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STEM, Social Mobility and Equality

Avenues for Widening Access

Kate Hoskins
Bernard Barker

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STEM, Social Mobility and Equality

“This book provides compelling evidence not only of the failure of UK social mobility policy but why it fails. This book is essential reading for all those concerned about inequalities in education. It combines a carefully considered genealogical analysis of the social mobility of university students studying STEM subjects with the powerful message that social mobility policies have been woefully inadequate.”

—Diane Reay, *University of Cambridge, UK*

“For a generation, the ideas of social mobility and science have intertwined in British governments’ education policies. This book combines big ideas and minute qualitative research to question a good deal of what we—and governments—have taken for granted. It’s a book which should be read by every education policy maker who wants to think seriously about education, technology and class.”

—Chris Husbands, Vice Chancellor, *Sheffield Hallam University, UK*

“A carefully executed study that critically examines the realities of STEM for the possibility of achieving social mobility and equality. This book provides rich insights into the identities of chemistry undergraduates and the experiences of staff with Athena Swan and the challenges of equity policies. A quality and timely sociological contribution to science education research and scholarship.”

—Billy Wong, *University of Reading, UK*

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*KH: For Ian, the most amazing, kind and supportive brother I could ask
for. Thank you.*

BB: For Margaret and David Killingray, lifelong friends and supporters

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CONTENTS

1	Introduction	1
2	The Contemporary Social Mobility and Equality Policy Context: Framing the Problem	19
3	Making Chemists	61
4	Equality Policies and Initiatives at Marsden	89
5	The Limits of Equality Policy	113
6	Conclusion	133
	Appendix	147
	References	151
	Index	169

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Bernard Barker is Emeritus Professor of Educational Leadership and Management at the School of Education, University of Leicester and Chair of Governors at Queen Katharine Academy in Peterborough. He was educated at Eltham Green School in south London and Gonville and Caius College, Cambridge. He progressed to York University where he researched the Labour movement in the years immediately before and after the First World War. Between 1971 and 1999 he taught at schools in

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ABBREVIATIONS

A level	Advanced Level
ARM	Advanced Resource Managers
ASC	Athena Swan Charter
ASE	Association for Science Education
BAE	British Aerospace Systems
BAME	Black, Asian and Minority Ethnic
BBC	British Broadcasting Corporation
BCS	British Cohort Study
BERA	British Educational Research Association
BHPS	British Household Panel Survey
BITC	Business in the Community
BME	Black and Minority Ethnic
BSA	British Sociological Association
CUPESSSE	Cultural Pathways to Economic Self-Sufficiency and Entrepreneurship
CV	Curriculum Vitae
DCSF	Department for Children, Schools and Families
DfE	Department for Education
DFES	Department for Education and Skills
ECG	Electrocardiogram
ECU	Equality Challenge Unit
EHRC	Equality and Human Rights Commission
ESRC	Economic and Social Research Council
EU	European Union
FSM	Free School Meals
GCE	General Certificate of Education
GCSE	General Certificate of Secondary Education

GIST	Girls into Science and Technology
HE	Higher Education
HEI	Higher Education Institutions
HESA	Higher Education Statistical Agency
HMG	Her Majesty's Government
HMT	Her Majesty's Treasury
HP	Hewlett Packard
HSCC	Health and Social Care Committee
IT	Information Technology
KCL	King's College London
LGBO	Lesbian, Gay, Bisexual Outreach
LGBT	Lesbian, Gay, Bisexual, Transgender
LGBTQI+	Lesbian, Gay, Bisexual, Transgender, Questioning (or queer), Intersex
M. Chem	Master of Chemistry
MCS	Millennium Cohort Study
MP	Member of Parliament
NCDS	National Child Development Study
NIH	National Institutes of Health
NSF	National Science Foundation
NUS	National Union of Students
OECD	Organisation for Economic Cooperation and Development
PFAP	Panel on Fair Access to the Professions
PhD	Doctor of Philosophy
POLAR	Participation of Local Areas
REC	Race Equality Charter
REF	Research Excellence Framework
ROSLA	Raising of the School Leaving Age
SEB	Socio-Economic Background
SEND	Special Educational Needs and Disability
SET	Science, Engineering and Technology
SMC	Social Mobility Commission
SMCPC	Social Mobility and Child Poverty Commission
STEM	Science, Technology, Engineering and Mathematics
STEMM	Science, Technology, Engineering, Medicine and Mathematics
TISME	Targeted Initiative on Science and Mathematics Education
UCAS	Universities and Colleges Admissions Service
UK	United Kingdom
US	United States
WISE	Women into Science and Engineering



Introduction

Abstract In this chapter, we contextualise our project and relate the case study to the wider educational policy concern in England, which emphasises equal opportunity policies that aim to improve social mobility for all (DfE, *Unlocking Talent, Fulfilling Potential: A Plan for Improving Social Mobility Through Education*, CM 9541, 2017), and Athena Swan’s (2005) concern with gender equality, fairness and the workforce’s welfare. We provide a rationale to justify our choice of case study within the STEM (Science, Technology, Engineering, Mathematics) subjects, which we argue is because of the importance given to these disciplines by policy-makers (HMG 2012: House of Lords, 2012). We provide an in-depth discussion of the methodology and methods informing our study and justify taking a case study approach. In doing this, we point out the wider appeal of our case study findings to fields beyond chemistry and show how our work provides insight into studying STEM subjects more broadly.

Keywords STEM • Social mobility • Equality opportunities • Policy

A casual conversation with a former Pro Vice-Chancellor of Marsden University (pseudonym) gave an unexpected introduction to a top-rated Russell Group chemistry department, where over 90 per cent of the research is rated as ‘internationally excellent’ (Research Excellence

Framework [REF] online). The department believes passionately in social inclusion and equal opportunities for students and staff. It aims to improve and enhance every aspect of its work so that everyone is empowered to pursue their studies and careers without hindrance from background variables, including social class and disadvantaged circumstances, in addition to the characteristics protected by the Equality Act (2010), namely age, disability, gender reassignment, pregnancy and maternity, race, religion and belief, and sex and sexual orientation. It has engaged on a sustained basis with the Athena Swan Charter (ASC). The Charter assists institutions to build a culture that values diversity and equality; and encourages cultural and systemic changes that make a real impact on the lives of staff and students (Bhopal 2018; AdvanceHE 2019).

Our chance contact presented, therefore, an unusual opportunity to examine troubling concerns arising from government policies to promote social mobility, *Science, Technology, Engineering and Mathematics* (STEM) and equality more generally. There is a remarkable gulf between ambitious policy plans in this arena and the limited outcomes achieved, especially in science-related disciplines and occupations. Initiatives and legislation intended to ensure equal opportunities, regardless of an individual's background characteristics, have achieved less than many hoped. This is a case study in higher education (HE), therefore, that traces the STEM student trajectory through family, school and university (based on interviews with undergraduates); and examines the adoption, implementation and relative success of the ASC in the Marsden chemistry department (based on interviews with staff). Departmental plans and submissions for charter recognition are examined and discussed in the context of staff perceptions of the Athena Swan process.

The overall aim of our book is to better understand how students' identities and aspirations are formed and developed; and in light of that understanding to assess the effectiveness of strategies to enable career progression and mobility; to extend and enhance equal opportunities; and also, to identify improvements that may help institutions become more fully inclusive. This case study has wider significance, although the thick descriptions and detailed knowledge we have assembled here do not lend themselves to generalization. The aim is not to generalize, but to identify and describe influences and relationships and to formulate hypotheses about mobility processes that can be compared with the results of similar enquiries (Bertaux 1995). The Marsden findings are relevant to the wider debate

because they identify areas of inclusion that work well and draw critical attention to systems and processes that need improvement.

THE PROBLEM

Since at least *Labour's Plan for Science* (Wilson 1963), human capital theory (Goldin 2014) has justified an almost continuous effort to educate young people for an advanced, science-based economy. The aim has been to make the country richer by opening routes to new, rewarding careers, with upward social mobility for highly skilled individuals who choose to work in STEM subjects. The widespread perception that social mobility is open to everyone who aspires to success, works hard and seizes opportunities, has further encouraged multiple attempts to raise aspirations, improve STEM skills and create a meritocratic society (Hoskins and Barker 2019).

These goals have proved elusive, however, despite reforms that were supposed to enable disadvantaged children to overcome their backgrounds (Department for Education [DfE], 2010, 2017), and the rapid expansion of HE, designed to widen participation, especially for under-represented groups. Equal opportunities, apparently secured by the Equality Act (2010), seem less open to all when closely examined. There is evidence, for example, that disadvantaged students perform consistently less well at school than their peers (Cook 2012; Andrews et al. 2017) and that top professions are dominated by people with private school backgrounds (Social Mobility Commission [SMC] 2016; Friedman and Laurison 2020). Women are 'vastly under-represented among top earners' (Fortin et al. 2017: 1) and a substantial pay gap persists across all occupations (Olsen et al. 2014). Race and ethnicity are equally powerful in shaping people's opportunities (Powell 2019) and what individuals believe is possible and desirable (Archer et al. 2012).

The drive to promote STEM subjects at school and university seems to have been equally unsuccessful. As the President of the Royal Historical Society says,

Especially from the late 1950s, when economists and industrialists began to bear down on educational policy, the public discourse about subject choice has been dominated by the alleged insufficiency of science (or what we now call STEM) and policy has been aimed almost exclusively at remedying that insufficiency. How misleading this discourse is as a guide to actual behaviours is clear from the brute fact that there has been a nearly continuous

swing away from science from the early to mid-1960s up until the last few years. (Mandler 2017)

The expansion of HE seems to have made little difference to relative life chances, while participation in STEM courses has been stable in terms of undergraduate backgrounds and ethnic group (Smith 2011). Young people, regardless of their origins, seem resistant to attempts to steer their choices and decisions; and appear driven by background influences that do not appear on the policy-makers' mobility map.

THE CASE STUDY

At South Park and Felix Holt, two high-performing academics, we chose a best-case scenario for an earlier social mobility study, designed to test the government's assertion that improved educational access, combined with high-quality teaching, will enable young people to transcend disadvantaged backgrounds and achieve hard-earned success. Interviews with 16 and 18-year olds led to the conclusion that government expectations are unduly optimistic (Hoskins and Barker 2014). We found little evidence that school reforms created favourable conditions for upward mobility; and our data confirmed the importance of family, community and other deep structural influences in shaping aspirations and goals.

Individual and family employment trajectories emerged as intimately related, with social, economic and cultural capital transmitted through the three generations (grandparents, parents, young person) investigated (Hoskins and Barker 2019). Interests and occupational dispositions were linked, with participants' progress making sense in the context of their extended family history and historic changes in the local and national job markets. These findings suggest the government's reliance on an oversimple, individualist approach to education and vocational choice has contributed to the sustained failure of initiatives to increase social mobility in general, and to expand the supply of STEM graduates in particular. Policy-makers are trapped in their own assumptions, especially with the idea that family background is a handicap to be overcome, not a shaping influence on young people's education and vocational choices.

This investigation begins therefore from a different perspective, grounded in our earlier work, and uses a genealogical method to examine the family and policy influences on undergraduate chemists. How have equal opportunity policies (e.g. widening participation; the ASC)

combined with family networks, teachers, schools and universities to influence the attitudes and aspirations that condition academic and vocational choices and pathways in a STEM subject? What barriers have the students encountered so far, even in the positive environment of a department strong in Athena Swan values, and how might they be overcome? The influence of gender, ethnicity and social class are considered in relation to their role in enhancing or limiting aspirations to study chemistry.

A genealogical, qualitative case study, as recommended by Bertaux and Thompson (1997), is a promising way to examine the influence of family networks, habitus and dispositions on the academic and vocational pathways selected and followed by undergraduate chemists at a Russell Group university. The approach opens territory not easily accessed with the statistical methods familiar from so many social mobility studies. Labour market economists, for example, have prioritised the use of large-scale quantitative surveys to chart income differences between fathers and sons in successive birth cohorts, and so to measure intergenerational fluidity. But although such surveys emphasise the relative importance of individual male incomes in social change, they often neglect other dimensions, especially advances in women's employment status and earnings, and the role of family networks in holding and transmitting social, economic and cultural capital through the generations (Lambert et al. 2007; Bertaux and Thompson 1997). Quantitative surveys and data may show broad movements and trends, like the fluctuating lines on an electrocardiogram (ECG) print out, but they provide few insights into the decisions made by individual agents and the underlying social processes that influence choice and action.

A genealogical approach has distinctive advantages when the aim is to understand how young people's aspirations and identities are formed, and to investigate how their achievements relate to family and science capitals as well as to their social class background. We should acknowledge that 'mobility is as much a matter of family praxis as individual agency,' with families rather than individuals carrying social and occupational status (Bertaux and Thompson 1997: 7). This recognition broadens and deepens our understanding of mobility processes. The unit of sociological investigation becomes a section of an unlimited texture of kinship ties, rather than an individual or even the nuclear family (Bertaux 1995). In this context, occupations cease to be the sole indicator of social position and interest shifts from fathers and sons to the wider family network over time. Housing, education and culture are also taken into account. These

are considered in light of a multi-generational perspective that shows how some families are able to build on advantages they already have to move up in successive generations (Mare 2011). The role of women in raising children and transmitting family influences is clarified while the family itself is recognised as the principal channel for the transmission of language, culture, status and values (Thompson 1997).

Genealogical methods have been developed less than they might have been, however, because most mobility studies have relied on data for just two generations of family members. This is because information about grandparents and great grandparents can be difficult to collect and may not be readily available (Chan and Boliver 2013; Erola and Moisio 2007). The two-generational model seems to have prompted an over-estimate of intergenerational mobility and has encouraged an unhelpful emphasis on fathers and sons (Pfeffer 2014). Our understanding of family networks is considerably enriched when three generations are included and the multi-generational effects of processes unfolding within the nuclear family can be examined (Mare 2011). There is a growing understanding of the role of grandparents. Analysis of data from three British cohort studies has shown, for example, that absolute mobility rates vary substantially by grandparents' social class and that even when parents' class is taken into account, there is a statistically significant association between grandparents' and grandchildren's class positions. The study concludes that the grandparent effect on social mobility is considerable and operates throughout the class hierarchy (Chan and Boliver 2013).

A set of individual, semi-structured life history interviews, each an hour in duration, is at the heart of this enquiry. Individual undergraduate chemists present perceptions and interpretations of their family background; their experience of primary and secondary school as well as their choices of course and university; and the shaping of their current aspirations and expectations for the future. The intention was to gather trustworthy information about each student and six other members of her or his family by adopting a neutral stance in clarifying and accepting the accounts offered. Where memories were vague or incomplete, especially about the grandparents, participants' recollections were recorded as they were given. This is a highly efficient means of data collection about a kinship network and produced thick descriptions rich in family history although there are costs in validity and reliability (Bertaux 1995). It would have been difficult within the resources of our research to have triangulated participants' stories with other family members but there is the compensating thought that

the personal accounts gained strength from the interpretations and descriptions offered.

SAMPLE & ACCESS

The study is based on interviews with a sample of 11 undergraduate students at Marsden University pursuing 3- or 4-year degree courses in chemistry; and with 8 staff members of the chemistry department. Student participants are self-selected volunteers who responded positively to a general invitation to take part in the research. The sample is not representative of undergraduate chemistry students at this or any other university but nevertheless provided ethnologically dense knowledge and ‘thick’ descriptions that can lead to interpretive ideas, hypotheses and concepts (Geertz 1973). Staff participants were nominated by the head of department and represent the current outlook in chemistry.

We explained the aim and objectives of the project and outlined the time commitment required. The eventual opportunity sample of students included variations in gender and socio-economic background. The gender composition of the sample was set by the individuals volunteering but Marsden chemistry cohorts are near parity in terms of male/female representation. We hoped to achieve diversity in relation to ethnicity, but this was limited as course participants tended to be white British or white European students. This lack of ethnic diversity is a limitation for the study and is discussed in Chap. 4 in relation to the policies and initiatives implemented to enhance minority ethnic representation in the department.

The student sample is smaller than originally planned but has yielded rich data consistent with other, much larger mobility studies, and provides insight into personal and background influences on academic and career decisions. These included questions about the background, occupational trajectory, dispositions and influence of parents and grandparents. Participants also completed a social mobility questionnaire about their parents’ and grandparents’ education, work history and perceived social class background. They were asked in addition to match family members with job/status descriptors on the Registrar General’s Occupational Classification Chart. The data collected includes rich material on the lives and mutual influence of 77 individual family members, including the participants themselves. The findings based on the undergraduate interviews, as reported in Chap. 3, help further illuminate the operation of Athena Swan in the chemistry department (as detailed in Chap. 4). Student details

and background are summarised in Appendix 1: Chemistry Students: Family Occupations and Class Identities.

The staff sample comprises 8 individual interviews, each of approximately 40 minutes. These capture staff perceptions of current progress towards improving equal opportunities and reducing obstacles for the undergraduates, postdoctoral students and early career researchers who seek to achieve educational success and career mobility in chemistry.

ETHICS

The study complies with the ethical protocols set out by the British Education Research Association (BERA) (2018) revised ethical guidelines and the British Sociological Association (BSA) (2002) ethical guidelines. Participants were assured that confidentiality would be safeguarded, with anonymity maintained throughout. Identifying features would be removed from the data, with pseudonyms used for all names, including the university itself. We protected the rights of participants by advising that they could withdraw at any time and/or not answer questions. Staff and students were not approached directly but through appropriate office holders. Participants were invited to review the transcripts and data extracts selected for inclusion in the published study. The decision to offer this opportunity recognised and aimed to mitigate the differential power relations between researchers and participants, particularly in the case of undergraduate students.

We reflected throughout on our role as researchers and the associated position of power we occupied. Skeggs (2002: 369) points out that ‘telling has always been moral’ and reflexivity is needed throughout the process of undertaking research. The data presented here was thematically analysed and reanalysed by both authors. Interview accounts were reflexively constructed and reconstructed through conference papers and research seminars to refine our interpretations and so provide an accurate presentation of the experiences shared with us.

CONCEPTUAL FRAMEWORK

Habitus and Dispositions

This study follows Archer et al. (2012) in drawing on Bourdieu’s (1986) concepts, as well as his later insight that family habitus facilitates an individual’s ‘practical evaluation of the likelihood of the success of a given

action in a given situation which brings into play a whole body of wisdom, sayings, commonplaces, (and) ethical precepts (e.g. “that’s not for the likes of us”)’ (1990: 77). Interview transcripts were combed for evidence of dispositions constitutive of habitus, and for examples of

Unintentional learning made possible by a disposition acquired through domestic or scholastic inculcation of legitimate culture. This transposable disposition, armed with a set of perceptual and evaluative schemes that are available for general application, inclines its owner towards other cultural experiences and enables him to perceive, classify and memorize them differently. (Bourdieu 1984: 20)

In drawing on the theoretical resources of habitus and dispositions, however, the process of acquiring dispositions is viewed as ‘durable but not eternal’ (Ball 2003: 16). Like Archer et al. (2012), we used these ideas to make sense of the family context and influences operating on individual members as well as to understand their effects.

To theorise the influence of social class background on our participants’ choices, we draw on Bourdieu’s (1977) concept of habitus and field. We use habitus and field to understand any tensions in the participants’ stories between individual agency, shaped by cultural and familial factors, and the wider impact of economic, social and structural factors. We also use the concepts to deepen understanding of the reproduction of class inequalities and of the impact of social class on prospects for intergenerational social mobility (Bourdieu 1986). Habitus is also used to explore the influence of familial dispositions (Crozier et al. 2008).

We analyse social class and its intersections with gender to yield a deeper, more rounded understanding than might arise from a concern with class alone (Brah and Phoenix 2004). Our perspective on social reproduction and inter-generational mobility is informed by Bourdieu’s (1986: 46) claim that the social world cannot be understood without recognizing ‘capital in all its forms,’ including the transmission of economic, social and cultural resources through the family. The term habitus refers to the recurring, durable patterns of social class dispositions and outlook—the beliefs, values, conduct, speech, dress and manners—that are ingrained by everyday experiences within the family, peer group and school (Bourdieu 1979). Habitus conditions and guides individuals as they respond to everyday life without consciously obeying explicit rules. The dispositions