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The Equator Project Research School and Mentoring Network: evaluated interventions to improve equity in geoscience research

Natasha Dowey^{1✉}, Anya Lawrence^{2,1}, Munira Raji^{3,4,1}, Christopher Jackson^{5,6}, Rebecca Williams⁷, Ben Fernando^{8,1}, Sam Giles², Jenni Barclay^{9,10}, Louisa Brotherson^{11,12}, Ethny Childs¹³, Jacqueline Houghton^{14,15}, Anjana Khatwa¹⁶, Keely Mills¹⁷, George Jameson¹⁸, Francisca Rocky¹⁹, Steven Rogers²⁰, Catherine Souch²¹

¹Geography and Environment, Sheffield Hallam University, Sheffield, UK ✉ N.Dowey@shu.ac.uk

²School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, UK

³Sustainable Earth Institute, University of Plymouth, Plymouth, UK

⁴Black In Geoscience, UK

⁵Jacobs Engineering Ltd UK, Manchester, UK

⁶Department of Earth Science & Engineering, Imperial College London, London, UK

⁷School of Environmental Sciences, University of Hull, Hull, UK

⁸Department of Earth and Planetary Sciences, John Hopkins University, Baltimore, USA

⁹School of Earth Sciences, University of Bristol, Bristol, UK

¹⁰Aries Doctoral Training Partnership

¹¹Department of Earth, Ocean and Ecological Sciences, University of Liverpool, Liverpool, UK

¹²BeZero Carbon, London, UK

¹³Institution of Environmental Sciences, London, UK

¹⁴School of Earth and Environment, University of Leeds, Leeds, UK

¹⁵Diversity in Geoscience UK

¹⁶School of Environment, Earth and Ecosystem Science, Open University, UK

¹⁷British Geological Survey, Keyworth, UK

¹⁸Geological Society of London, London, UK

¹⁹Black Geographers, UK

²⁰School of Geography, Geology and the Environment, University of Keele, Keele, UK

²¹Royal Geographical Society (with IBG), London, UK

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4

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8 Francisca Rockey¹⁹, Steven Rogers²⁰, Catherine Souch²¹

9

10 ¹Geography and Environment, Sheffield Hallam University, Sheffield, UK ✉ N.Dowey@shu.ac.uk

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29 ²⁰School of Geography, Geology and the Environment, University of Keele, Keele, UK

30 ²¹Royal Geographical Society (with IBG), London, UK

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32 **Keywords:**

33 Equity; diversity; inclusion; geoscience; doctoral; recruitment; retention; widening
34 participation

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38 **Positionality statement**

39 Equator is a research group working towards Equity, Diversity and Inclusion (EDI) in
40 Geography, Earth and Environmental Science (GEES). This paper focuses on a 2021/22
41 Natural Environment Research Council-funded project that set out to improve access
42 and participation of Black, Asian and minority ethnic students in GEES research. Of the
43 seventeen authors of this report, seven identify as Black, Asian or minority ethnic.
44 Although primarily geoscientists in academia, industry and the public sector, many of
45 the authors have been involved in research and interventions related to Equity, Diversity
46 and Inclusion (EDI) over the past five years, and/or hold EDI responsibilities in their
47 respective institutions or charities.

48

49 **ABSTRACT**

50 There is a well-documented racial and ethnic diversity crisis in Geography, Earth and
51 Environmental Sciences (GEES) subjects in the Global North that leads to inequities in
52 who does environmental research. The Equator project set out to increase participation
53 and retention of UK-domiciled Black, Asian and minority ethnic students in GEES
54 research by developing evidence-based, ring-fenced, fully remunerated interventions.
55 These interventions were co-created with and informed by the voices of students and
56 professionals within the GEES community, following a Theory of Change-based, action
57 research approach. The Equator Research School brought together 30 Black, Asian and
58 minority ethnic students in GEES, and 12 academics, professionals and mentors, from
59 across the UK for a five-day residential workshop in April 2022. The Research School
60 was designed to facilitate network-building, improve awareness of research careers,
61 enhance confidence in continuing in research, and strengthen a sense of belonging in
62 GEES research for participants. The Equator Mentoring Network, which took place from
63 January to May 2022, facilitated networking between 10 Black, Asian and minority
64 ethnic student mentees and 20 academic and industry mentors involved in GEES
65 subject areas. The overall goal of the Mentoring Network was to increase retention of
66 Black, Asian and minority ethnic students into postgraduate research and to improve
67 their overall experience. Evaluation of these interventions took the form of surveys to
68 capture thoughts and reflections before, during and after interventions. Participants in
69 both interventions provided very positive feedback; the majority of those involved felt a

70 stronger sense of belonging and inclusion in GEES research and were more likely to
71 consider a research career after taking part. The evaluation process showed
72 unequivocally that the ring-fenced, discipline-specific, fully funded nature of the
73 interventions was a critical factor in participant involvement. The work led to the
74 development of recommendations for creating successful interventions for improving
75 participation and retention in research, as well as templates for future, related EDI
76 activities.

77

78 **INTRODUCTION**

79 There is markedly lower representation of Black, Asian and minority ethnic¹ students in
80 postgraduate research than in undergraduate or taught postgraduate study in the UK²
81 (UKRI / Office for Students, 2019; Dowey et al., 2021). This ultimately leads to very poor
82 representation within senior levels of professional GEES research (e.g., IES, 2024), with
83 implications for the outcomes of that research in broader society. This disparity is
84 influenced by factors across the educational lifecycle. For example, Black, Asian and
85 minority ethnic students are less likely to be awarded a 1st or 2:1 undergraduate (UG)
86 degree than their white counterparts³ (Office for Students, 2022) and are less likely to
87 attend the high-tariff research institutions that act as feeder universities for most
88 postgraduate research (PGR) study⁴ (GOV.UK, 2022). These groups are also more likely
89 to lack a sense of belonging in higher education (Mountford-Zimdars et al., 2015) and
90 are particularly vulnerable to withdrawing from their undergraduate degree (Woodfield,
91 2014). Evidence shows that this situation is a result of inequitable frameworks and
92 racism that systematically disadvantages students from excluded ethnic backgrounds
93 (Leading Routes, 2019).

94

¹ This grouping is used here in line with Higher Education Statistics Agency reporting, but we recognize that it homogenises different identities and obscures experiences felt by one race or ethnicity

² In 2020-21, 70% of UK domiciled students undertaking full time undergraduate study were white, and 27% were Black, Asian or minority ethnic. 70% of those undertaking full time taught postgraduate study were white, and 25% were Black, Asian or minority ethnic. For postgraduate research, 77% of students were white and just 17% were Black, Asian or minority ethnic (Higher Education Statistics Authority, 2022).

³ In 2020-21, there was a difference of 17.4 percentage points between the proportion of white and black students getting a 1st or 2:1, with the 1st awarding gap growing in recent years (Office for Students, 2022).

⁴ In 2020-21, 77.4% of students at high tariff providers were white and 20.8% were Black, Asian or mixed ethnicity; 71.1% of students at low tariff providers were white and 26.6% were Black, Asian or mixed ethnicity. The disparity is greatest for Black students (4.4% in high tariff versus 11.5% in low tariff providers) (GOV.UK, 2022).

95 The lack of racial and ethnic diversity in GEES in the Global North is well-documented.
96 In the USA, the geosciences are “the least diverse of all STEM fields” and the number of
97 geoscience doctoral candidates from underrepresented minority groups has stagnated
98 for the past 40 years (Bernard & Cooperdock, 2018). In the UK, the picture is similar. Of
99 44 physical science topics categorised by the Higher Education Statistics Authority
100 (Higher Education Statistics Authority, 2022), GEES-related topics are amongst the very
101 lowest in terms of ethnic minority representation at undergraduate level⁵. The picture is
102 typically worse in PGR study. For example, from 2014-2019, on average, representation
103 of ethnic minority students was lower at PGR than UG for both Earth Science and
104 Physical Geography (Dowey et al., 2021). In 2020-21, ethnic minority representation in
105 Earth Science was 12% at UG compared to just 8.7% at PGR (Higher Education
106 Statistics Authority, 2022); well below government census data showing that 21.5% of
107 UK 18–24-year-olds identify as Black, Asian or minority ethnic (GOV.UK, 2021).

108

109 The under-representation of ethnic minorities in GEES permeates the highest levels of
110 academia and related professions. Across the United Kingdom, just 10.8% of
111 professors identify as Black, Asian and minority ethnic; but of the 2,390 staff working in
112 Earth, marine and environmental sciences in 2018/19, only 90 (3.9%) identify within
113 these groups. This is the second lowest figure of all science, engineering and
114 technology disciplines in the UK (Advance HE, 2019; Higher Education Statistics
115 Authority, 2019). The environment sector is one of the least ethnically diverse
116 professions in the UK (IES, 2024). In a 2017 UK Policy Exchange report, the environment
117 sector was ranked as the second least ethnically diverse, with 3.1% of environmental
118 professionals identifying as non-white British ethnicities versus 19.9% across all
119 occupations (Policy Exchange, 2017).

120

121 A variety of discipline-specific issues disproportionately impact Black, Asian and
122 minority ethnic students in GEES and have been summarised in previous studies (Dutt,
123 2020; Fernando & Antell, 2020; Marín-Spiotta et al., 2020; Dowey et al., 2021). They

⁵ CAH identifiers 26-01-01, -02, -04, -05 and -06: average 9.7% representation compared to overall average of 23% across all physical science subjects.

124 include the legacy of colonialism and resource exploitation, fieldwork accessibility,
125 discriminatory stereotypes and lack of visible role models, hostile environments, and
126 career perceptions. Such disadvantages are multidimensional, with ethnicity being just
127 one barrier; intersecting characteristics may act to increase the marginalisation felt by
128 any one student. For example, a more complex picture of disadvantage occurs when
129 ethnicity is considered alongside socioeconomic indicators of disadvantage (Office for
130 Students, n.d.). Anand et al. (2024) found that the career paths of UK geochemists
131 belonging to multiple disadvantaged groups are restricted, and that women from ethnic
132 groups are lacking representation in senior or leadership roles in academia.

133

134 The issues highlighted above matter, given that geoscience knowledge has an essential
135 role to play in equitable and sustainable development; it cannot, however, be applied
136 without equity among those studying and working in GEES subjects. The less diverse a
137 field is, the less welcoming it is to minority groups, and “the more prevalent implicit
138 biases become” (Dutt, 2020). To be able to address global problems and work with
139 people from all communities, the GEES community must acknowledge and tackle
140 subject-specific structural inequities that have long persisted (Dutt, 2021). Such reform
141 is needed in areas across the GEES academic pipeline (see Figure 1 and references
142 within Dowey et al., 2021), with work and recommendations to decolonise geoscience,
143 address racism, develop more inclusive curricula and environments, and improve
144 fieldwork accessibility gathering pace (e.g., Dutt, 2019, 2021; Anadu et al., 2020; Marín-
145 Spiotta et al., 2020; Núñez et al., 2020; Ali et al., 2021; Greene et al., 2021; Morris, 2021;
146 Lawrence & Dowey, 2022; Rogers et al., 2022, 2024; Geocontext, 2022; UK Research
147 and Innovation, 2022; Yorke et al., 2022; Acosta et al., 2023; Cisneros & Guhlincozzi,
148 2023; Fernando et al., 2023; Marín-Spiotta et al., 2023; Fox et al., 2024; Holliman et al.,
149 2024; Decolonising Earth Science, 2024; GAIA, 2024)

150

151 The Equator project targeted the transition from undergraduate study to postgraduate
152 research, with the aim of increasing participation and retention of Black, Asian and
153 minority ethnic PGR students in GEES subjects, ultimately leading to increased racial
154 and ethnic diversity in GEES research in the UK. This was done through the creation of a
155 doctoral recruitment working group to remove barriers to access (the findings of which

156 are reported in Fernando et al., 2023), and the delivery of two action research-based
157 interventions (a Research School and Mentoring Network) to improve access and
158 retention, the findings of which are presented in this paper.

159

160 **Access and participation**

161 Ethnic minority students are more likely to feel disconnected from research networks
162 and lack awareness of research opportunities and careers (Adwoa et al., 2022). This
163 disconnect is related to many structural and cultural factors, such as a lack of
164 exposure to active research in their field; ethnic minority students are less likely than
165 their white counterparts to attend research-intensive universities (GOV.UK, 2022), and
166 have less access to opportunities such as internships and workshops that build
167 confidence in their ability to undertake research (Adwoa et al., 2022).

168

169 Previous initiatives have demonstrated the power of bringing people from marginalised
170 ethnic backgrounds together to improve access and participation in research. In the
171 USA, work at Lamont-Doherty Earth Observatory demonstrated that creating
172 immersive, *paid* opportunities for ethnic minority students to engage in research
173 themes in a nurturing environment leads to increased engagement with STEM in higher
174 education (Dutt, 2019). In the UK, the National History Museum Explorers Programme
175 (Natural History Museum, 2022) has successfully provided ring-fenced⁶ events and
176 resources to support students from marginalised ethnicities to pursue research and
177 career pathways in Earth, environmental and ecological sciences. Targeted research
178 schools for ethnic minority students improve participants' awareness of career paths
179 and opportunities, as evidenced in other disciplines such as physics (Wade et al.,
180 2022). Work with other minoritised groups, such as the Access Anglesey project for
181 geology students with mental health, learning and/or mobility conditions, has proven
182 the value of residential, discipline-specific events to improve access and inclusion
183 (Houghton et al., 2020).

184

185 **Student experience and retention**

⁶activities targeted to a particular demographic group

186 Black, Asian and minority ethnic students studying GEES subjects in the UK are likely to
187 be isolated in their learning environments. They may be the only students of colour in
188 their department (Thomas et al., 2007; Dowey et al., 2021) and lack access to visible
189 role models (Universities UK and National Union of Students, 2019; Fernando & Antell,
190 2020). Ring-fenced workshops for UK geoscience undergraduates and recent graduates
191 from underrepresented groups found that these students may experience alienation
192 from peers and feel isolated (Adwoa et al., 2022).

193

194 Work undertaken by grassroots groups such as Black in Geoscience and Black
195 Geographers (Black Geographers, 2024) shows the benefits of building networks within
196 ethnic minority student communities. Research within the environment sector has
197 highlighted the importance of sense of belonging and networks for professionals (IES,
198 2022). Grassroots efforts to share experiences and improve sense of belonging in
199 academia such as the X (formerly Twitter) #BlackInTheIvory hashtag have highlighted
200 the bias and discrimination faced by students of colour, and demonstrate the
201 importance of connecting students and staff with shared lived experience to support,
202 encourage and share opportunities to those students who may feel isolated.

203

204 Mentorship has positive impacts on the sense of belonging and overall outcomes for
205 Black, Asian and minority ethnic students across academia (Thomas et al., 2007). As a
206 result, mentoring programmes have been developed by universities, professional
207 bodies and charities in recent years. Examples relevant to this work are the Cowrie
208 Scholarship Foundation programme (Cowrie Scholarship Foundation, n.d.), which links
209 Black students to mentors with shared lived experience, and the ASPIRE programme
210 (Sheffield Hallam University, 2023), a multi-institution (not discipline specific) effort
211 funded by the Office for Students to improve retention into PGR.

212

213 In UK geoscience, mentoring has been recognised as a vital part of improving the sense
214 of belonging for underrepresented GEES students (Adwoa et al., 2022). The Fi-Wi Road
215 internship programme, a collaboration between Black Geographers and the Royal
216 Geographical Society (with IBG) (Black Geographers, 2021), is an example of a

217 successful, discipline-specific mentorship scheme, in this case embedded into a paid
218 internship initiative.

219

220 The Equator project set out to build upon previous examples of best practice to develop
221 the first fully remunerated, discipline-specific research training and mentoring
222 programmes for Black, Asian and minority ethnic students in GEES subjects in the UK.

223

224 **Theory of Change and objectives**

225 The Equator project used a Theory of Change (ToC) framework. ToC has most often
226 been used in the development sector and is an outcomes-based approach using
227 critical thinking of how change happens in a given context (Vogel, 2012). A ToC provides
228 a ‘roadmap’ from intervention to outcome, whilst encouraging an on-going process of
229 reflection to explore how change happens.

230

231 The Equator Theory of Change (Figure 2) identified targeted interventions at crucial
232 career stages that will quantifiably increase recruitment and retention of GEES
233 researchers from marginalised ethnic backgrounds. The ToC represents the outcomes
234 of many conversations, and involved co-creation, knowledge sharing, reflection and
235 feedback together with minority ethnic students, postgraduate researchers and staff
236 with lived experience of the challenges being tackled. The ToC was further shaped by an
237 EDI consultant and an international development expert to understand the behavioural
238 changes needed to achieve the project goal, and the interventions needed to drive
239 these changes. Assumptions, risks and mitigations were considered (see
240 Supplementary Data). Equator considered both medium-term (discussed in Fernando
241 et al. 2023) and shorter-term interventions (the focus of this work), and the ToC places
242 these within a broader context; the interventions described within this paper are just
243 one part of the structural changes needed within GEES disciplines.

244

245 The Research School aimed to increase participation and retention of Black, Asian and
246 minority ethnic students in PGR and beyond. This overall goal was broken down into a
247 series of desired changes, linked to four research objectives (RO): (RO1) facilitate
248 networking and create a broader network of community for the participants; (RO2)

249 improve awareness and perceptions of the broad spectrum of GEES research careers;
250 (RO3) increase sense of belonging in the GEES academic environment; and (RO4)
251 improve confidence in moving forward into GEES research.

252

253 The overall goal of the Mentoring Network was to increase retention of Black, Asian and
254 minority ethnic students in GEES study and improve student experience. The four
255 mentoring objectives (MO) were to: (MO1) facilitate networking; (MO2) improve sense of
256 belonging and inclusion for Black, Asian and minority ethnic students in GEES; (MO3)
257 build a body of experienced mentors to support future students within GEES; and (MO4)
258 improve confidence in moving forward into GEES research.

259

260 **METHODS**

261 Equator was novel in that it was student-led and collaborative, and applied best-
262 practice from social science qualitative action research to make GEES disciplines more
263 equitable.

264

265 **Co-creation and oversight**

266 The discipline-specific approach of Equator was informed by the voices of Black, Asian
267 and minority ethnic students and professionals within GEES. The Equator Project Team
268 (comprising four Academic Investigators [ND, SG, CJ and RW] and three employed
269 Post-Doctoral Research Associates [BF, AL, MR]) and Steering Committee have worked
270 together since summer 2020, co-authoring EDI-focused research and co-designing
271 interventions that respond to identified needs. The Equator Steering Committee, which
272 provided oversight of project activities, includes students/alumni with lived
273 experiences of the challenges being tackled, and representatives of some of the
274 grassroots organisations actively engaged in EDI in geosciences (Black Geographers,
275 Black in Geoscience and Diversity in Geoscience UK). The Project Team and Steering
276 Committee include allies in senior research roles, removing some of the burden on
277 minoritised individuals in the group, whilst also ensuring a balance of different levels of
278 experience.

279

280 Equator involved collaborative partners across different Higher Education institutions,
281 professional bodies (Geological Society of London, Royal Geographical Society with
282 IBG and Institution of Environmental Sciences), public institutions (British Geological
283 Survey), doctoral training organisations (NERC Panorama, EPSRC-NERC Aura, NERC
284 ARIES, NERC CENTA, and NERC-UK Space Agency SENSE doctoral training
285 organisations), grassroots organisations, and industry. Partners committed time and
286 resources to ensure the success and sustainability of the project outcomes.

287

288 **Ethics and code of conduct**

289 This project included evaluation of experiences of students and professional
290 geoscientists and received ethical approval at Sheffield Hallam University
291 (ER39312553). All findings are presented here in an anonymised, unidentifiable format,
292 and data are available open access through Sheffield Hallam's data repository (see
293 Supplementary Data).

294

295 All Research School and Mentoring Network participants were provided with a
296 participation information sheet and consent form for project monitoring and evaluation.
297 It was made clear to participants that they could withdraw from participation at any
298 time, that participation in monitoring and evaluation was not required to partake in
299 activities, and that responses would be anonymous. It was also made clear that if for
300 any reason a mentee was unhappy within their mentor pairing, that this could be
301 reported to the project team and an alternative pairing would be found.

302

303 A Code of Conduct was developed for Research School participants, informed by
304 examples such as those created for Geological Society of London conferences (The
305 Geological Society of London, n.d.) and the Natural History Museum Explorers
306 Conference (Natural History Museum, n.d.).

307

308 Before the Mentoring Network started, kick-off meetings were provided, one for the 10
309 mentees and one for the 20 mentors. These sessions introduced mentoring and what to
310 expect. In these sessions, a Mentoring Agreement, a document that included a code of

311 conduct for the mentoring process, was introduced to participants. This was signed
312 and returned by each mentor pairing.

313

314 **Intervention format and design**

315 *Research school programme*

316 The five-day Research School was delivered at Sheffield Hallam University in the UK in
317 April 2022. It was designed to create a fully-funded, discipline-specific experience for
318 both undergraduate and postgraduate students from ethnic minority backgrounds in
319 GEES research. The Research School addressed the project objectives by:

- 320 - creating networking sessions that facilitated social interactions, and by
321 providing talks by mentors and role models (RO1, RO3). The decision was taken
322 to have the school in-person to facilitate these important social interactions.
- 323 - providing talks and workshops that explain what a PhD is, and that highlight
324 research career pathways inside and outside of academia (RO2)
- 325 - providing training sessions on grant-writing, article-writing, geoscience
326 communication, public-profile building, application and interview skills, and a
327 conference day to put presentation training into practice (RO4)

328

329 The programme was divided into two streams: (1) PhD students/postdoctoral and (2)
330 Masters and Undergraduate students. The PhD stream was supported by additional
331 sponsorship from the British Geological Survey (BGS). Three of the five days involved
332 sessions including both streams, with two days of split activities targeted at the
333 different levels. The opportunity for daily interactions between the streams, the external
334 speakers and the Equator Project Team was included. This provided the participants
335 with exposure to a variety of role models of diverse backgrounds in GEES, who
336 themselves were at various stages in their careers.

337

338 The Master's/Undergraduate streams of participants attended Research awareness
339 workshops including 'how to thrive in your PhD and research career', 'preparing for
340 academic career', 'a whistlestop tour of applying for a PhD', 'creating a PhD
341 application', 'research presentation skills' and 'PhD interviews'. For the PhD stream,
342 the workshops on 'grant and fellowship writing fundamentals' and 'preparing for an

343 academic career' provided guidance on academic careers and introduced the
344 participants to the funding landscape, fellowship funding opportunities, and generating
345 fundable research ideas.

346

347 Workshop sessions were organised so that each built on knowledge from the previous
348 session, and included a mix of skills-based, application-based and discussion sessions
349 (see programme in Supplementary Data). In addition, interactive exercises and hands-
350 on activities promoting critical thinking and inquiry-based learning were incorporated
351 into each session. On the last day, each participant presented a five-minute oral
352 presentation as part of a half-day mini-conference, focusing on their planned, ongoing
353 or previous research. The mini-conference also included highlight talks by a professor
354 of geoscience and a recent geography graduate working with the Royal Geographical
355 Society.

356

357 *Research school design*

358 Consultation and brainstorming sessions with recent and current Black, Asian and
359 minority ethnic students, and postdoctoral researchers from the Equator team and
360 Steering Committee, were critical to the successful planning and delivery of the
361 programme and activities of the Research School. Insights gained from these
362 conversations included creating safe spaces for frank and open conversations,
363 community engagement and skill development, and minimising all costs to
364 participants.

365

366 The Research School unavoidably fell over Ramadan due to the timing of the funding
367 and university term schedules. This was considered carefully, with provisions put in
368 place and advertised in advance for applicants. These included Halal food options, the
369 availability of prayer rooms, and scheduling the day around Ramadan prayer times.

370

371 The selection of speakers and trainers for the school was based on the goal of having
372 diverse attendees and role models willing to share their lived experience and connect
373 with the participants. Speakers and trainers were paid an agreed fee for time spent
374 preparing and delivering the sessions, as well as their travel and accommodation

375 expenses (apart from Dr Melissa Plail, whose time was gifted by Nature
376 Communications). The four Academic Investigators and three employed Post-Doctoral
377 Research Associates helped facilitate and deliver sessions, and a postgraduate student
378 member of the Equator Steering Committee was also paid a fee for presenting and
379 mentoring during the Research School.

380

381 *Mentoring network*

382 The Equator Mentoring Network was fully-funded and ring-fenced for mentees who
383 identify as Black, Asian and minority ethnic, and were studying for or a graduate of a
384 GEES-related subject. The network ran for four months (Jan to May 2022) and involved a
385 total of six mentoring sessions for each mentee. The decision whether to continue the
386 mentoring connection beyond the life of the project was left to each mentor-mentee
387 pairing. The mentoring was designed to meet project objectives by:

- 388 - pairing each mentee with both an academic and a non-academic mentor, to
389 provide insights from different sectors and to broaden the network of the mentee
390 (MO1, MO4)
- 391 - using mentors with shared and/or relevant lived experience who work in the
392 GEES sector (MO2)
- 393 - bringing together a group of mentors who may not have been involved in such
394 schemes before, and providing support to them throughout the process (MO3)

395

396 Pairing was conducted by the Equator project team. Participants were asked to provide
397 a brief explanation of why they wished to be involved in the network, as well as brief
398 details of their subject of study (mentee) and job role (mentor). This information was
399 used to link mentees with one academic and one non-academic mentor.

400

401 Mentoring can take different forms, for example in nature of support (e.g., moderate
402 versus unconditional) and in style (e.g., motivational versus informative) (see
403 Leidenfrost et al., 2011 and references therein). The nature of the Equator Mentoring
404 Network sessions was purposefully left unstructured, to allow each pairing to develop a
405 style of mentoring that worked best for them. However, guidance on possible topics for
406 discussion, and ideas for the first session, was provided in the kick-off sessions.

407

408 **Participant recruitment and remuneration**

409 Recruitment for the Mentoring Network and Research School was via advertising on the
410 Equator project website, across social media platforms, through higher education
411 institution contacts, and via professional body mailing lists. Demographic networks
412 such as Black in Geoscience and Black Geographers played a crucial role in reposting
413 and advertising to target communities. Recruitment materials highlighted the
414 discipline-specific nature of the schemes, explicitly stated the time contribution
415 involved in taking part, and stated eligibility requirements (e.g., for Research School
416 participants and mentees, being over 18 years old, a British citizen and identifying as
417 Black, Asian or minority ethnic in Geography, Earth and Environmental Sciences). As
418 the Equator project focused on the outcomes of UK-domiciled students (as monitored
419 by the Higher Education Statistics Authority), the interventions were not open to
420 international (i.e., non-domiciled) students.

421

422 Participant selection for the Mentoring Network took place via email communication,
423 and was conducted on a first-come, first-served basis, subject to eligibility criteria, with
424 a maximum capacity of 10 mentees and 20 mentors due to project funding. 10
425 additional eligible mentor applicants and 18 additional eligible mentee applicants were
426 added to a reserve list in case mentors or mentees withdrew from the scheme.

427

428 The Research School received 53 applications from 20 participants at universities
429 nationwide. After an eligibility check, (which ruled out international applicants), 38
430 applicants were entered into a lottery. Selection was carried out using a random
431 number generator.

432

433 Participants in both the Mentoring Network and Research School were compensated
434 for both their time and expenses to remove financial barriers to access (which can
435 include socioeconomic background, caring responsibilities, and the cost of missed
436 employment). Research School participants received a £250 stipend and were able to
437 claim travel expenses of up to £220 and subsistence of up to £25.60/day for the
438 duration of the five-day Research School, in addition to lunch and accommodation

439 being provided. Each mentee received a £150 stipend for taking part in six mentoring
440 sessions. Mentors were offered £75 for the three mentoring sessions, although some
441 declined the payment.

442

443 **Evaluation and Monitoring**

444 To evaluate the effectiveness of the two interventions against the Equator Project
445 Theory of Change and their goals, a variety of evaluation and monitoring techniques
446 were used.

447

448 *Online surveys*

449 Online Qualtrics surveys were chosen as the principal method of evaluation for the
450 Research School and Mentoring Network. All surveys were anonymous and the results
451 are presented here in a way that does not identify participants. Demographic data was
452 collected using questions in the format of the UK Government Census.

453

454 The surveys, which included both Likert-style and free-text questions, were designed to
455 directly address the objectives identified by the ToC. Questions explored themes
456 including sense of belonging, attitudes toward GEES research, barriers to access, and
457 desire to participate in/continue with postgraduate research. Questions also
458 requested feedback to inform future iterations of interventions (see Supplementary
459 Data for copies of all questionnaires).

460

461 Where possible, questions were posed in a format allowing for quantitative analysis, to
462 allow for rapid comparison between “before” and “after” data. Many questions also
463 gave an option for free text responses, to obtain additional qualitative (i.e., experiential)
464 data. These responses were evaluated to identify any key themes arising in the surveys
465 and some are included verbatim below to highlight these themes.

466

467 The benefits of an online survey approach include convenience of design, low cost of
468 implementation, anonymity, ease of distribution via email, and speed to complete for
469 participants (Evans & Mathur, 2018). However, this approach did create limitations; we
470 could not directly track pre-, mid- and post-intervention surveys due to anonymity;

471 therefore, comparisons are made at an aggregated (i.e., cohort) level. This could be
472 improved in future by asking participants to generate an anonymous code that is
473 included across responses. The surveys, although containing options for free text
474 responses, could have been seen as impersonal, and were potentially limiting for
475 capturing rich dialogue from participants. In future, if more time and resource were
476 available, a mixed-method approach, including selected interview or focus groups,
477 could mitigate some of these limitations; either by using focus groups to co-create
478 survey design with participants (as in Gallott & Graham, 2016, for example) or in
479 combination during evaluation to provide a richer dataset (Savin-Baden & Howell Major,
480 2013) (see Longevity and Future below).

481

482 *Research school*

483 The 30 Research School participants were invited to complete two anonymous surveys
484 conducted using Qualtrics software in April 2022, pre-and post- Research School (see
485 Supplementary Data). Of these participants, 28 completed the survey before attending,
486 and 27 completed the post-school survey (response rates of 93% and 90%,
487 respectively). Nine participants attended the PhD Stream of the Research School, and
488 post-Research School survey responses were received from seven (response rate of
489 78%). 21 participants attended the Masters/undergraduate stream, and 20 responses
490 were received to the post-Research School survey (response rate of 95%).

491

492 Informal methods for feedback were also encouraged: an anonymous online Padlet
493 was set up to allow participants to quickly add contributions during the school, and a
494 Post-It wall allowed participants to rapidly capture and feed-back ideas and
495 recommendations to the Project Team (Figure 3). Direct feedback to the Project Team
496 during the event was also encouraged, with a Twitter Hashtag
497 (#EquatorResearchSchool) allowing participants to their share experiences on social
498 media.

499

500 The Equator Academic Investigators were present at the Research School and delivered
501 some workshops. The Equator Post-Doctoral Research Associates were also present
502 and gave presentations and participated in workshops. The Project Team used

503 participatory science methods, including developing relationships with community
504 members to construct knowledge (Bourke, 2014). The team's observations and
505 reflections of the school form part of the event evaluation. Positionality is critical to
506 insider/outsider research (Rose, 1997). Evaluation of the event was conducted by the
507 same team that designed and delivered the event, which has the potential to introduce
508 bias: the use of participatory methods may create a potential disconnect between how
509 we have perceived the participants' experiences and the experiences actually felt by
510 the participants. This is mitigated by also using anonymous survey data to evaluate the
511 effectiveness of the intervention.

512

513 *Mentoring network*

514 The Mentoring Network was evaluated by inviting each participant to take part in three
515 anonymous Qualtrics surveys (see Supplementary Data), conducted between January
516 and May 2022. The surveys took place at the start, middle and end of the project, with
517 different versions for mentees and mentors. Analysis of the surveys was used to
518 measure attitudes towards mentoring at different stages in the project from different
519 perspectives.

520

521 Participants were able to contact the project team at any time to discuss thoughts on
522 the process. In addition, two mid-project group meetings (one for mentees, one for
523 mentors) were facilitated online. This allowed the Project Team to monitor the progress
524 of the project, and to support participants, who could share their experiences and voice
525 any concerns. These were productive sessions, particularly for the mentors, allowing
526 those in attendance to share ideas and communicate what methods were working best
527 for their pairing.

528

529 Of the 10 mentees and 20 mentors, 10 mentees and 19 mentors completed the survey
530 before taking part in the Mentoring Network (100% and 95% response rates,
531 respectively). 10 mentees and 20 mentors completed the survey administered at the
532 midway point of the scheme (100% response rates). Eight mentees and 12 mentors
533 completed the post-mentoring survey (80% and 60% response rates, respectively). It is
534 unclear why the reduction in survey completion amongst mentors occurred at the final

535 survey. Non-response is a recognised issue in web surveys (Manfreda et al., 2008); it
536 may be that email reminders were missed due to the timing of the survey at the end of
537 the academic term. It may reflect that participants were happy with the process and did
538 not feel the need to comment; conversely, however, it may reflect that some
539 participants became disengaged or were unhappy with the network. The overall
540 positivity of the recorded responses (see below) suggests that the latter is less likely.
541 The high participation in the first two surveys, and the reduction in response rate in the
542 third survey, may indicate that ‘over-surveying’ impacted willingness to participate
543 (Manfreda et al., 2008); this is something to consider for future interventions.

544

545 **WHO TOOK PART?**

546 **Research School**

547 Most Research School respondents were aged 18-24 and all were younger than 54.
548 Participants were from a range of ethnicities and religions, with multiple gender
549 identities represented (see Figure 4)⁷. Most respondents (62%) identified as
550 heterosexual, with 28% selecting other sexual identities. 18% of respondents identified
551 as having a disability or long-term health condition. 39% of respondents were the first
552 generation in their family to attend higher education. Ten of the respondents felt their
553 degree/research aligned to Earth Science, 10 to Geography, and 8 to Environmental
554 Science/Studies.

555

556 **Mentoring Network**

557 Mentees ranged in age from 18 to 44, with most falling in the 18-24 category. The
558 mentees came from a range of ethnicities and religions, with multiple gender identities
559 and sexualities represented (see Figure 5). No mentees identified as having a disability
560 or long-term health condition. The mentees were predominantly students, with 3
561 undertaking their first degree, 1 studying another undergraduate degree or equivalent, 1
562 pursuing a taught Master’s degree, 3 undertaking doctorate research, and 1 involved in
563 other PGR. 1 participant was temporarily on a break from work or study. 4 were aligned
564 to Earth Sciences, 2 to Geography, and 4 to Environmental Sciences/ Studies (Figure 6).

⁷ Survey sex/gender questions were guided by UK Government 2021 Census questions, with additional tick box options for more inclusive self-identification

565

566 The mentors ranged in age from 18-54, with approximately two-thirds identifying as
567 female and a third as male. 95% of mentors identified as belonging to an ethnic
568 minority, with respondents belonging to a range of ethnic and religious backgrounds
569 (Figure 7). Most mentors (70%) identified as heterosexual, with 30% selecting other
570 sexual identities. Most mentors identified as having no known disability or long-term
571 health condition. Mentors described a range of titles/employment roles, with 10 aligned
572 to Earth Sciences, five to Geography, and five to Environmental Sciences/ Studies.

573

574 **RESEARCH SCHOOL EVALUATION**

575 The Research School is here evaluated against ToC project objectives.

576

577 **Attitudes towards the Research School**

578 Before attending the Research School, participants were asked to rate the Research
579 School programme based on how important each workshop would be to them. 80%
580 rated the 'conference and networking' event as extremely important, 70% rated
581 'geoscience communication and building a public profile' as extremely important, and
582 50% rated 'journal writing' as very important. 45% rated 'PhD funding' as extremely
583 important. One participant elaborated on the importance of conferences and
584 networking;

585

586 *“Conference and networking is the most important for someone like me, who doesn't*
587 *know anyone at all in this field or even related STEM fields”*

588

589 Another participant responded that meeting people with more experience for guidance
590 is vital:

591

592 *“Meeting others gives others guidance and experience, ensuring the right academic and*
593 *career choices are made with knowledge and this is quite a big deal and is an obstacle*
594 *in career and academic progression”*

595

596 Participants were asked what they would like to gain from the Research School in the
597 pre-survey. Most of the responses were networking, gaining skills in science
598 communication, grant writing and career guidance.

599

600 For comparison, in the post-survey, participants were asked to rank the Research
601 School program in order of importance (with 1 being most important/useful) to gauge
602 the differences in their responses after attending these workshops. Of the seven PhD
603 participant respondents, three listed 'networking during icebreaker, lunches and break
604 times' as the most important to them, and two listed 'grant writing' as most important.
605 The 'research conference day' and 'preparing for an academic career sessions' were
606 each ranked top by one respondent.

607

608 *"The grant writing and fellowship information was priceless and by far the most*
609 *valuable- from small grants to fellowship applications and the processes involved,*
610 *criteria, common pitfalls etc. Everything had a benefit, but for me - the tips around how*
611 *best to pursue a career in academia and the associated talks- publishing etc were the*
612 *most beneficial."*

613

614 The results from the Master/undergraduate students stream showed that 'networking
615 during icebreaker, lunches and break times' was ranked top by most respondents
616 (50%). 'How to thrive in your PhD and research career' (talks from recent PhD
617 graduates), 'science communication' and the 'research conference day' were each
618 ranked top by 15% of respondents. 'The value of a PhD; transferable research skills'
619 session was ranked top by 5% and second favourite by 20% of respondents. The spread
620 of favourite workshops suggests that the balance of the programme was right and that
621 there was something valuable in each workshop for most participants.

622

623 The participants were asked if there was any training they would have found useful that
624 was not covered. The most common suggestion was a workshop on career and job
625 applications outside of research.

626

627 Having considered overall attitudes towards the Research School, we now explore
628 whether the school met the objectives of the Equator project.

629

630 **RO1: Facilitation of broader networks**

631 One of the goals of the Research School was to facilitate a broader community network
632 and create a safe networking space for participants. In the pre-survey, when asked
633 what barriers were holding back the participants from a research career, participants
634 mentioned lack of guidance/support network, lack of minority ethnic role models, lack
635 of representation in GEES, lack of finance, and knowledge of the sectors, skill
636 development and uncertainties in career paths.

637

638 *“A barrier holding me back from this career path at present is my lack of knowledge of*
639 *the paths I can take as well as uncertainty regarding future prospects”*

640

641 *“The lack of representation of people who look like me in research”*

642

643 The Equator team observed that participants quickly became a close-knit cohort, in
644 part facilitated by the icebreaker, but predominantly (and spontaneously) during
645 registration. After each day, the participants met for dinner and walks in the countryside
646 (prompted initially by one of the Equator Project Team) and started LinkedIn and
647 WhatsApp groups. The Equator team felt there was a very positive atmosphere
648 throughout. One participant reported:

649

650 *“We are all keeping in touch on WhatsApp and have created a LinkedIn group, so I am*
651 *confident that the network will be useful in future. If this were to take place again, I*
652 *would strongly recommend it to many of my contacts who missed out on a place this*
653 *time”*

654

655 Participants stressed the importance of networking with people from similar ethnic
656 backgrounds, degrees, and research areas at the Research School.

657

658 *“I found the research school very useful and gained so much exposure to people in the*
659 *industry with similar background and experience, this is a very important thing and will*
660 *definitely be helpful/ useful for me in the future and I am sure future participants will*
661 *feel the same way too”.*

662

663 Overall, 85% of the participants felt the goal of having a broader network in GEES was
664 accomplished, while 11% somewhat agreed.

665

666 **RO2: Improved awareness and perceptions of GEES research careers**

667 In the pre-survey, when asked if the participants planned on applying for a PGR degree
668 following the completion of their undergraduate program, 21% of the participants said
669 yes, 64% were unsure, and 14% said no. However, when asked a similar question in the
670 post-survey, 55% of the participants answered yes, 40% were unsure, and 5% said no
671 (Figure 8).

672

673 In the post-survey, the PhD stream were asked if they plan to apply for postdoctoral
674 research positions and fellowships; 42% answered yes, and 57% were unsure. One
675 participant said:

676

677 *“I feel much more equipped to apply for research positions and fellowships”*

678

679 One participant described how the school had equipped them with the knowledge of
680 available funding for PhDs and commented on the network it had provided;

681

682 *“Financial burden of a self-funded PhD programme discouraged me to start that page.*

683 *Joined the Equator Research School, I knew what funds could be applied. Also, my*

684 *network in GEES research became broader after meeting school mates from various*

685

institutions and different level of studying”

686

687 Overall, most participants indicated they benefited from these workshops, with 92% of
688 the participants agreeing they had improved awareness of GEES research careers.

689

690 80% of participants strongly agreed that they have a more positive opinion of careers in
691 GEES research following participation in the Research School. When asked if the
692 Research School affected their thoughts on a career in environmental research, 90%
693 said that 'I now feel MORE keen to pursue/continue a career in research' (Figure 9). One
694 of the participants said, "This opened my eyes to PhD". Another participant said:

695

696 *"The School was a great experience for me to learn a bit more about the challenges that*
697 *ethnic minorities like me have to deal with in GEES subjects and to learn new insight on*
698 *how to overcome these. It definitely has increased my interest in environmental*
699 *research/PhD"*

700

701 **Enhanced confidence in academic skills**

702 The Equator team noticed increased confidence in the undergraduate students
703 throughout the week, noted in the following qualitative observations. At the start of the
704 week, some of the undergraduates reported in conversations to the team that they felt
705 nervous, particularly about participating in group work and giving oral presentations on
706 the last day. However, they became more vocal during the 'introduction to science
707 communication' workshop as they were encouraged to work with each other. They were
708 visibly excited to learn and seemed to become more comfortable when working in
709 groups with other participants. During the week, they attended a workshop on
710 'presentation skills', and played word games together. The Equator team noticed the
711 boost in their confidence when they applied their new skills in the mini-conference on
712 the last day of the Research School, with each participant giving a five-minute
713 presentation on a chosen topic of research interest.

714

715 *"Before this research school, I didn't have any confidence that I can have a career in*
716 *GEES or do a PhD, mainly because I am from a minority group and never in my university*
717 *career met someone doing a PhD or research who was just like me. This research*
718 *school gave me so much confidence that I am worth it and that I can have a career in*
719 *GEES research"*

720

721 After the Research School, when asked if they feel more confident about the possibility
722 of a career in GEES, 81.5% of participants strongly agreed, and 11% somewhat agreed,
723 with one respondent exclaiming, “I just feel a lot more confident and supported!”
724 Another participant said they feel even more confident now at the possibility of a
725 research career in GEES;

726

727 *“Yes, 100%, this school helped me get my confidence and my motivation/ ambition*
728 *back to pursue a career in research. Can't thank enough to Equator team and other*
729 *participants”*

730

731 **RO3: Increased sense of belonging**

732 In the pre-survey, participants were asked about the barriers they felt might be holding
733 them back from a research career. Some of the barriers mentioned were the lack of
734 representation and not feeling a sense of belonging in GEES. In the post-survey, 78% of
735 the participants strongly agreed to having an increased sense of belonging in GEES
736 research and 19% somewhat agreed (Figure 10).

737

738 *“I feel a sense of belonging as I have a network of people in the field”*

739

740 Participants were exposed to potential role models from Black, Asian and minority
741 ethnic backgrounds in GEES during the Research School. The team also facilitated a
742 positive environment for interactions between the project team and participants, and
743 incorporated a range of measures to build a collaborative and inclusive environment
744 that contributed to an increased sense of belonging for the participants, e.g., social
745 elements (group lunch/dinners and countryside walks). The participants also created a
746 peer community and developed friendships outside the Research School. A participant
747 said:

748

749 *“it did not feel like a school even though it was run like one. the sessions were fun, very*
750 *informative and inclusive and lunchtimes especially everyone including the speakers*
751 *were mingling which made them very normal and approachable”.*

752

753 This quote reflects the fact that the Research School involved elements of co-
754 production, with knowledge sharing and a two-way learning experience between the
755 Equator project team, speakers and participants.

756

757 Participants engaged openly and positively with their fellow participants and the
758 Equator team. The fact that the workshops, group work and presentations were not
759 credit-bearing, and solely designed to benefit the participants, may have contributed to
760 this positive atmosphere. The majority had not taken part in similar initiatives
761 previously; when asked if they had participated in ring-fenced initiatives before, only
762 10% said yes. One participant stated that they had attended a ring-fenced "application
763 procedure for my CDT" and another had attended the "Natural History Museum
764 Explorer's Project Inaugural conference".

765

766 When asked if they would attend future events related to the Equator project, 100% of
767 the respondents said yes. Furthermore, 82% strongly agreed that the Research School
768 was useful for them and 89% strongly agreed that they enjoyed the Research School
769 and that it was well organised.

770

771 **RO4: Improved confidence in moving forward within GEES research**

772 Doctoral students in the PhD participant stream learned new skills during the Research
773 School workshops that they could apply to their current studies and when progressing
774 in their research careers. These skills were gained in workshops including grant and
775 fellowship writing, journal publishing, open science, and 'preparing for an academic
776 career'. One of the participants said:

777

778 *"I feel like there were some aspects of a research career that were highlighted to me*
779 *during the research school which really made me think research was the right career for*
780 *me"*

781

782 The results from the pre- and post-school surveys, together with informal feedback
783 provided in discussions during the school and via participant use of social media during
784 the week (see #EquatorResearchSchool hashtag on Twitter/X), clearly demonstrate a

785 positive attitude change toward GEES PGR and research careers for the Research
786 School participants.

787

788 **MENTORING NETWORK EVALUATION**

789 In this section, the Mentoring Network is evaluated against the ToC project objectives.

790

791 **Attitudes towards the Mentoring Network**

792 The pre-Mentoring survey sought to understand what participants wanted to get out of
793 participating in Equator.

794

795 Mentees were asked to rank a series of possible mentoring outcomes in order of
796 importance to them. The most important outcomes to the mentees were setting and
797 meeting goals/aims, and gaining resources and advice. These were followed by
798 developing a mentoring relationship; confidence-building, and good mentee-mentor
799 communication. Help with achieving a good work-life balance was ranked as the least
800 important outcome. Eight of the ten mentees expanded on the outcomes of mentoring
801 that were most important to them through free-text comments. Comments included
802 themes of careers advice, peer-support, networking opportunities, and personal
803 development:

804

805 *"To hear about the experiences and potential struggles BAME colleagues have faced*
806 *within GEES in the workplace and in academia."*

807

808 Prior to starting the Equator mentoring scheme, most of the mentors felt experienced in
809 a range of mentoring skills, including active listening, giving constructive feedback,
810 identifying and accommodating different communication styles, motivating a mentee,
811 building a mentee's confidence, encouraging a mentee to ask questions, and working
812 effectively with a mentee whose identity was different to their own. However, some
813 mentors (10-20%) felt 'not at all experienced' in certain skills, including setting clear
814 expectations of the mentoring relationship, working with a mentee to set goals, helping
815 a mentee to develop strategies to meet their goals, and helping a mentee to achieve a
816 good work-life balance.

817

818 When asked what they would most like to gain from the Equator Mentoring Network, the
819 *mentors* were unanimous in their desire to offer help and support to their mentees:

820

821 *“My main motivation for taking part in this programme is to help others who may face*
822 *similar challenges to myself, pursue a career in geosciences. When I was a student,*
823 *there was no such mentoring scheme.”*

824

825 *“To help someone in a way I wish I'd been helped earlier in my career.”*

826

827 Mentors were also hopeful that participation in the Mentoring Network would
828 contribute to their professional and personal development:

829

830 *“More personally, I would like to try and overcome some of the imposter syndrome I*
831 *have when operating in academic spaces and gaining more confidence that I do have*
832 *valid and relevant experience and knowledge of my field.”*

833

834 Mid- and post-mentoring surveys indicate that, overall, mentor pairing worked well.

835 90% of the mentees rated how well-matched they felt with their academic and industry

836 mentors as 7 or higher on a scale of 1 to 10, with 10 being most positive. All mentees

837 felt comfortable talking with their mentors, which suggests that the pairings made were

838 compatible and is an important consideration in building support networks within

839 academic GEES.

840

841 Mentees' free-text comments from the mid- and post-mentoring surveys suggest that

842 being assigned both an academic and industry mentor, a defining element of the

843 Equator Mentoring Network, was beneficial:

844

845 *“The most beneficial aspect of the scheme is being able to be matched with someone*
846 *where you want to be, and gain insight into how to get there. It is difficult to connect to*
847 *industry professionals on one's own, but through the scheme I have formed a great*

848 *mentor-mentee relationship with someone who I greatly get along with, yet I may not*
849 *have met nor had the chance to connect with without the scheme.”*

850

851 A mentoring onboarding/support session was provided at the start of the project for
852 both mentees and mentors, and an approach was taken to encourage each pairing to
853 develop a style of mentoring that worked for them. Mentors were positive about the
854 network:

855

856 *“Equator is very well organised. I enjoy that due to the organisation, it didn't take much*
857 *of my time. Whereas when I do mentoring as part of my job and volunteer work, it takes*
858 *tremendously more time to do it in a free-style way. I am planning to build a similar*
859 *mentoring scheme focusing on my subject, thanks to the great example Equator had*
860 *set. The matching between me and my mentee is brilliant. We will carry on doing it”*

861

862 However, several mentors commented that additional guidance from the Equator
863 project team or a mentoring “toolkit” would have been useful in helping to structure the
864 initial mentoring sessions.

865

866 The mentees and mentors who completed the post-mentoring survey all indicated that
867 not only would they take part in the scheme again should it run in the future, but also
868 that they would highly recommend it to their peers. 100% of the 12 mentors who
869 responded said that being part of Equator has made them more likely to be involved in
870 ring-fenced mentoring in the future. Of the mentees who responded, all responded
871 positively (rating of 7/10 or higher) when asked to rate their overall experience.

872

873 Mentees and mentors were asked what improvements they would like to see should the
874 project, or similar schemes, run again in the future. Although overall, pairings seemed
875 to be successful, some of the free-text mentee responses mentioned mentor selection.
876 In future, in projects with more time allocation, more time could be taken at this stage
877 and more information gathered about participants to help with pairing. Some mentors
878 felt that greater assistance from the Equator project team with setting up the first
879 mentoring sessions would have been helpful. Some suggestions for improvements

880 focussed on increased opportunities for interactions between participants. The Equator
881 project was constrained by project time and budget, but future schemes should aim to
882 provide (and fund) more opportunities for mentoring networks to come together in
883 person.

884

885 Having considered the overall effectiveness of the format and logistics of the Mentoring
886 Network, we now focus on whether this intervention met the Equator project objectives.

887

888 **MO1: Facilitation of networking**

889 The Equator Mentoring scheme aimed to help mentees to feel more connected to
890 networks within the study via their mentoring contacts. All mentees who responded
891 agreed that they now feel connected into broader networks in GEES, which may be of
892 help in developing their career (Figure 11). One mentor commented that being part of
893 the network was also good for them and the other mentors:

894

895 *“Meeting with the other mentors in the scheme has been great, hearing their opinions
896 and perspectives on why they are doing this and what they are gaining from it.”*

897

898 **MO2: Improved sense of belonging and inclusion**

899 All 8 mentees who completed the post-mentoring survey agreed that they had a greater
900 sense of belonging within their field of study after being mentored (Figure 11). One
901 mentee explained that this was due to understanding that there are “people like me” on
902 this same journey:

903

904 *“I learnt that there are people like me who have been on the same journey as me, and it
905 was just so reassuring to know that they’re willing to help was great too.”*

906

907 The mentors also felt benefits to their sense of belonging by being involved in the
908 Equator community:

909

910 *“Feeling part of a community of motivated and similarly interested people, of making a*
911 *difference and being able to help someone like myself but back in an earlier time when I*
912 *would have loved such support.”*

913

914 In the post-mentoring survey, all respondents agreed that they now felt more able to
915 discuss concerns (Figure 11). Seven out of 8 respondents felt more comfortable
916 discussing their experiences within GEES. One mentee commented on the importance
917 of shared intersectional characteristics with their mentor:

918

919 *“I gained a fantastic relationship with my industry mentor, as she has provided a lot of*
920 *great motivation, guidance, and support, almost being close to a mother or elder sister*
921 *in a way. I am very grateful for this opportunity to have met her as I would not have had*
922 *the chance without the EQUATOR network. Especially both being WOC [Women of*
923 *Colour] I feel that she understands deeply a lot of things that not many people in my*
924 *current environment do.”*

925

926 **MO3: Build experienced mentors**

927 Many of the mentors that took part in Equator had previous experience of mentoring
928 and felt confident in their skills before taking part. It is therefore positive to see that
929 even so, of the mentors who responded to the post-mentoring survey, many felt they
930 had gained useful experience during the Equator project (Figure 12). The area where
931 skills development was most strong was in helping mentees to develop strategies to
932 meet their goals.

933

934 Mentors commented on how the scheme had contributed to their own continued
935 professional development, and to their confidence levels:

936

937 *“Working with my mentee also allowed me to feel confident. When I was able to*
938 *provide advice and strategies for my mentee on questions for job interviews, this*
939 *allowed me to see my growth and this made me feel comfortable with this mentoring*
940 *project.”*

941

942 **MO4: Improved confidence in moving forward with GEES research**

943 Prior to starting the Equator mentoring scheme, most mentees agreed that in future
944 they were likely to pursue a career in GEES research, with 20% unsure. Most mentees
945 (70%) agreed with the statement: “I feel comfortable discussing my experiences of
946 studying within GEES”, with the remainder (30%) unsure. However, there was a large
947 variance in responses in terms of future career paths, sense of belonging, being able to
948 discuss concerns, and accessing support networks within GEES. When asked to
949 expand on the responses, the mentees articulated a sense of enjoyment of their chosen
950 subjects and clearly had ambitions to continue their studies, but lacked confidence or
951 were uncertain about future career pathways in GEES research:

952

953 *“I would love to have a career in GEES but I’m not sure how I can get it.”*

954

955 When asked about present barriers to pursuing PGR in GEES disciplines, the mentees
956 identified a range of challenges including unwelcoming academic climates, difficulties
957 navigating academia, and a lack of support networks within academia:

958

959 *“I feel like whilst I may have a queer POC [person of colour] support network outside of
960 my degree, I don't feel like there are people in my faculty that understand the struggles
961 that come with having an intersectional identity, especially in a field where POC or
962 queer people aren't typically welcome or accepted.”*

963

964 *“I feel like I don't belong to research society here. I think the problem is the big cultural
965 differences between western and eastern, and it's challenging to make friends with
966 researchers. Another side of this problem might be that the research society is not
967 inclusive.”*

968

969 In the post-mentoring survey, all mentees who responded felt more confident at
970 successfully progressing in their studies. Free text responses made it clear that the
971 knowledge and skills gained during the sessions had improved their confidence:

972

973 *“To gain insight about careers, conferences etc that others may already know was*
974 *brilliant, feels like I’m not behind anymore”*

975
976 *“My mentors shared with me lots of valuable knowledge about interviewing, early*
977 *careers, and jobs. I also got support with my Master’s application that was very helpful*
978 *in making that period of applying a smoother process.”*

979
980 Seven of the eight mentees who responded agreed that they are now more likely to
981 continue into GEES PGR than before being mentored; six strongly agreed, and one was
982 unsure:

983
984 *“As an individual I feel very empowered to undertake postgraduate research.”*

985
986 *“I realised that everything is possible, and I am good enough to be part of the GEES.”*

987
988 This very positive outcome indicates that mentoring could be an important intervention
989 in increasing applications from students from marginalised backgrounds for PGR
990 degrees.

991
992 **DOES RING-FENCING, REMUNERATION, AND DISCIPLINE MATTER?**

993 These interventions were fully funded, ring-fenced for Black, Asian and minority ethnic
994 students, and discipline-specific, a decision based on existing evidence indicating
995 these as important factors in successful interventions (see Introduction). Our
996 evaluation explored the significance of these factors for participants and found them to
997 be very important (Figure 13).

998
999 The discipline-specific nature of the school was an overwhelming factor; 93% of
1000 Research School participants and 88% of mentees said that the intervention being
1001 discipline-specific was a major factor in their decision to apply. 100% of mentors who
1002 responded said this was important to them, with 60% saying it was “very important”.

1003

1004 Ring-fencing of the initiatives for participants from ethnic minority backgrounds was
1005 also a crucial factor; all mentees who responded said the ring-fenced nature of the
1006 scheme was important to them, with over 85% saying it was a major factor in them
1007 applying. The scheme being ring-fenced was “very important” to 75% of mentors. This
1008 speaks to the importance of providing a space for ethnic minority students to build a
1009 community amongst those with shared lived experiences. Unless ring-fenced schemes
1010 are designed to tackle EDI, those who need the program most may be further excluded.

1011

1012 The Research School being fully funded was cited as a ‘major factor in decision to
1013 apply’ by 59% of participants. 75% of mentees said remuneration was important, with
1014 half of those indicating it as ‘very important’. Two thirds of mentor respondents said
1015 remuneration was “not at all important” to them. This perhaps reflects that some
1016 mentors had employer support for their mentoring time; eight mentors chose not to be
1017 remunerated, and one employer contacted Equator directly to explain that they would
1018 cover the time their employee spent on the scheme. However, the fact that 12 mentors
1019 accepted remuneration highlights that it should not be assumed that time for outreach
1020 and mentoring is provided by all employers.

1021

1022 **RECOMMENDATIONS**

1023 The recommendations presented here (Figure 14) are written in the context of Equator
1024 as a short-term project with limited resources and scope. Rather than being a
1025 conclusion, the team hope that these suggestions form a starting point for academics
1026 and leaders to open conversations and take action to improve equity in research.

1027

1028 **Fund it. Ringfence it. Make it discipline-specific.**

1029 Equator’s evaluation indicates that provision of ring-fenced, fully-funded and
1030 discipline-specific opportunities to connect with mentors, develop networks and gain
1031 training are an effective method to increase participation and improve inclusion. Such
1032 efforts offer accessible and attractive interventions to those from marginalised groups
1033 who may otherwise be unable to take part due to financial considerations, caring
1034 commitments, or a sense of isolation. This evidence, together with previous efforts in
1035 this area (e.g., Dutt, 2019; Natural History Museum, 2022), suggests that ring-fenced

1036 and discipline-specific schemes should be a vital part of centrally funded (e.g.,
1037 Research Council and Office for Students) schemes to address disparities in research
1038 participation and outcomes. Funding can also be sourced through internal university
1039 schemes and external organisational sponsorship. The focus of funding should be on
1040 ensuring the continued provision of successful, evidenced schemes, rather than on a
1041 constant drive for novel interventions. In the UK, several ring-fenced opportunities and
1042 activities have been advertised in recent years (e.g., White Rose DTP & Stuart Hall
1043 Foundation, 2020; Leverhulme Trust, 2023; Sheffield Hallam University, 2023; UCL,
1044 2023; CENTA, 2024; GAIA, 2024)

1045

1046 **Co-create and collaborate with the right people**

1047 Any intervention relies on the team, and the broader network of people, that make it
1048 happen. Co-production is understood to be a key feature of inclusive research, and
1049 careful consideration of whose voices should be listened to and experiences drawn on
1050 when designing interventions is essential (Holt et al., 2019). Recent NERC-funded
1051 interventions in geoscience (Quaggiotto et al., 2022; Fox et al., 2024; Holliman et al.,
1052 2024) demonstrate the effectiveness of thoughtful engagement with marginalised
1053 groups to understand barriers and improve inclusion. During Equator, discussions
1054 within the Project Team and Steering Committee of the steps needed, and the
1055 assumptions and risks involved, were critical to the development of our Theory of
1056 Change. We found that conversation and co-creation involving those with lived
1057 experience of the barriers being addressed, within different levels and across different
1058 sectors, was vital in ensuring our interventions were as effective as possible.

1059

1060 Feedback on the Research School demonstrates the importance of involving the right
1061 specialist speakers and mentors to be involved in an event, to help build networks that
1062 are so important to increased sense of belonging. The Mentoring Network feedback
1063 demonstrates the importance of mentoring and role models. Although the issue of low
1064 numbers of minority mentors and role models may mean that participants may not be
1065 able to hear from or engage with someone from their cultural or ethnic background
1066 (Thomas et al., 2007), efforts to ensure improved visibility of those with shared lived
1067 experiences should be central to the design of interventions. Such efforts have been

1068 central to GEES-related initiatives such as Fi-Wi road, the Explorers programme, and
1069 the GAIA project (Black Geographers, 2021; Natural History Museum, 2022; Fox et al.,
1070 2024), and are also a key part of work to decolonise the geoscience curriculum (e.g.,
1071 Rogers et al., 2022; Decolonising Earth Science, 2024)

1072

1073 **Accessible, detailed planning that creates a safe space**

1074 Once funding is secured, detailed planning is needed to ensure interventions are
1075 successful. This may include ensuring that venues are accessible to those from a range
1076 of identities, or that religious calendar timings are considered. It may involve
1077 considering whether preparations are in place to ensure all feel supported, and having
1078 back-up plans to consider a range of needs (e.g., Lawrence & Dowey, 2022). Sufficient
1079 time in advance of activities is also needed to ensure participants are informed, and
1080 feel prepared, to take part in the intervention.

1081

1082 By carefully defining codes of conduct, expectations and guidelines up front,
1083 participants are given a clear framework within which to engage. Ensuring that enough
1084 time is given for participants to engage informally with each other, as well as
1085 participating in formal elements of the intervention, is key. By involving the right people,
1086 informal discussions become important spaces for network-building, discussion,
1087 support and idea-sharing.

1088

1089 **Give the full picture**

1090 Although the authors are not aware of GEES-specific data on doctoral graduate
1091 outcomes, it is known that typically, across academia, less than 50% of doctoral
1092 graduates will become employed within academia immediately after graduating and
1093 less than 10-15% will have a long-term academic career (Vitae, 2016). Research is vital
1094 in a variety of sectors, but awareness of research careers beyond academia is often
1095 lacking (European Commission, 2019). Mentees involved in Equator appreciated being
1096 matched with both an academic and industry mentor, and participants at the Research
1097 School were very positive at the inclusion of materials on non-academic pathways. By
1098 sharing the full spectrum of possibilities in research, it is possible to build greater

1099 awareness, improve perceptions, and show futures away from the traditional
1100 structures of academia, within which some students may feel unwelcome.

1101

1102 **Be open to feedback - and do something with it**

1103 By creating spaces for both formal anonymous feedback, and informal and continuous
1104 idea-sharing, participants are empowered and given a voice. However, it is essential to
1105 act on, and implement feedback, once received. During Equator, many participants and
1106 contributors were asked to contribute their time, energy and effort, as well as to provide
1107 feedback on how to improve future initiatives with an end goal of improving access and
1108 participation of Black, Asian and minority ethnic students in research. The Equator
1109 Project Team hope that this energy will not be in vain and will be used to contribute to
1110 change within GEES and beyond. We hope that future initiatives can learn from and
1111 build upon both the work conducted here and the feedback provided by participants to
1112 inform their actions (see Longevity and Future below).

1113

1114 **Take time, and take a long view**

1115 Improving participation cannot happen with rushed, poorly conceived, or badly
1116 executed interventions. Systemic, institution-directed efforts to fix hostile
1117 environments for marginalised groups are essential for improved equity in science
1118 disciplines (Laursen & De Welde, 2019). Equator only had six months' funding, and
1119 rapid delivery was necessary. The Equator team and Steering Committee was already in
1120 place to co-create the proposal, and key necessary partnerships and relationships had
1121 already been developed. However, more notice in advance of funding and a longer
1122 timescale on which to carry out activities would have allowed the project to have
1123 connected with other groups working on similar efforts, and to have engaged in
1124 continual knowledge-sharing and deeper forms of critical evaluation (such as focus
1125 groups) during the project. Permission was obtained from Equator participants to
1126 contact them in the future (see below), but longer-term EDI projects are essential to
1127 allow for longitudinal analysis as part of original project design (such as the long-lived
1128 US National Science Foundation's ADVANCE program; Laursen & De Welde, 2019).

1129

1130 **SUMMARY**

1131 The first iteration of Equator worked with >60 students, mentors and speakers to carry
1132 out three targeted interventions. Monitoring and evaluation conducted before, during
1133 and after project activities shows that the objectives of the research were met.
1134 Participants overwhelmingly agreed that they had an improved awareness of GEES
1135 research careers, and that they broadened their networks, felt an increased sense of
1136 belonging, and had a more favourable opinion of GEES research careers. Our work
1137 underlines that the development of ring-fenced, discipline-specific initiatives is crucial
1138 in improving access and participation in GEES research careers.

1139

1140 The results from the pre- and post-Research School surveys, together with informal
1141 feedback provided in discussions and over social media during the week, clearly
1142 demonstrate a positive attitude change toward GEES PGR and research careers for
1143 Research School participants. Participants had improved networks (RO1), improved
1144 awareness and opinion of GEES research careers (RO2), increased sense of belonging
1145 (RO3), and were more confident at the thought of taking up a career in research (RO4).

1146

1147 Based on feedback from mentees and mentors, through formal pre-, mid- and post-
1148 mentoring surveys and informal mid-project group meetings, it is evident that the
1149 Mentoring Network also achieved its objectives. Feedback demonstrates that the
1150 interaction between mentees at an early stage in their academic careers and mentors
1151 with established careers in GEES led to an increased sense of belonging and inclusion
1152 (MO1, MO2), and increased likelihood of retention into research (MO4). Equator
1153 mentees cited feelings of empowerment and improved confidence in continuing into
1154 PGR following the project. The majority felt more likely to pursue a career in GEES
1155 research due to their participation in the Mentoring Network. All Equator mentors
1156 reported improvements in their personal skills development as a mentor and felt that
1157 being part of the Equator Mentor Network had increased their likelihood of being
1158 involved in ring-fenced mentoring schemes in the future (MO3).

1159

1160 This paper reports the action research elements of Equator that were designed as
1161 interventions to help students overcome barriers to access, participation and retention
1162 in GEES. But ultimately, the system and PGR environment present the largest barriers.

1163 Interventions such as the Equator Research School and Mentoring Network should not
1164 be seen as an alternative to addressing structural issues, but as short-term actions that
1165 are highly necessary while long-term efforts to dismantle discriminatory practices and
1166 hostile environments are ongoing. The third Equator work package set out to address
1167 some of the broader structural barriers that result in inequity in postgraduate research.
1168 The findings are reported by Fernando et al. (2023), who share best practice
1169 recommendations for more equitable doctoral recruitment.

1170

1171 **LONGEVITY AND FUTURE**

1172 The NERC-funded Equator project is being extended into a longitudinal study in spring
1173 2024. Sheffield Hallam University research funding is enabling focus group analysis to
1174 track the viewpoints and experiences of our participant cohort two years after the
1175 original interventions. The work plans to investigate whether the initial successful
1176 outcomes reported here have created long-lasting impacts on participants' sense of
1177 belonging in research, and their progression into research careers.

1178

1179 In 2023, Equator team members at the University of Birmingham secured a successful
1180 replication of activity for “Equator 2.0” from Research England QR funding through the
1181 University of Birmingham, together with support from the BGS, the ARIES doctoral
1182 training partnership and the Central England NERC Training Alliance (CENTA). Equator
1183 2.0 delivered a second iteration of the Research School (June 2023) and Mentoring
1184 Network (ongoing at the time of submission), with high numbers of applicants to the
1185 program. The Equator 2.0 evaluation outcomes will be evaluated and disseminated in
1186 2024-25.

1187

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1193 speaker time to the Research School.

1194

1195 **SUPPLEMENTARY DATA**

1196 Open access evaluation data, questionnaires, and all project documents are available
1197 here: <https://doi.org/10.17032/shu-0000000174>. Equator has ethical approval under
1198 Sheffield Hallam University, code ER39312553.

1199

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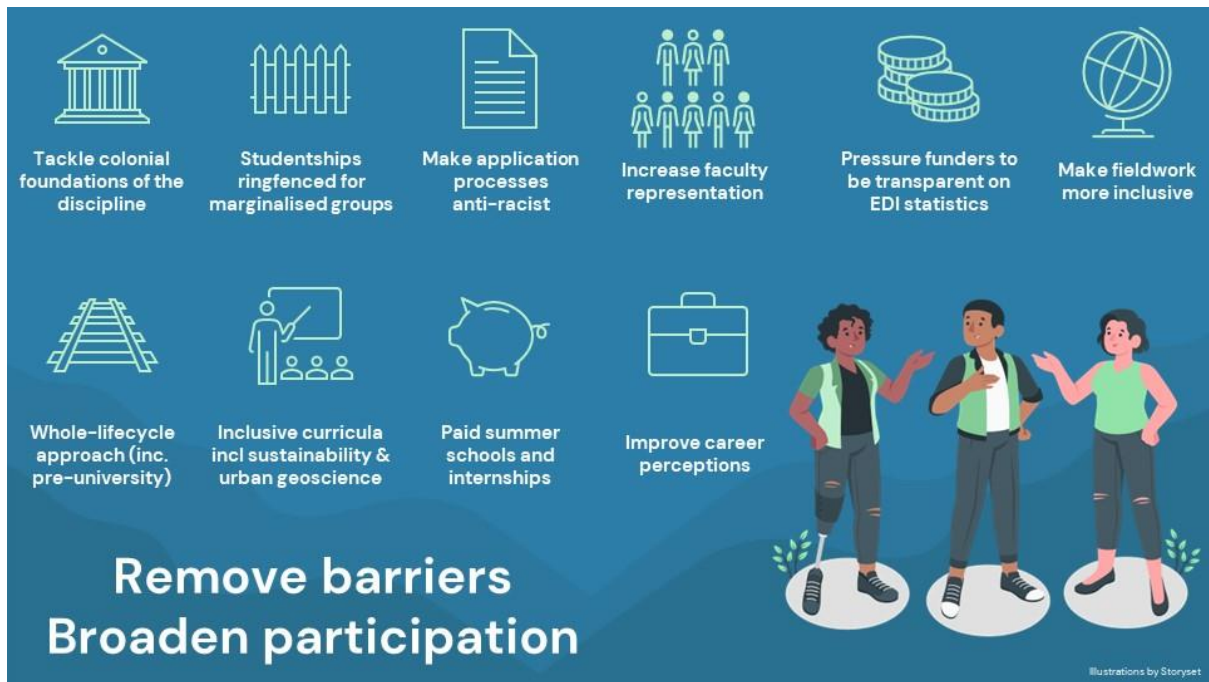
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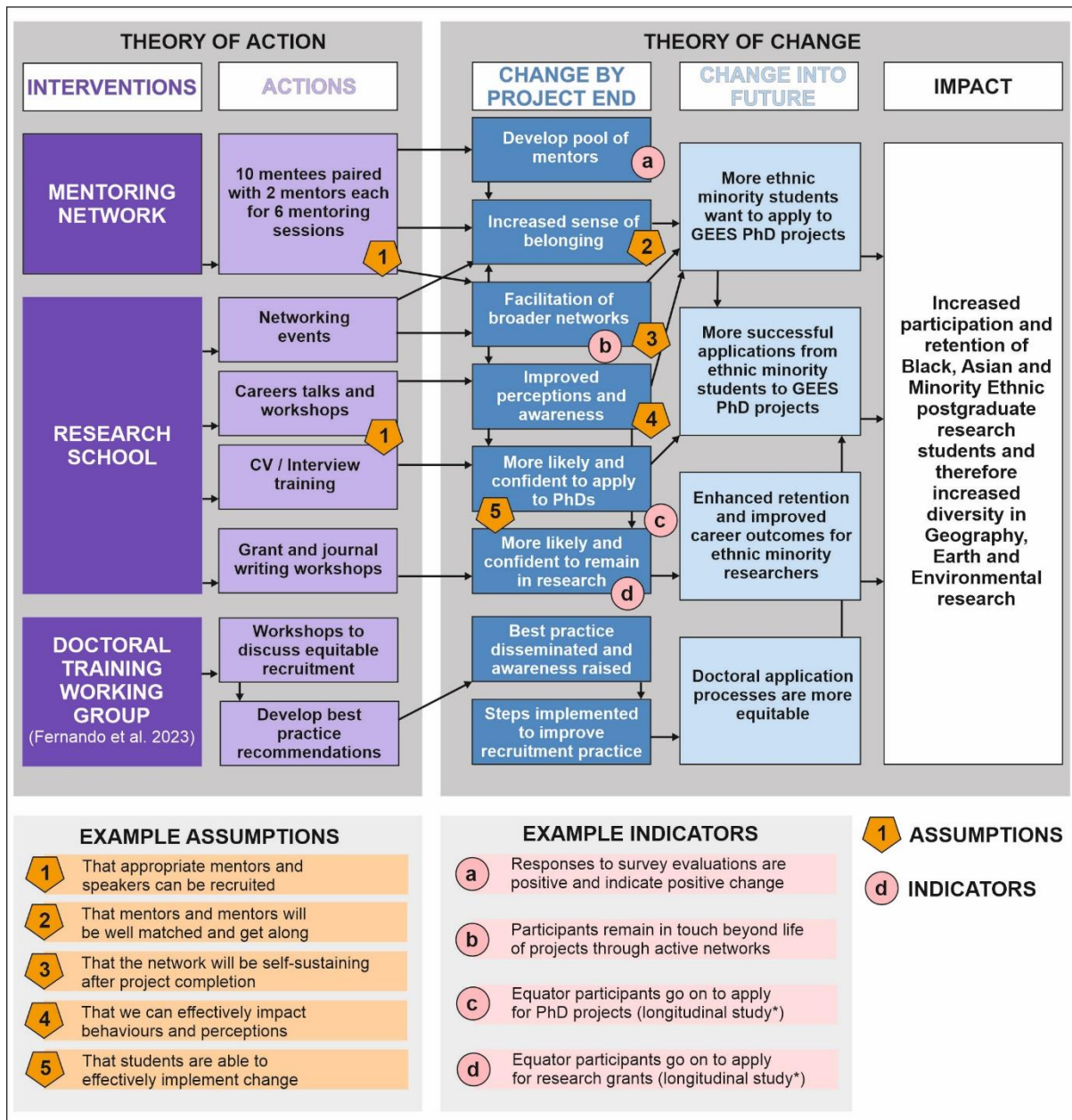


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1417 Figure 1: A range of structural changes are needed to remove barriers and broaden

1418 participation within Geography, Earth and Environmental Science disciplines.

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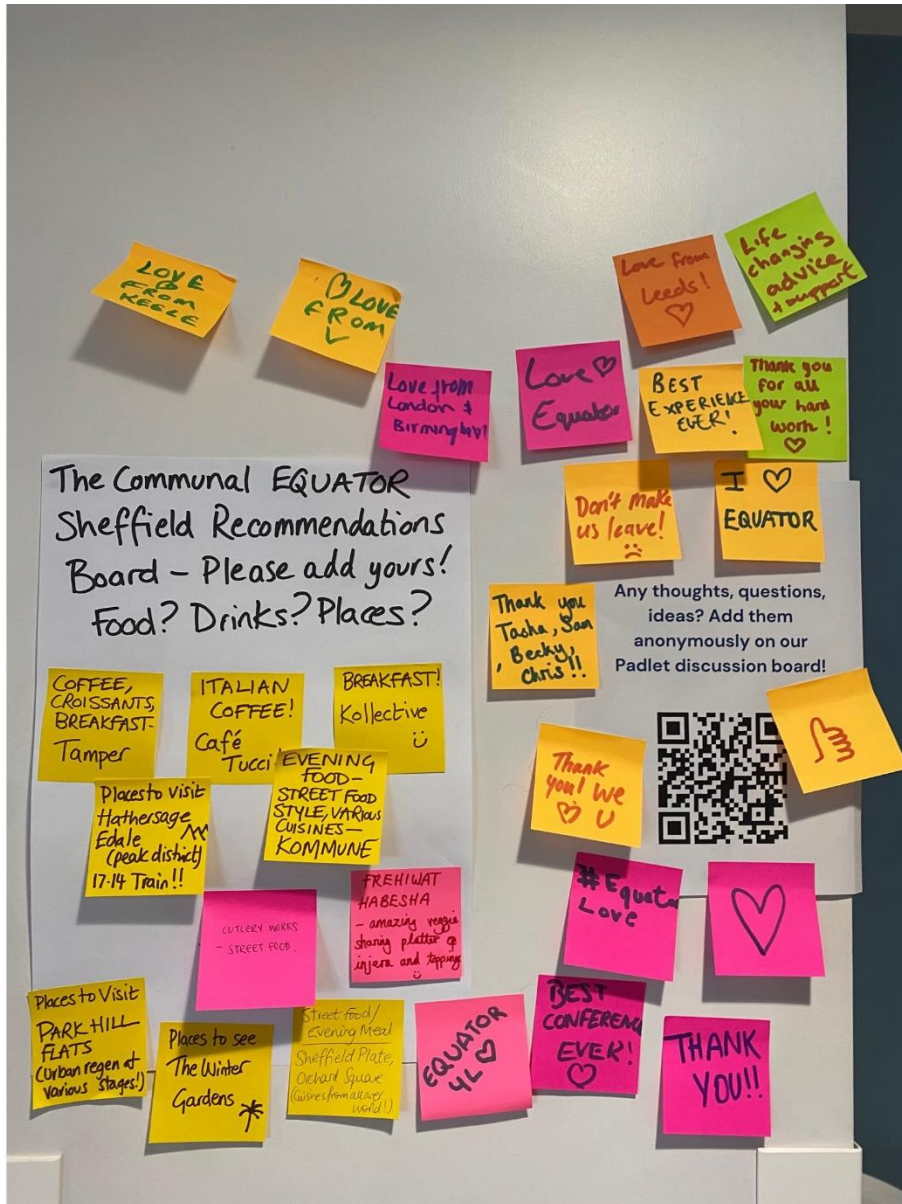


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1421 Figure 2: Summary of the Equator Theory of Change Model (for full version, see

1422 Supplementary Data). *For details of longitudinal study, see Longevity and Future.

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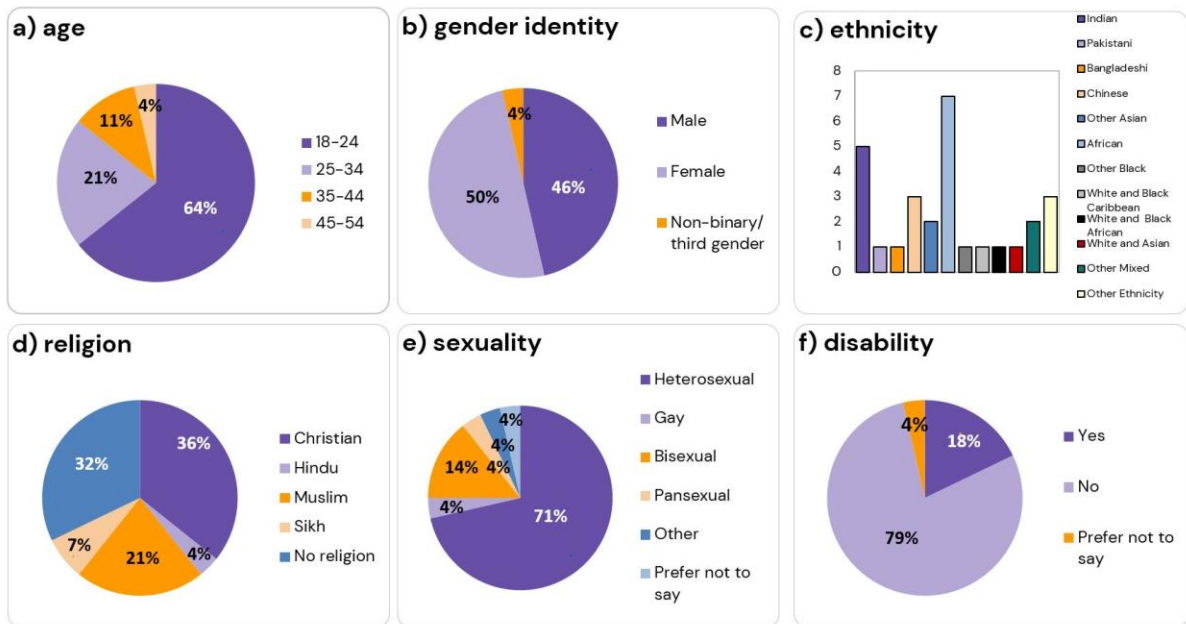


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1425 Figure 3: The Equator Research School Post-It wall, which became a spot for

1426 impromptu feedback

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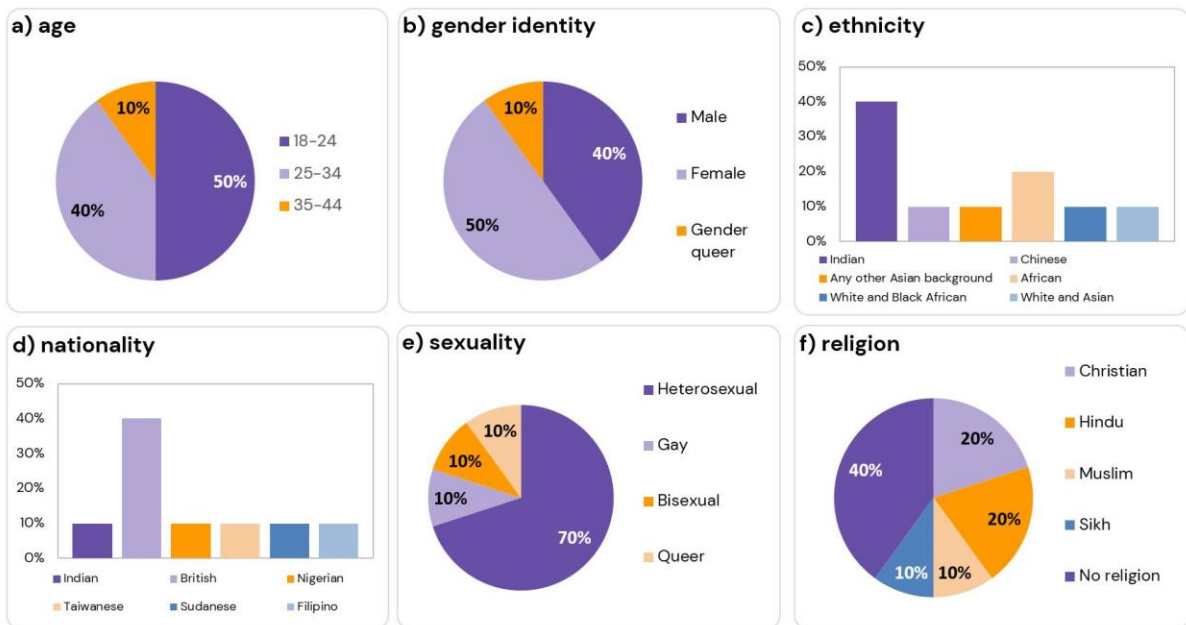
1429 Figure 4: Research school participant demographics by: a) age; b) gender identity; c)

1430 ethnicity; d) religion (note that “Christian” includes Church of England, Catholic,

1431 Protestant and all other Christian denominations); e) sexuality; f) disability and health

1432 conditions.

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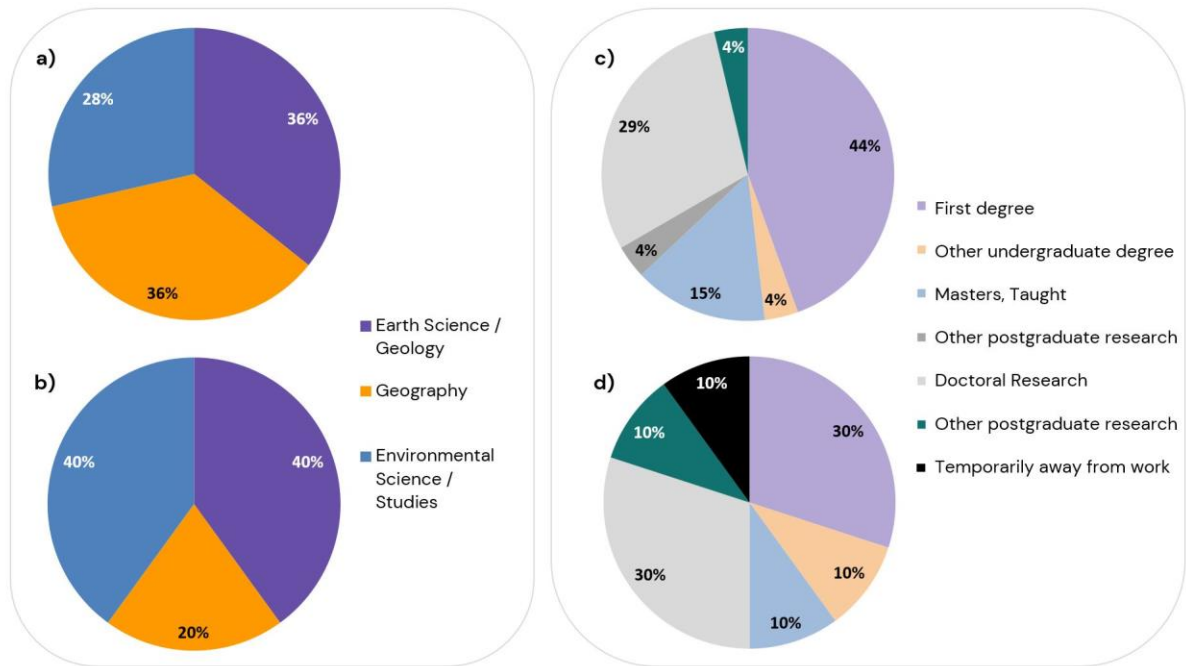
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1435 Figure 5: Mentee demographics by a) age; b) gender identity; c) ethnicity; d) nationality;

1436 e) sexuality and f) religion (where ‘Christian’ includes Church of England, Catholic,

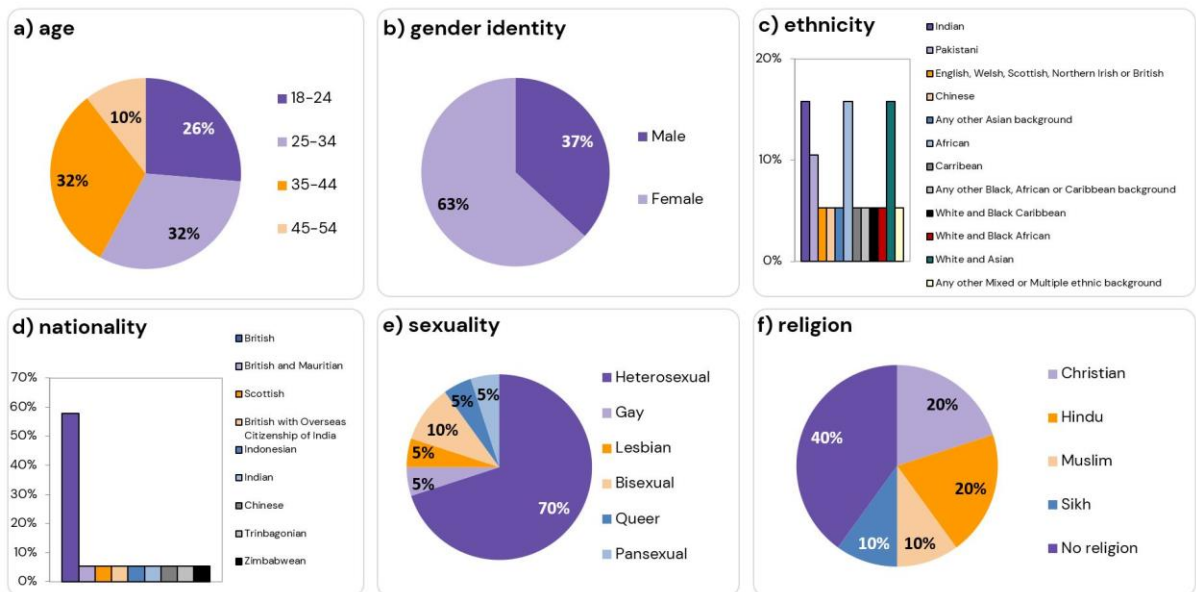
1437 Protestant and all other denominations)

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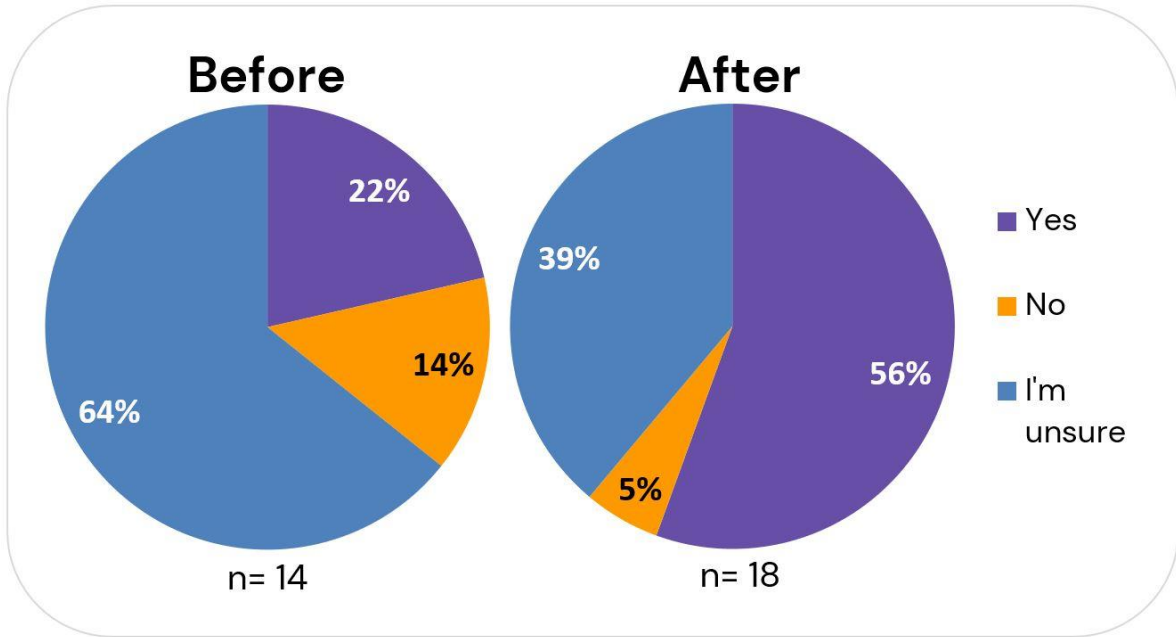
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Figure 6: Selected area of GEES for a) Research School participants and b) mentees; and academic background for c) Research School participants and d) mentees.



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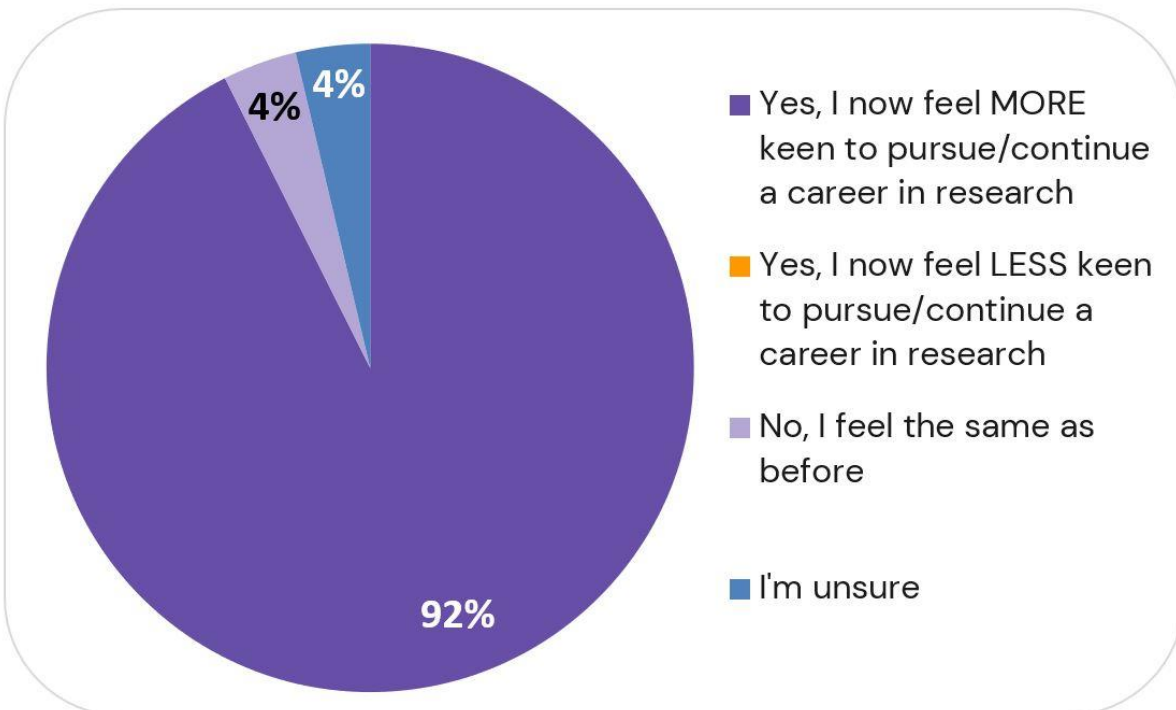
Figure 7: Mentor demographics by a) age; b) gender identity; c) ethnicity; d) nationality; e) sexuality f) religion ('Christian' includes Church of England, Catholic, Protestant and other denominations)



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1452 Figure 8: Undergraduate/Master's level Research School participant responses to the
 1453 question 'are you planning to apply to postgraduate research', from surveys before and
 1454 after the school

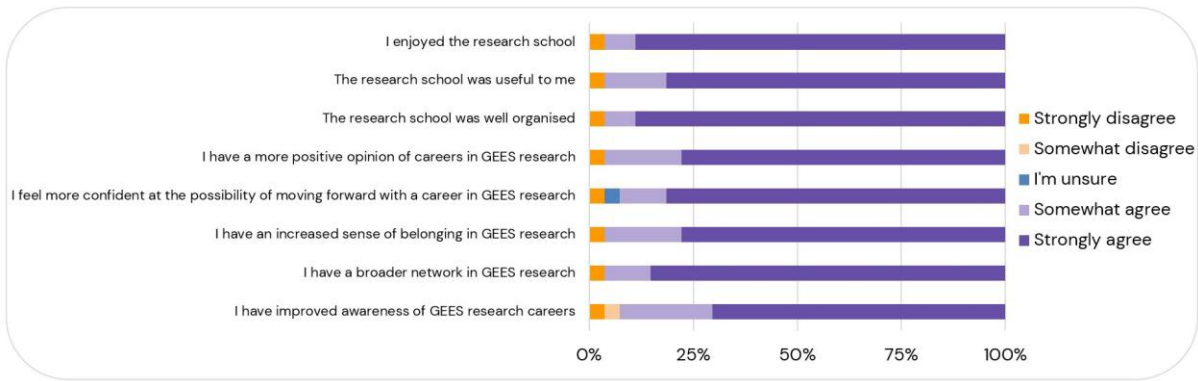
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1457 Figure 9: All Research School participant responses (n = 27) to question exploring
 1458 whether the Research School has changed their career aspirations

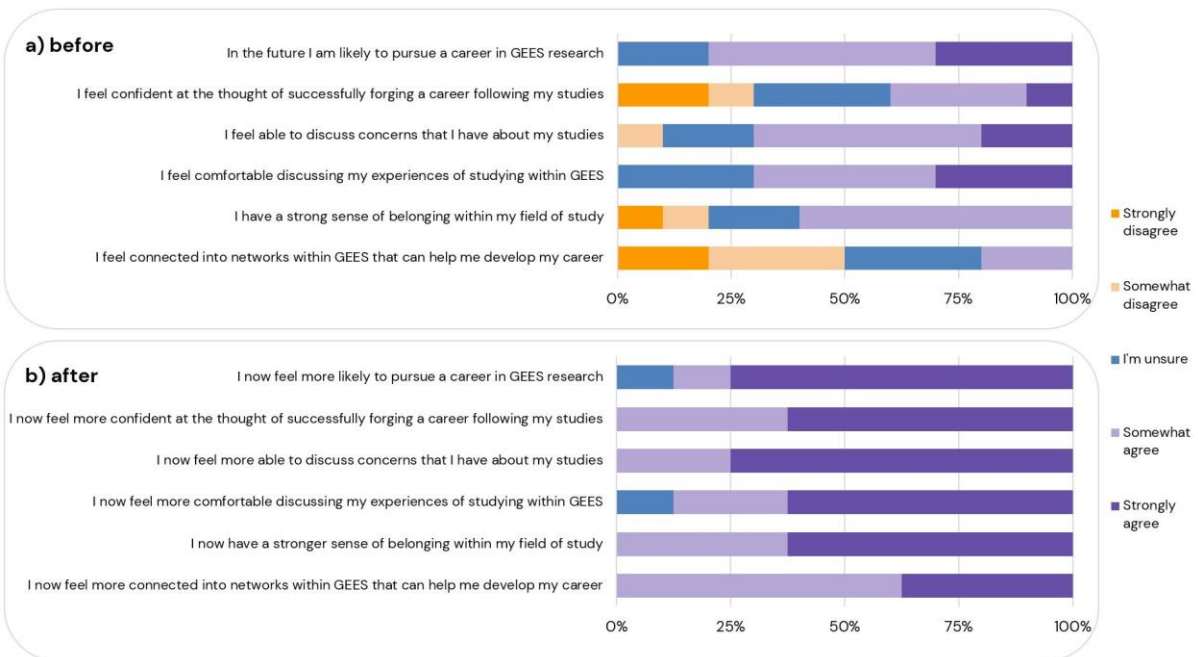
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1461 Figure 10: Research school participant responses (n= 27) to post-Research School
 1462 question exploring project outcomes. [Note, one respondent selected “strongly
 1463 disagree” to all answers, but this selection is believed to have been in error, given the
 1464 highly positive nature of their accompanying free text comments to all other answers]

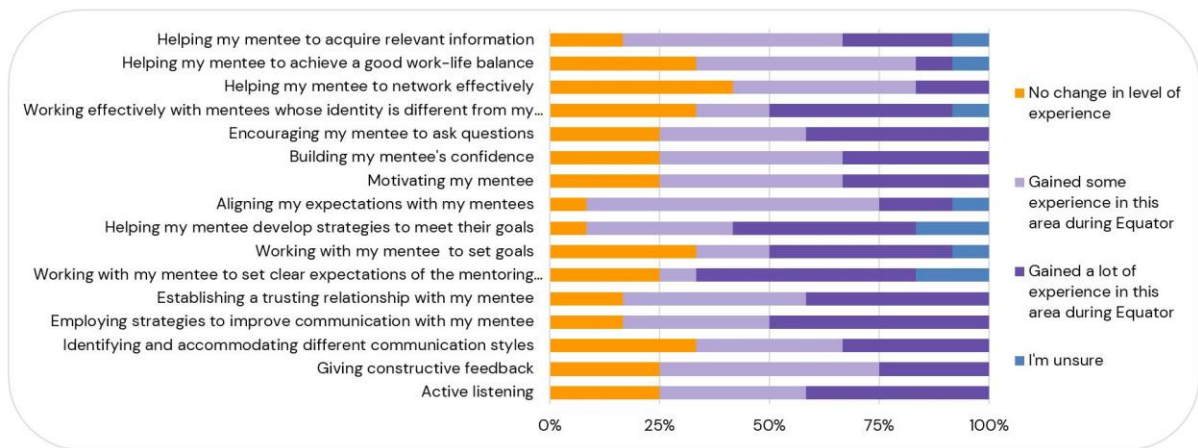
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1467 Figure 11: Mentee responses to questions exploring project objectives before
 1468 mentoring (n= 10) and after Mentoring Network completion (n=8).

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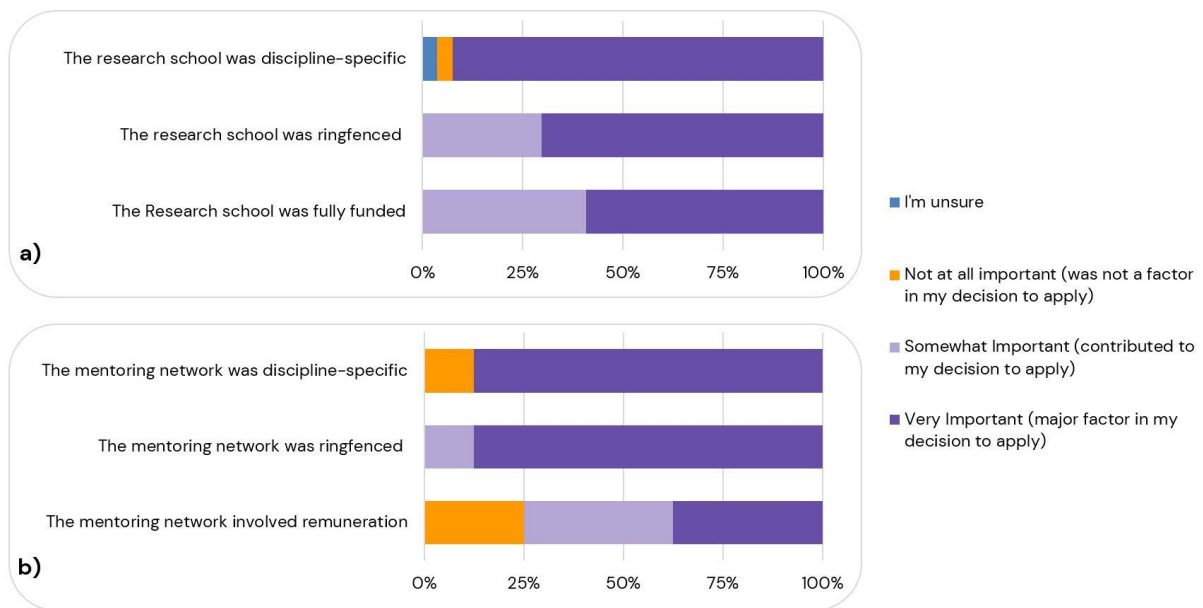
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1471 Figure 12: Mentor responses (n= 12) to post-Mentoring Network survey exploring project

1472 outcomes (Q: “Has participating in the Equator project benefitted your own personal

1473 skills development?)

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1476 Figure 13: Responses of a) Research School participants (n=27) and b) mentees (n=8) to

1477 the question “how important was the following to you”?

1478

1479

Carefully planned, targeted interventions can improve sense of belonging, build confidence, improve access & increase chance of retention into postgraduate research



Co-create with a diverse community and involve the right people



Plan the inclusivity of interventions in detail



Ringfence to the target audience



Make it discipline specific



Pay for time, not just expenses



Create a safe space



Be open to feedback and take the long view

Illustrations by Storyset

1480

1481 Figure 14: Recommendations for building interventions to improve access and sense of
1482 belonging in postgraduate research, developed from Equator Research School and
1483 Mentoring Network outcomes