



# 1 Students' sense of belonging and its impact on effectively teaching about 2 environmental changes in high latitudes during a master's programme

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14 **Abstract.** Sense of belonging plays a significant role in students' academic success. For the 'Environmental Changes at Higher  
15 Latitudes' master's programme, success is effectively communicating geoscience research and ideas to the students. This study  
16 explores students' perceived sense of belonging, the conditions for belonging among master's students of this particular  
17 programme, and the impact of belonging on educational effectiveness in a climate change context. This programme is organised  
18 jointly between universities of three Nordic nations and for it—and for the multilocality of the geoscience themes—has a  
19 particularly high degree of mobility. Therefore, the programme lacks elements present in a typical higher education experience,  
20 such as on-site attendance in a physically shared space with a relatively stable group of peers and instructors which are thought  
21 significant for the students' feelings of belongingness. Based on 15 interviews, we elaborate on the findings of the students'  
22 motivation, ability and opportunities to belong and on the construct of their perceived belonging. Emerging from this study, these  
23 constructs for sense of belonging consist of the students' sense of familiarity – familiar elements in the place, surroundings and  
24 culture; sense of recognition – recognised by oneself and others as a peer and a member of the knowledge community; and last,  
25 sense of relevance – finding their studies relevant and interesting. Due to the unique set-up of the programme, the study reveals  
26 insight into elements that support the sense of belonging, crucial in such geoscience and climate education and communication  
27 that might lack the typical shared physical space of a programme.

## 28 29 1 Introduction

30 Environmental changes and the discourse surrounding climate change have become ubiquitous in global society. Among the  
31 various approaches aimed at mitigating and adapting to both anticipated and ongoing changes, education has long been proposed  
32 as a seemingly reliable strategy (Anderson, 2012). Education on climate change and sustainability issues is often characterised by  
33 its interdisciplinary and problem-based nature (McCright et al., 2013) to emphasise the development of practicable skills to tackle  
34 global problems. Various approaches can be taken in this endeavour. Climate science education focuses on teaching the scientific  
35 basis of the Earth's climate system and the factors affecting it, focusing on atmospheric, oceanic and terrestrial interactions. It is a  
36 subset of geoscience education, which covers the Earth's physical systems beyond climate. On the other hand, climate science  
37 education is also a subset of climate education, which involves a broad understanding of the climate system, human impacts, and  
38 policy responses, thus addressing also climate change impacts, mitigation, and adaptation. Education with such importance yet  
39 with such demanding dispositions has been the subject of extensive research and development, encompassing pedagogical  
40 methodologies (Perkins et al., 2018), educational outcomes (Monroe et al., 2019), global implementation (Molthan-Hill et al.,  
41 2019) and professional practices (Salovaara and Soini, 2021). Similarly to sustainability, geoscience education as well is thought



42 to require proper contextualisation—of being engaged with relevant locations (King, 2008). To continue, organising geoscience  
43 education as situated learning would also suggest that such elements as the learning community and development of professional  
44 identity are to be given more attention (Donaldson et al., 2020) and that feelings coming from the exposure to various contexts,  
45 cultures and communities ought to be better managed in geoscience education (Hall et al., 2022; Todd et al., 2023). More generally,  
46 according to Delors et al. (1996), education of people to manage in the rapid changes of 21st century societies, the four pillars of  
47 learning should be considered: first, learning to know; second, learning to do; third, learning to live together; and fourth, learning  
48 to be. The third pillar, inherently connected to sense of belonging and involving the creation of a new spirit based on understanding  
49 and recognising others' history, traditions, and spiritual values, is highlighted as vitally important. However, the research on the  
50 impact and conditions leading to better communication of geoscience in climate education seems to seldomly address a sense of  
51 belonging, which centres many of the aforementioned topics.

52

53 Sense of belonging is a fundamental human need (Maslow, 1943), and feeling relatedness to other people is crucial for all human  
54 motivation (Ryan and Deci, 2000). Sense of belonging can be defined as the emotional attachment that individuals feel towards  
55 specific groups, systems or environments (Maestas et al., 2007) and their perception that their personal attributes fit with these  
56 entities (Hagerty and Patusky, 1995). In higher education, a sense of belonging among students is widely acknowledged for its  
57 influence on academic performance and overall success within the university environment. Students with a high sense of belonging  
58 tend to have high motivation and enjoyment in their studies (Pedler et al., 2022), self-worth (Pittman and Richmond, 2007) and  
59 high academic achievement (Edwards et al., 2022, Pittman and Richmond, 2007), both in online and traditional education set-ups  
60 (Edwards et al., 2022; Thomas et al., 2014). Sense of belonging is widely recognised as essential for fostering student engagement  
61 in their studies (Thomas, 2012). While engagement is important across all educational contexts, its significance is particularly  
62 heightened in the training of professionals in climate change, given the urgent nature of the issue.

63

64 Previous studies have examined how various domains contribute to students' sense of belonging, including social relationships,  
65 academic environments, physical places and overall surroundings, encompassing the entirety of the higher education experience  
66 (Ahn and Davis, 2020). However, it is evident that sense of belonging remains highly personal, with no one-size-fits-all solution  
67 (Cohen and Viola, 2022), and ultimately, a student's sense of belonging is grounded in their perception of their connection to a  
68 chosen group, place or other entity (Allen et al., 2021; Mahar et al., 2014). Therefore, it is essential to understand the underlying  
69 constructs of belonging, independent of specific contexts. This entails understanding the emotional responses and interpretations  
70 that lead to both high and low feelings of belonging. By uncovering these fundamental elements, we can gain insights into how to  
71 effectively nurture and support students' sense of belonging across diverse educational settings.

72

73 This study examines the factors that foster and cultivate a sense of belonging within a particular, interdisciplinary master's  
74 programme on environmental changes at high latitudes; operates across multiple universities; and involves students attending  
75 courses in different countries and institutions. Consequently, the student group is dispersed across various institutes and countries,  
76 diverting from what is typically associated with the graduate student experience, such as on-site attendance in a physically shared  
77 space with a relatively stable group of peers and instructors. Due to the unique set-up of the programme, exploring how students'  
78 sense of belonging evolves and what supports it in these circumstances can bring about insights into what conditions are important  
79 for sense of belonging, even without permanent location, institute or people to attach to, thus seemingly continuously challenging  
80 the students' sense of belonging. How does a sense of belonging evolve in students who are subject to constantly shifting teaching  
81 methods and ever-changing surroundings? In this study, we focus on aspects relevant to sense of belonging, adapting the Allen et



82 al. (2021) framework to emphasise the students' perceptions of their belongingness. Thus, we ask the following questions: *what*  
83 *conditions support and foster a sense of belonging in climate education?*, and: *what attributes do students perceive in their*  
84 *experiences to affect their belongingness?*

85  
86 **2 Theoretical background**

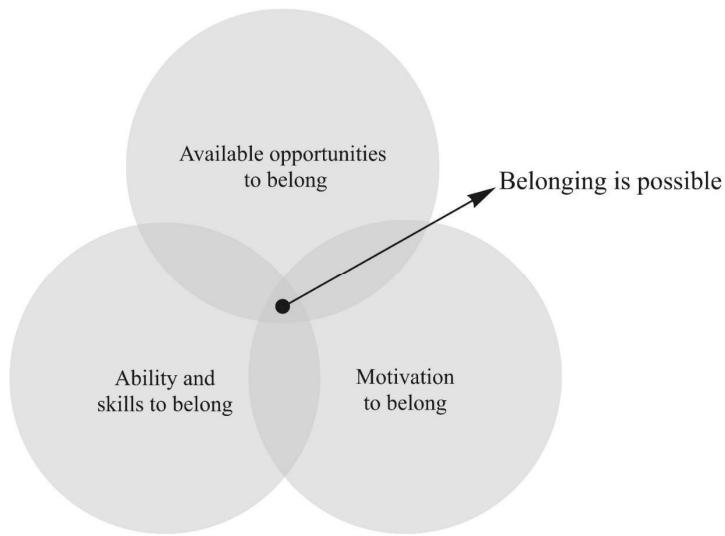
87 Recent re-conceptualisations suggest that belongingness is a dynamic and non-static process that is dependent on situational factors  
88 and that the sense of belonging fluctuates over time (e.g. Guyotte et al., 2019). Rather than focusing merely on social connections,  
89 belongingness is proposed to be seen as a 'situated practice' that is rooted in place (Grawett and Ajjawi, 2022). To continue, *state*  
90 *belonging*, referring to a sense of belonging that fluctuates over time and is context-dependent, is distinguishable from *trait*  
91 *belonging*, referring to an individual's inherent tendency to feel belonging irrespective of context (Allen et al., 2021). In higher  
92 education research, a sense of belonging has been suggested to be composed of feelings associated with various domains, such as  
93 the academic environment and community, institutes, people and places, with their cultural significance (Ahn and Davis, 2020;  
94 Thomas, 2012). The importance of these elements in contributing to students' sense of belonging varies depending on the  
95 individual, thus making belonging a highly personal experience (Viola and Cohen, 2022) contingent upon individuals' perceptions  
96 of their belongingness (Allen et al., 2021). In geoscience education—also as a practice of communicating geoscience and its ideas  
97 further—belongingness has been recognised, predominantly implicitly, as a relevant element. Situated learning has been suggested  
98 as a potential key direction of pedagogical development in geoscience education, which has thematic ties to a sense of belonging  
99 by its suggested three core components: community of practice—relating to for example social belongingness, authentic context—  
100 relating to for example cultural belongingness, and embodiment—relating to for example academic belongingness (Donaldson et  
101 al., 2020).

102

103 Numerous factors contribute to shaping higher education students' sense of belonging, including peer relationships, engagement  
104 and activities with and within the academic community, personal well-being and connection to physical and cultural environments  
105 (Ahn and Davis, 2020). Overall, students' sense of belonging in higher education is heavily influenced by the quality of  
106 relationships they form with their peers and faculty members (Thomas, 2012). Recent studies have also highlighted the role of  
107 place and surroundings as key elements in shaping one's belongingness (Abu et al., 2021, Ahn and Davis, 2020). As higher  
108 education becomes increasingly mobile and organised online, belongingness too gets cultivated less in fixed times and spaces  
109 (Grawett and Ajjawi, 2022). The rapid shift to online education due to COVID-19, although improved flexibility and accessibility,  
110 had a trade-off; challenges arose in maintaining and altogether having a lower sense of belonging among students who were no  
111 longer anchored to the physical and temporal boundaries of traditional educational settings (Abu et al., 2021). To continue,  
112 geoscience students can also experience a low sense of confidence, which is tied to poorer academic performance (Heron and  
113 Williams, 2022) and coincidentally relevant to feelings of belonging. Belongingness, thus, is an outcome of a process of complex  
114 experiences in multiple spaces and places (Guyotte et al., 2019, after Braidotti, 2006).

115

116 In operationalising the theory, we adopt the framing by Allen et al. (2021) on elements that build belonging. Belongingness requires  
117 an opportunity to belong, such as an available social, cultural and environmental context to interact with; a motivation to belong  
118 to that context; and an ability (necessary resources and skills) to interact with it. However, ultimately, the feeling of belonging is  
119 based on the perception of belonging (Allen et al., 2021). In our analysis, we examine how opportunities, motivation and ability to  
120 belong serve as conditional factors that facilitate the development of perceived belonging (Fig. 1). Our focus is on understanding  
121 the emotional responses and interpretations that contribute to shaping this perception.



122

123 Figure 1. Necessary conditions for fostering belonging, adapted from Allen et al. (2021).

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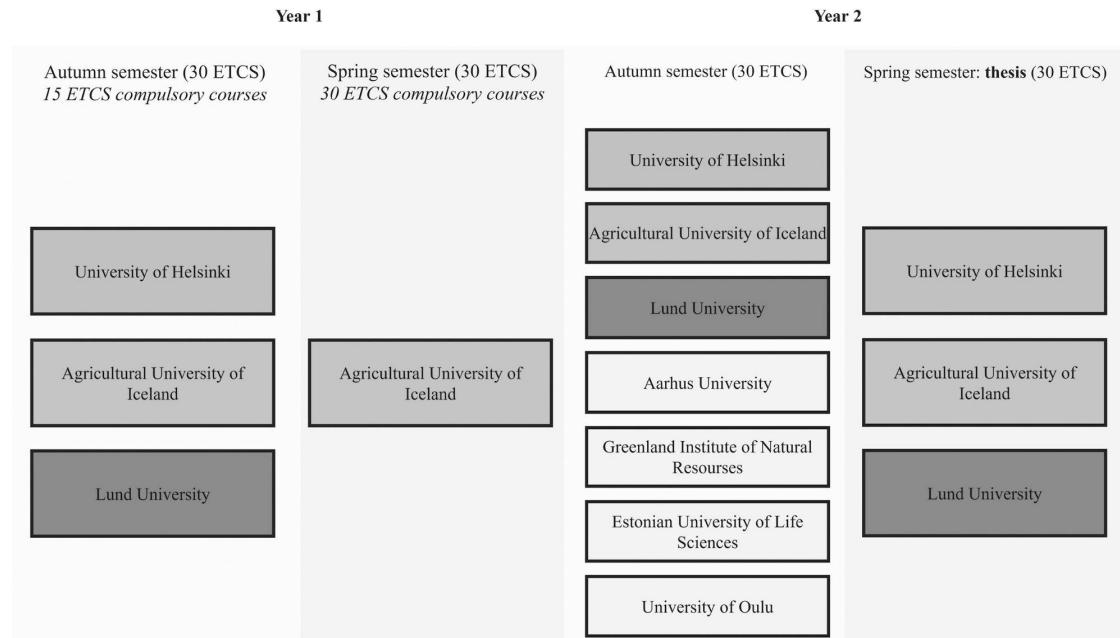
125 **3. Materials and methods**

126 **3.1 Programme**

127 The joint Nordic master programme in Environmental Changes at Higher Latitudes (EnCHiL) is a two-year 120 ECTS Master's  
128 programme that is offered by University of Helsinki (UH), Lund University (LU), and the Agricultural University of Iceland (AUI)  
129 together with four supporting partner institutes. The first cohort of students started their studies in the autumn of 2020. The  
130 programme offers education in multidisciplinary environmental/geosciences with a focus on high latitude ecosystems and societies.  
131 The aim is to communicate 'the underlying processes responsible for environmental changes at higher latitudes (Antarctic, Arctic  
132 and sub-Arctic areas)' and to educate to the students with a natural science or engineering background a 'deep multidisciplinary  
133 knowledge on the past, ongoing and predicted environmental changes at higher latitudes' (The Nordic Master in Environmental  
134 Changes at Higher Latitudes, n.d.). In addition to the programme's academic goals, it aims to build a strong Nordic contact network  
135 for the students.

136

137 Students will study in at least two of the degree-awarding institutes (AUI, UH and LU) in which they are expected to spend a  
138 minimum of one semester each (Fig. 2). However, all the students spend the spring semester of their first year at AUI where they  
139 study compulsory courses together on campus. In addition to the degree-awarding institutes, students can enrol in courses from the  
140 partnering institutes: Aarhus University (Denmark), Greenland Institute for Natural Resources (Greenland), Estonian University  
141 of Life Sciences (Estonia) and University of Oulu (Finland).



142

143 Figure 2. Structure of the EnCHiL programme. Students study the first autumn semester at either the University of Helsinki  
144 (UH), Agricultural University of Iceland (AUI) or Lund University (LU). For the first spring semester, all of the students in the  
145 cohort study at AUI. During the second autumn semester, the students are free to choose courses from all the degree-awarding  
146 and partnering universities and institutions. The second spring semester typically consists of the 30-credit thesis, which the  
147 students can submit to any of the degree-awarding universities.

148

149 During the first autumn semester of the programme, students start their studies in either AUI, UH or LU. Half of the ECTS credits  
150 in the autumn semester are from optional courses, and the other half are from compulsory courses that are offered online for the  
151 whole cohort. In the spring, the whole cohort studies in AUI and lives on the campus in Hvanneyri, Iceland. All the spring courses  
152 are compulsory. During this semester, the cohort has a field course in Greenland. The second year consists of a 30-ECTS thesis  
153 and 30-ECTS optional courses from any of the degree-awarding or partnering institutes. The programme is rather small as the first  
154 three cohorts had 5, 10 and 6 students, respectively. Due to the small size of the cohort and the fact that the student body is dispersed  
155 among the institutes, only a few students study at the same place at the same time. In the first three cohorts, only 6 out of 21  
156 students were local students from Finland, Iceland and Sweden. Therefore, the majority of the students move from their home  
157 country in the beginning of their studies and, due to the mobility scheme, move again to another country at least for one semester.  
158 It is to be noted that the main author of this paper is also a graduate of the programme. Thus, this study can be considered to be an  
159 insider study (Mercer, 2007) as well, granting the author in question both familiarity to the research case and credibility among the  
160 interviewees.

161

### 162 **3.2 Interviews**

163 We conducted 15 semi-structured interviews with current students and graduates of the programme. The interviewees were  
164 approached via direct emails (with messages via phone as reminders) introducing the research themes in general and asking for  
165 their interest in participating to this study. Along with the initial email, a Participant Information Letter was sent which also acted  
166 as a document of implied consent. The letter informed the participants of the study design, data utilisation, and storage, and  
167 explained how their answers and anonymity would be handled in the submission. The primary focus of the interviews was to



168 explore the sense of belonging that evolved and was constructed during their time in the programme and to deepen our  
169 understanding of the various factors that contribute to shaping the sense of belonging. To continue, we explored the influence of  
170 their peer relationships, staff-student interactions, programme curriculum, personal feelings of achievement and the effect their  
171 physical surroundings might have had on their overall sense of belonging. We were also interested in whether certain courses or  
172 academic experiences held particular significance to their sense of belonging.

173

174 The interviewed 15 students were from the first three cohorts of the programme: four that started their studies in 2020, six in 2021  
175 and five in 2022 (see Table 1). The interviews took place in the summer of 2023. Most interviewees had a bachelor's degree in  
176 applied natural or biosciences (e.g. environmental science, geology or biology and related sub-fields), a few had a bachelor's  
177 degree in engineering, a few had a bachelor's degree in fields outside natural sciences.

178

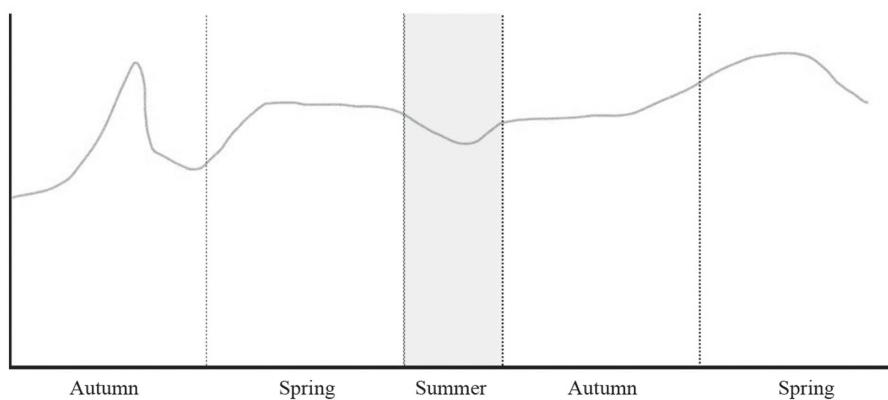
179 Table 1. Disciplinary/study backgrounds of the interviewees and the year they started their studies.

Background / Cohort	2020	2021	2022
Biology	1	1	
Eco/Bio engineering		2	
Environmental sciences		1	1
Geology		2	
Natural resources	1		1
Arts/agronomy/geography/other	2		3

180

181 At the start of the interview, we elaborated on the concept of sense of belonging through such descriptions as feelings of attachment  
182 to groups, systems or environments, as well as the perception that one's personal characteristics align with those groups, systems  
183 or environments. Participants were then provided with a figure schematising a timeline of their studies, on which they were asked  
184 to visualise how their sense of belonging changed over time. The exercise provided participants with an opportunity to recall and  
185 reflect on their experiences during their studies, and the visualisation served as a reference guiding the conversation through periods  
186 of varying belonging or shifts in their experiences. Thus, the visualisation served as a concise yet comprehensive overview of the  
187 pivotal moments, supporting the verbalisation of their study experience as a whole. The participants had the opportunity to modify  
188 and reflect on their visualisations as they continued their musings throughout the interview.

**Sense of belonging during your EnCHiL studies:**



189

190 Figure 3. Example draft of the drawing exercise that was used to guide the interview. The interviewees were provided with a  
191 template representing their timeline in the programme. On the template, they could visualise (e.g. by a line) how their sense of  
192 belonging evolved during their studies.



193

194 The interviews were conducted as online meetings using the Zoom platform and were 30 to 75 minutes in duration. The recorded  
195 interviews were later transcribed, and these transcriptions were then subjected to content analysis, utilising Atlas.TI for computer-  
196 assisted coding (Bryman and Burgess, 1994). The interviews were initially coded to inductive codes on different reappearances  
197 (Krippendorff, 2018) of the interview's key interests, specifically on perceived degrees of belongingness. These initial codes were  
198 then further grouped into emerging thematic groups. A second round of code grouping was conducted against the formed theoretical  
199 background, as depicted in Fig. 1 of framing inspired predominantly by Allen et al. (2021). The themes emerged as: ability and  
200 skills to belong; motivation to belong; available context to belong to; and emotional responses constructing belonging.

201

## 202 **4 Results and discussion**

203 The results of our study are presented in two main chapters. First, we focus on the theory-backed analysis, describing our empirical  
204 insight from the interviewees through the previously theoretically conceptualised sense of belonging. Second, we elaborate on an  
205 emerging conceptualisation of sense of belonging, which reveals the construct behind the perceived belongingness rather than  
206 describing the conditions of belongingness.

207

### 208 **4.1 Necessary conditions to belong**

#### 209 ***Motivation to belong***

210 Belonging is a basic human need, and motivation is what drives the action to fulfil that need (Ryan and Deci, 2000). Most students  
211 identified the motivation to belong as a necessity, especially when related to social interactions within their peer cohort. Sense of  
212 motivation seemed to coalesce with feelings of responsibility and independence; it was their responsibility to seek opportunities to  
213 connect with their peers:

214 “That [activities they did as a group that brought them closer] was all our ideas. There were no teachers telling us to do that;  
215 you have to also find it in yourself that you want to do this. So maybe it's hard to organise it also”. *Interviewee 3*  
216 “So, it's also up to oneself to kind of make that social network around you, and it's not supposed to be the programme's  
217 objective to bring that”. *Interviewee 6*

218

219 A few interviewees directly expressed a lack of motivation to belong in their cohort. With these cases, lack of belonging was not  
220 explicitly negative, as it was their decision to preclude from such connections:

221 “Sense of belonging to other people [in the cohort] – was not so strong. I don't think it really disturbs my experience overall  
222 because I already had a group that I belonged to, so I didn't need another group. It didn't disturb me”. *Interviewee 11*  
223 “There are some people with ethics that I will not want to associate myself with. So, I do not feel a sense of belonging to  
224 this group”. *Interviewee 9*

225

226 In both of the previous cases, interviewees stated to have found other groups of people to interact with, and both attached feelings  
227 of belonging to those respective groups. To some extent, the lack of belonging to their peer cohort, even though it was not viewed  
228 as negative *per se*, lowered their sense of attachment to the programme.

229

#### 230 ***Opportunities to belong***



231 Sense of belonging is predicated by concrete opportunities to form relationships with groups, systems or environments (Allen et  
232 al., 2021). The accessibility of these opportunities was stated as an important factor governing belongingness. Most opportunities  
233 that the interviewees recalled were either intrinsically or instrumentally related to conditions that allowed or restricted social  
234 interaction. Social interaction has been consistently found to be the most important aspect affecting student belonging (Thomas,  
235 2012).

236 The students spent their first spring semester in a small rural town called Hvanneyri in Iceland. For many of the interviewees, their  
237 stay in a small seclusive place was seen as a catalyst to heightened sense of belonging to their peer group. The small group, with  
238 almost all students accommodated at the campus, made them more dependent on each other and thus created a tighter network of  
239 the group:

240 “[It helped with] that sense of belonging because it’s a very small community. Everybody, I mean, my dear, everybody  
241 knew almost everybody there and the professors. I mean everything was near, like the houses, the campus and everything.  
242 So it was like easier to, you know, talk and communicate. So it helped the sense of belonging to not only to the master’s  
243 [programme] but to the community, to the campus, to the country”. *Interviewee 7*

244 “You also need to be more, not friendly, but patient, with other people. Because if we were just a tiny community and you’re  
245 always with the same people, you don’t want to look for trouble. You just want everyone to be happy. You just see the  
246 things in a completely different way. I guess in Helsinki you could meet all the time people, so you don’t really care about  
247 the personal well-being of everyone because there are so many people [...] rather than in Iceland, since we were just a very  
248 small community, and there is no one else. You kind of want to know that everyone is feeling great”. *Interviewee 12*

249  
250 For some, the lack of opportunities to interact with other people outside the programme and the small cohort size were viewed as  
251 restrictions to social interaction, as interviewees said:

252 “I was living in the house with just [the programme] students, so you know, taking the courses together and living together  
253 really just kind of sucks you into this one place and makes it, yeah, the lack of opportunities to reach out to new people”.  
254 *Interviewee 8*

255 “I would have preferred living with other people than who I study with, and I would have preferred also living in a big, or  
256 just someplace bigger. But that’s just how I get energy from outside my study and the stuff I do outside. Then I tap into  
257 university, and I bring in energy from outside, and it was very hard in Iceland to get that of course”. *Interviewee 6*

258  
259 The importance of having opportunities to spend time together was frequently brought up. Most interviewees preferred informal  
260 interaction in regard to building belonging over more formal interaction, such as during classes. For example, interviewee 3  
261 explained that: ‘only school related [student interaction], feels really professional and distant, and then you don’t really get the  
262 sense of belonging’. Although courses vitally served as spaces for informal interaction to happen, there was also time for non-  
263 curricular activities, particularly during residential and field courses:

264 “Some courses where we are going on trips, so we have to spend time together outside of studying; also that really helps  
265 make you feel belonging”. *Interviewee 3*

266 “The strongest sense of belonging arises when you are participating in activities outside of the curriculum, that also involve  
267 the local students. So in the case of Helsinki, it is for example going to the sauna, experiencing with everyone. There was a  
268 strong sense of belonging. In the case of Iceland, it was the impromptu activities we had. We went cross-logging with the  
269 other students. We went to the campfire and things like that”. *Interviewee 9*



270 “[A classmate] and I took methods and measurements and the hydrosphere, geophysics [a course]. So we had a couple of  
271 field trips out in the Bay of Helsinki, and so it was very nice to do fieldwork but also to see the city and get to know your  
272 teacher and your classmates a lot more closely. For this reason and definitely after that course, I also felt the belongingness  
273 and in different ways as well from that experience. [...] And you know something like Hytylä [a remote forestry research  
274 station], that was of course a way to bond with people. We had time to go to the sauna and to swim and to have like lunch  
275 time with teachers as well”. *Interviewee 8*

276

277 Altogether, engaging in course peer projects was beneficial for belonging, as interviewee 11 explained: “I think in general, group  
278 work, trying to figure out things together, sort of makes a group. You know, as we did in Hytylä, for example. And so the  
279 opposite, I guess you know when you work by yourself, as was my experience mostly in the second year, I was mainly working  
280 by myself. Which probably contributed to not feeling as belonging”.

281

282 Then again, courses with restricted interaction, mostly mentioned as online courses, were consistently thought of as negative for  
283 belongingness:

284 “When you don’t connect to the people, I think you feel less like you belong. Then you feel like really distant. When I felt  
285 the least like belonging [was] probably when we only had online classes, then we were like all really busy just trying to  
286 understand this and maybe just the only interaction we were having also was related to school. I really didn’t feel good. [...]  
287 I almost quit the studies, actually. [...] I was just also feeling really isolated and yeah, but then I still decided to stay”.  
288 *Interviewee 3*

289 “Maybe some of the remote courses that we did kind of in the beginning [decreased the belonging], even though they were  
290 interesting [...] it feels strange to be working online, like doing a group project with people you’ve never met and you’re  
291 just doing it online. And it’s very difficult to really kind of connect with the people”. *Interviewee 10*

292

### 293 ***Ability to belong***

294 Competency to belong refers to capabilities to connect with other people or environments. Many interviewees brought up how, for  
295 example, mental strain decreased their ability to interact with others or to take part in studies, which then affected their sense of  
296 belonging. Interviewees explained the linkage between personal well-being and belonging:

297 “If you don’t feel good inside, you maybe are not as ready to connect to others. I think, just at least to me, I feel more like  
298 I belong to a group if I feel good myself”. *Interviewee 3*

299 “I just struggled with some [psychological challenges] that haven’t been diagnosed. [...] That’s just a personal thing that  
300 has been influencing my entire time in this first and second year”. *Interviewee 6*

301

302 Related to such strain, some interviewees highlighted how courses with a heavier workload, regardless of if they found the topic  
303 interesting, seemed to decrease their sense of belonging. Interviewee 1 said:

304 “So, it was just a lot of workload, so that’s the dip [in the belonging in the chart they drew] because it was just like, you had  
305 been going on for nine months basically and just no break. I mean I was I was working on Christmas Day even. [...] Of  
306 course it was a little bit of a dip [in the belonging] because I thought it was difficult to do my master’s thesis. You know, it  
307 took a lot of me to do it”.

308



309 Similarly, lacking sufficient readiness (e.g. background information) for a course caused stress and struggles with studies, which  
310 again decreased the sense of belonging:

311 “[Low belonging], like when we were doing the statistics and stuff. Then it really like affected my self-esteem”. *Interviewee*  
312 3

313 “Maybe the Greenland course [decreased my sense of belonging] because I don’t have a very solid like science background.  
314 So, it was like all these measurements and things like that”. *Interviewee 5*

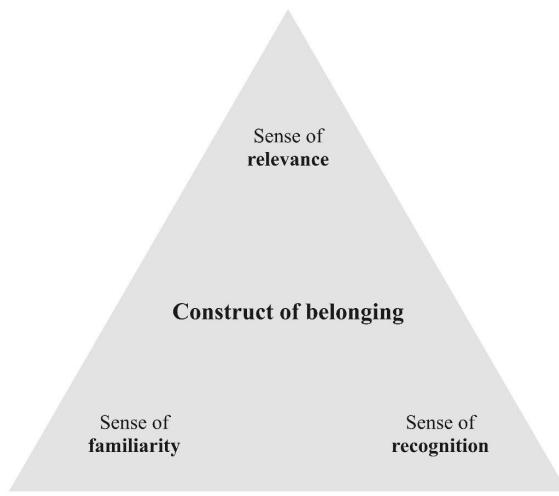
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316 Mental well-being and life satisfaction thus seem to influence the students’ sense of belonging, as also noted by Ahn and Davis  
317 (2019). Essentially, fostering a sense of belonging in higher education is not isolated from other aspects of life, as, for some  
318 interviewees, struggles in personal life decreased their capability to belong – to feel belongingness overall. Studies-related stress  
319 can be a significant contributor to students’ distress and consequently impair their sense of belonging.

320

#### 321 **4.2 Constructs of belonging**

322 From our analysis of the students’ perceived belonging, three dimensions of a *sense of belonging* construct were identified: sense  
323 of familiarity, sense of recognition and sense of relevance. These significantly contributed to the students’ feelings of connection,  
324 acceptance and engagement with the academic environment. This construct emerged from the interviews as emotional and/or  
325 perception dimensions that take part in creating belongingness (Fig. 4). These dimensions were associated with a high sense of  
326 belonging in the complex and dynamic educational context that enveloped the students’ whole education experience with the  
327 EnCHiL programme.



328

329 Figure 4. The construct of sense of belonging. Based on the content analysis of the interviewees’ experiences, three main  
330 dimensions were identified by the interviewed students: sense of familiarity, sense of relevance and sense of recognition.  
331

#### 332 ***Sense of familiarity***

333 Sense of familiarity was often associated with various elements supporting belonging. Especially in a new environment,  
334 encountering something familiar created a sense of comfort and ease that assisted the creation of attachment to new places,  
335 countries and institutions. Familiar elements, e.g. in the landscape or in the culture, created a feeling of being ‘at home’. Interviewee  
336 2 explained how they found the Icelandic landscape familiar: ‘for me, it was like coming home’. Interviewee 13 explained how, at



337 their apartment in Iceland, they had a mountain view, which reminded them of home: 'I belong to the mountains in [my home  
338 country]'. To continue, agriculture-related study activities at the campus were familiar to interviewee 2 because of their  
339 background, which therefore supported their sense of belonging:

340 "So, I felt like I fit in right away there. [...] So I actually think, from the get-go, I really felt like I belonged. But I think it's  
341 a combination of the rurality being very familiar to me and the kind of vibe of the campus being familiar for me as well".  
342

343 Knowing the local language and culture also made it easier to adapt to new settings. Some interviewees had previously spent time  
344 in their new place of residence, which they expressed as helpful for feeling belonging:

345 "Well, I mean, for me it was very nice. I already went to Finland that year before Iceland, so I knew the city and I knew, I  
346 mean, how everything works". *Interviewee 7*

347 "I would say that I had a pretty strong sense of belonging just because I knew a little bit of the area and the language and  
348 the culture of people". *Interviewee 8*

349

350 Prior knowledge of language and some local customs were important aspects in creating a sense of ease for belongingness, as  
351 interviewee 14 elaborated:

352 "So, I think the combination of knowing the physical environment, like knowing the almost bureaucratic processes, but also  
353 having a community was kind of crucial to the very stabilised sense of belonging".  
354

355 Familiarity associated with study topics was also important, as interviewee 5 explained:

356 "The [course about the] geology in Iceland. [...] So I mean that was something I was very familiar with, so I've had strong  
357 belonging there as well".  
358

359 Familiarity in course topics indicated competency in the topic in question or a connection to their disciplinary identity. Familiarity  
360 with study topics was seen as positive also because of emotional attachment to certain topics.

361 "With my thesis work, I think it makes me more connected, more enthusiastic about it because this is something that I've  
362 seen, and I've walked up on this glacier. You know, I've been there and I've seen this my whole life". *Interviewee 10*  
363

364 In a study conducted by Kahu et al. (2022), the authors investigated students' sense of belonging during their first year of higher  
365 education studies, highlighting the significance of familiarity, particularly during the orientation phase when students acquaint  
366 themselves with their studies, surroundings and peers. To continue, according to Antonsich (2010), sense of belonging, marked by  
367 a sense of comfort and safety, is highly relevant to one's attachment to a particular place. Given that the programme's students  
368 switch their study locations, institutes and social circles at least twice throughout their studies, the importance of familiarity is  
369 heightened when they orientate themselves and create a sense of place periodically.  
370

### 371 ***Sense of relevance***

372 Perceiving the programme as academically relevant for the student was beneficial for their sense of belonging. Especially courses  
373 that resonated with their future goals, hoped career paths and direction in life in general enhanced the experienced belongingness.  
374

375 "I did some courses here that I was super happy with, and I was like, OK, I'm on the right side of life. This is what I should  
375 be doing. [...] Yeah, I was working on my master's thesis, and I was also doing research [...] , and I just really sense that



376 this is what I want to do. I want to be out in the field doing some research, making some papers out of the research that I  
377 do, testing things out in nature". *Interviewee 1*

378 "[When asked which courses increased their sense of belonging] Actually, like the ecosystem ecology [course]. I think  
379 that's the one course that stood out for me because it was something a bit new. It was a big course, and I learned so much,  
380 and that's the lead into what I'm doing today". *Interviewee 5*

381  
382 Coincidentally, studying courses outside their interest areas lowered the sense of belonging for some students. For some, the  
383 multidisciplinary nature of the programme was challenging as it led to studying topics outside of their main discipline of interest.  
384 For instance, Interviewee 7 described feeling a low sense of belonging during a semester focused on social science subjects, which  
385 were perceived as unrelated to their own disciplinary expertise.

386 "For me it was like it was very messy like. I was like not fully understanding [...] what was the programme about [when]  
387 the second semester was like more like philosophy or environmental values or anthropology or something like that".

388 Despite integration and a sense of belonging in social relationships, the lack of alignment with their academic interests left them  
389 feeling disconnected from the programme.

390  
391 One interviewee had doubts in their interest in the programme in general. However, they noted that their sense of belonging  
392 improved when they enrolled in courses more closely related to their personal interests during the spring semester.

393 "Thinking back, relating to my interest and all, maybe this programme is not the best fit for me because it was maybe more  
394 [focused] into another direction [than the interviewee's interests]. But I guess during the spring, I think there I got the  
395 belonging, doing two courses that are really fitting my interest". *Interviewee 10*

396  
397 ***Sense of recognition***

398 Recognising oneself as competent and fitting to the study context, and getting external validation for it, was central for supporting  
399 belongingness. Several interviewees emphasised the crucial role of supportive teachers in shaping their positive study experience.  
400 Specifically, validation and recognition from thesis supervisors was significant for fostering a sense of belonging – potentially  
401 because, among all the coursework, thesis work most closely resembles professional research. Interviewee 2 explained that when  
402 they were doing their thesis in a research group, being treated as a colleague made them feel like they fit as a 'scientist' and into  
403 the academic sphere, thus increasing their sense of belonging:

404 "More and more, so kind of in like discussions around like, "have you looked at this paper", like kind of problem-solving  
405 discussions that I really increasingly feel more and more like a scientist, quote, unquote. So that's growing for me [as a  
406 domain to feel belonging in]."

407  
408 Interviewee 11 explained how such validation made them feel like they belonged to a research group:  
409 "Having had like a successful thesis project has helped me to you know, get a job. So I feel like I belong to that group now.  
410 [...] You know, doing this stuff well and getting good feedback of course helps in, you know, like establishing yourself in  
411 a group context".

412  
413 As crucial as it was to be recognised for one's competency by others, it was also important to recognise similarities between oneself  
414 and others alike – all 'fitting in' together:



415 “[Being around] like my kind of people, basically. Yeah, I think that makes you really belong. Like ok, these are the people  
416 you want to associate with in the future. Through all of my studies [...] I always liked the people I met, there’s not often  
417 been people that I don’t like in this field. [...] I mean, like-minded people choose, like, similar paths, basically”. *Interviewee*  
418 *I*

419  
420 Evidently, perceived misfitting then led to feelings of loneliness and alienation. Interviewees expressed feelings of detachment  
421 from their peers as they perceived themselves to be interested in things different than the majority of their peers:

422 “So, I really felt just on the side and especially because I was doing kind of another thing compared to the others. It was  
423 even harder to feel that I belonged there”. *Interviewee 12*

424 “Feeling of being kind of isolated, you know, because I was doing kinds of different things than, you know, you guys and  
425 the people around me. I felt like sometimes I was a bit isolated, and [that was] of course affecting my sense of belonging”.  
426 *Interviewee 10*

427  
428 Interviewee 10 explained having missed shared interests with others but managed to find people during some elective courses that  
429 better served their interests:

430 “Of course, I missed sometimes like having a chat about what you’re doing that is not just me talking about what I’m doing.  
431 Actually like somebody giving me feedback or having a discussion on like a deeper level related to the interest. But of  
432 course, you know, during the courses I was taking that were really interesting, I had this conversation and I could kind of  
433 have this type of, I don’t know, feeling I belonged in a group at a certain time, talking about what we are studying and what  
434 we are learning”.

435  
436 Recognition, both by oneself and others, plays a central role in fostering feelings of belonging. Being recognised for one’s  
437 competency by others was also central for the formation of professional identity. For example, Carlone and Johnson (2007) and  
438 Hughes et al. (2021) highlight the importance of recognition in a scientist’s identity development. Furthermore, Hazari et al. (2019)  
439 underscore how sense of belonging contributes to disciplinary identity. Sense of belonging and professional identity development  
440 can be thought of as interconnected processes that reinforce each other.

441  
442 Not being able to share interests or disciplinary identities with other students of the programme was disruptive for some students’  
443 sense of belonging. Even though interdisciplinary education is thought of as essential in addressing the complex issues of climate  
444 change, it also poses challenges to students with strong disciplinary identities and, consequently, to their sense of belonging.  
445 However, some research suggests that exposure to multidisciplinary environments can strengthen disciplinary identities  
446 (Geschwind and Melin, 2016).

447  
448 During master’s studies, one’s disciplinary identity is still under process. One interviewee explained how learning and engaging  
449 with the knowledge community affected their sense of belonging, as it seemingly led to the students to create a shared disciplinary  
450 identity:

451 “I think the more you learn about the topic, the more you feel that you belong there. Because the more you know about the  
452 topic of your studies, just the more you can connect with other people from your programme”. *Interviewee 12*



453

#### 454 **4.3 Sense of belonging in climate and geoscience education**

455 Effective climate and geoscience communication strategies in education overlap with elements that relate to the learner's sense of  
456 belonging to their learning community, to the cultures of their study contexts, to the field of experts they are developing to be a  
457 part of, and to the interactions with the society around them in their future expert role (Donaldson et al., 2020). In addition, factors  
458 that foster a sense of belonging among students—such as engaging in deliberative discussions, interacting with scientists, or  
459 implementing community projects—are recognised as generally effective in climate education (Monroe et al., 2019). These are  
460 elements that contribute to the students' sense of connection and belonging to the educational setting—which in their case  
461 encompasses the aforementioned elements and factors. This suggests that effective geoscience communication, also the case of  
462 climate change education, is interconnected with students' sense of belonging and vice versa: paying attention to effective  
463 pedagogies and methods of communication ought to heighten the students' belongingness and their heightened belongingness ought  
464 to strengthen the effect of the education. Thus, creating a learning environment where students can connect to the subject matter  
465 and its relevant context—be it socially, culturally, contextually—appears as a key element for effective climate change education.  
466

467 Familiarity and connection with places and locations is beneficial for belongingness. Place attachment can motivate someone to  
468 climate action (Devine-Wright, 2013) and is thus a relevant aspect in climate change education. By incorporating local and tangible  
469 aspects of climate change and sustainability, educators can foster a deeper connection between students and the subject matter,  
470 they could provide a meaningful learning experience while enhancing their understanding of the topic and their sense of  
471 belonging—while they could also manage a better comprehension of the plurality of perspectives that are attached to geosciences  
472 (Hall et al., 2022).

473

474 While interdisciplinary education is essential for addressing the complexity of climate change (McCright et al., 2013) and  
475 geoscience education benefits from happening in relevant locations (King, 2008), high mobility and interdisciplinarity can also  
476 pose challenges to students' learning and professional identity development (Donaldson et al., 2020; Geschwind and Melin, 2016)  
477 and to their sense of belonging. Support for the students' disciplinary and pre-professional identities, in the kind of programmes  
478 studied here, is crucial. For example, directing the students to self-determine the scope of their courses can further enhance their  
479 sense of belonging, and resulting in a balance with core geoscience concepts and interdisciplinarity of the programme again  
480 enhance the communication of the science itself—which too has various relevant disciplinary and non-disciplinary contexts (King,  
481 2008).

482

#### 483 **4.4 Limitations and future research**

484 With our study aimed to shed light on students' sense of belonging within a multidisciplinary master's programme, we will address  
485 some acknowledged limitations in contextualising the findings. First, the unique nature of the programme, characterised by its high  
486 level of mobility and research orientation, is a notable factor. The alignment between the programme and the future career  
487 aspirations of the participants could compare differently for students in other climate science-oriented programmes; thus, the  
488 relevance of our conclusions in other educational contexts could also differ. The relatively small size of programme cohorts and  
489 particular intensive teaching periods can also influence group dynamics and interpersonal relationships, thereby shaping students'  
490 experiences of belonging. This led us to mitigate the limitation by interviewing individuals from different cohorts. Last, the  
491 language proficiency of interviewees may have caused potential limitations in their ability to articulate their experiences more  
492 effectively during interviews. Despite these limitations, our study contributes valuable insights into the multifaceted nature of sense



493 of belonging within the context of higher education, particularly in multidisciplinary programmes focused on climate change and  
494 sustainability. With future research, we would address the mentioned limitations in the breadth and width of sample groups, further  
495 mitigating any factors influencing the theories and methods employed here. To continue, future research endeavours on students'  
496 sense of belonging, its effect on transformative learning and epistemic identity development and, foremost, the effect on the  
497 potential of effective impactful geoscience communication and education are surely due.

498  
499 **5 Conclusions**

500 The purpose of this study was to explore students' sense of belonging and the conditions for it in a multidisciplinary master's  
501 programme. Our interest in the programme stemmed from its high level of mobility, which poses a challenge to students in forming  
502 a sense of belonging compared to a typical educational setting. The chosen theoretical approach and the formulated framings for  
503 the interviews and further content analysis seemed to function well for the purpose and led to relevant and original insights. The  
504 semi-structured interviews among the purposefully sampled group of 15 students showcased the theory-suggested conditions for  
505 sense of belonging, namely motivation, opportunities and the ability to belong, and their empirical appearance among the students.  
506 Furthermore, an additional construct of sense of belonging emerged from the analysis. This construct consists of the students'  
507 sense of familiarity, recognition and relevance, which, in our view, could help address the sometimes-opaque presence of a sense  
508 of belonging as a vital condition for effectively communicating the concepts and ideas of geoscience in education. Considering  
509 this sense of belonging construct, we thus suggest that educational planning, curriculum design and professional development in  
510 climate change and sustainability-related education in general ought to consider the sense of familiarity, recognition and relevance  
511 as utilisable bridges to strengthen the learners' belonging in a given programme, or context, even if in flux.

512

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515 KS-A, and RL; and revision editing by SJ and LKA.

516

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518

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