only last year'. In his interview, her father said that they had been to the National Museum of Computing and the Natural History Museum.

Discussion

In attempting to understand the attitudes of school students towards science, it can be useful to distinguish between science as a discipline, science as a school subject and science as a career (compare with Archer et al., 2012; Osborne et al., 2003). Nevertheless, while school students also form their attitudes towards science (as a discipline) and the possibility of science as a career through out-of-school influences (for example, Rodd et al., 2014), their attitudes towards science and their science career aspirations are heavily influenced by their experiences of school science (Mujtaba et al., 2020). Accordingly, in school students' minds, there is typically a degree of conflation between the three (science as a discipline, science as a school subject and science as a career) and their attitudes towards them.

When we turn to the two students considered in his article, Senem had high science self-efficacy and was quite positive about some aspects of science in her questionnaire responses, strongly agreeing with the statement 'I am good at science', and agreeing with the statements 'I am happy working on science topics', 'I am interested in learning about science', 'I learn interesting things in science lessons' and 'I look forward to my science lessons'. However, in her questionnaire, she strongly disagreed with the statements 'Science is one of my favourite subjects', 'I would like to have a job that uses science' and 'I would like to become a scientist'.

Senem's parents are very committed to her education, despite their own quite modest educational backgrounds. They are prepared to invest in Senem's education in terms of both time and financial resources. From a Bourdieusian perspective, they see education as a means of changing the field.

Senem's mother's expectations for Senem's professional future seem to revolve around it being one that would allow Senem time and not be too pressurised for her. Senem's social capital seems to be relatively low, as is her science capital (compare with DeWitt and Archer, 2015). Although her mother says that she has a friend who works at Ford, whose husband is an engineer, and that 'if Senem's courses are very good when she starts university, [they] will arrange an internship for her at Ford and Ford will sponsor her for her university', from Senem's perspective, there is no one in her family who has a science-related job.

Going back to Deci and Ryan's self-determination theory, although Senem feels that she is good at science, she scores quite low on competence in respect to science, in that she does not evidence a desire to fulfil her capacity and so become a master at it. She also does not manifest wholehearted commitment to science, so she scores quite low on autonomy, and she does not feel the need for any help from her parents with her science homework.

Senem was not intending to become a scientist. It could be argued that one does not really need Deci and Ryan's self-determination theory to understand her current low science aspirations. In terms of Figure 1, Senem's relatively low sociocultural resources in respect of her science capital suffice to explain her lack of interest in continuing with science once she can choose whether to or not. Nevertheless, combining self-determination theory and a Bourdieusian perspective provides a more nuanced interpretation of her attitude towards school science and her science aspirations.

It is when we turn to Alya that we can particularly see the value of combining Deci and Ryan's self-determination theory with Bourdieu's theory of cultural and social capital, as a Bourdieusian perspective on its own may not suffice to explain why she too is not keen on continuing with science. From a Bourdieusian perspective, Alya's social and cultural capital are relatively high, as is her science capital. Nevertheless, in the interview, she is clear that while she used to think she wanted to be a software engineer, she has now changed her mind. Key to this, in the language of Deci and Ryan's self-determination theory, seems to be her intrinsic motivation for learning and the exercise of her autonomy. She likes reading, and she says that writing fiction helps her to express herself. Indeed, when asked, 'Do you have any person you particularly look up to? It can be in your family or beyond it', she responds by naming Erin Hunter, a pseudonym that refers to a collective of seven authors who write enormous numbers of juvenile fantasy books that focus on the adventures of non-human animals.

Our tentative conclusion is therefore that our theoretical framework, in its combination of a Bourdieusian perspective and Deci and Ryan's self-determination theory, provides a more powerful framework than either of its components on their own for helping explain why some immigrant students continue with science and others do not.

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Declarations and conflicts of interest

Research ethics statement

The authors declare that research ethics approval for this article was provided by University College London Research Ethics Committee (Data Protection Registration Number: Z6364106/2021/03/205 social research).

Consent for publication statement

The authors declare that research participants' informed consent to publication of findings – including photos, videos and any personal or identifiable information – was secured prior to publication.

Conflicts of interest statement

The authors declare no conflicts of interest with this work. All efforts to sufficiently anonymise the authors during peer review of this article have been made. The authors declare no further conflicts with this article.

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