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ARTICLE



## Students' negotiations of belonging in geoscience: experiences of faculty–student interactions when entering university

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### ABSTRACT

In this study, we explore how interactions with faculty influence first-year geoscience students' negotiations of belonging in a study programme. We situate the study within the field of retention and use the concepts of belonging and culture to analyse our empirical material, collected through ethnographic fieldwork. We explore how faculty–student interactions during geoscientific fieldwork and in an “interview exercise” give students access to explicit and tacit knowledge about doing geoscience research, the department culture and possible careers in geoscience. The analysis shows that faculty–student interactions offer important avenues for the students' negotiations of how they belong in the study programme (who they are) and in assessing their future possibilities (who they want to become). However, while positive for some students, the perceived needs to be highly devoted to the discipline and to perform in the field poses challenges for other students' sense of belonging in the geoscience programme. By situating activities in the wider context of the culture of the study programme and analysing the combined effect of different faculty–students interactions, we find that institutions must offer first-year students possibilities for creating a sense of belonging that are varied, authentic and inclusive.

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Faculty–student interaction;  
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### Introduction: arguing for a wider perspective on faculty–student interactions

In the literature on retention, students' interaction with academic staff is seen as an important part of studying at a higher education institution in the sense that affirmative and good interaction improves the students' educational experience (Pascarella & Terenzini, 2005). In higher education geosciences, a wide range of faculty–student interactions is used, fieldwork probably being one of the most characteristic. Fieldwork offers a space for both formal and informal interaction between students and faculty in a natural environment. Another specific approach to faculty–student interaction that seems to have originated within the discipline of geography is students interviewing

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researchers (Cosgrove, 1981; Dwyer, 2001; Gregg & Leinhardt, 1994). This staff–student interview has been suggested to be effective in introducing students to the scope and nature of geography (Dwyer, 2001). It is now used as an example of integration between research and teaching in higher education (e.g., Healey, 2005; Healey et al., 2003; Healey & Jenkins, 2006) and has in various forms been implemented at several universities in the United Kingdom (Jenkins, 2003, 2014).

In this paper, we wish to add to the existing literature by studying faculty–student interactions not as isolated events, but as part of a range of faculty–student interactions that occur in the first year in a geoscience programme at university. We do this to unfold how the faculty–student interactions during the first year gives the students’ access to the disciplinary practices, the scope and nature of the discipline and to learn what it means to become a geoscientist. To address this aim, we situate the study within the research area of retention and use the concepts of belonging and culture.

### *Faculty–student interaction in the retention literature*

Research on retention in higher education has changed from being focused on the students’ prior knowledge and preparedness to emphasizing the students’ teaching and learning experiences in the study programme (Ulriksen et al., 2010). The change in discourse shifts the perspective from viewing student dropout as personal failures, to focusing on the interaction between students, the programme and the institution (Seymour, 2002; Ulriksen et al., 2010). This shift has largely occurred after Seymour and Hewitt (1997) showed that there are more similarities than differences between the students that choose to either stay or leave a programme, and highlighted the structure of the programme and the culture of the discipline to explain this. Central in the retention literature is Vincent Tinto’s (1993) institutional model that emphasises a sociological approach to student interaction with the institution. In the model, students’ academic and social integration into the discipline are the central elements, and faculty–student interactions are explicitly identified as factors in the integration and retention of students. The research on retention has recently undergone a shift towards persistence and been linked more closely to students’ sense of belonging, exemplified in Tinto’s (2017) conceptual model of student persistence. Here, the students’ ability to see themselves as valued members of a community is significant for their persisting within a programme; hence, the sense of belonging becomes important.

### *Sense of belonging*

Sense of belonging is a product of how persons perceive themselves and how they feel that others perceive them. In a widely cited paper Baumeister and Leary (1995) state that “a need to belong is a fundamental human motivation” (p. 497). Belonging is also part of Maslow’s (1954) psychological hierarchy, and both are used in educational research to explain the importance of belonging. Research conducted in secondary schools show that students’ sense of belonging is important for motivation, behaviour and performance outcomes (Goodenow, 1993a, 1993b; Osterman, 2000). Higher education research shows that students’ sense of belonging is influenced by a wide range of factors both within the institution (Tinto, 1993, 2017) and beyond campus such as social class (Ostrove & Long, 2007) and ethnicity (Hurtado & Carter, 1997). Baumeister and Leary (1995) propose that

belonging has two main components: frequent interaction that preferably is positive, but most importantly not exclusively negative, and interpersonal affective bonds or relationships. The second aspect provides a relational context, where the perception of a bond is essential: belonging is connected to the belief that others care (Baumeister & Leary, 1995). Both components must be present to create a sense of belonging.

If we apply this insight to higher education and faculty–student interaction, it is clear that it takes more than irregular and/or uninterested interaction to create a sense of belonging. Faculty–student interactions need to be both authentic (or at least perceived by the students to be so) and take place over longer periods of time, with students meeting members of faculty that repeatedly affirm the faculty–student bond. Stable and supportive relationships with other students also play a role in belonging, underlining the importance of social networks among the students (Tinto, 2017).

Creating a sense of belonging is closely linked to developing identity, and research on retention has in recent years increasingly drawn on identity as a framework to explore the relation between the student and the institution (Ulriksen et al., 2010). Research shows that first-year students over time negotiate a coherent narrative in order to create belonging in a programme (Holmegaard et al., 2014; Ulriksen et al., 2017). When we narrate and negotiate our story, we make sense of our experiences and we cannot do this alone, in the same way that claiming an identity requires the participation and recognition of others (Carlone & Johnson, 2007). In the processes of creating belonging the student thus needs to navigate within the institution and the culture of the programme wherein lay norms, tacit knowledge and implied notions (Gerholm, 1990; Polanyi, 1966; Ulriksen, 2009).

### *Enacting a culture*

Every culture includes a specific set of rules and to become a member we must learn to navigate these rules (Gerholm, 1990). The cultural rules of science are linked to how we understand science and constituted in a set of cultural values governing the activities termed scientific (Merton, 1973). In higher education, each member of faculty takes part in shaping, performing and carrying the cultural rules of science within a particular institution. The cultural knowledge can be explicit (formally stated), or tacit (implicit rules guiding behaviour), and is deeply embedded in the scientific discourse (Brew, 2001; Polanyi, 1966). It informs its members on, e.g. how the scientific discipline produces knowledge, what is regarded as worthwhile scientific questions to pursue, and what the faculty and student's roles are at the department. To successfully act in academia the students need access to both the explicit and the tacit knowledge particular to their scientific discipline and the department they attend. Students typically gain access to this cultural knowledge over time as they progress in their studies and interact with older students and faculty: “The more frequent the contact between experienced researchers and their students, the greater the likelihood that the tacit knowledge of the discipline is being passed on” (Gerholm, 1990, p. 268).

In other words, students need to interact with faculty to learn both the explicit and the tacit knowledge in science. Both types of knowledge can be used in the students' negotiations of belonging to the discipline. We, therefore, argue that in order to explore first-year retention and belonging we need to take a wide view of the activities in the first year and how they intersect.

## The study

The current study aims to analyse faculty–student interactions from a perspective of belonging and culture. Above, we have unfolded the faculty–student interaction in relation to retention, which provides us with a framework to analyse the complex linkage between the student, the institution and negotiations of belonging. The faculty–student interaction can be viewed as a way of presenting the student with ways to “fit in” at the institution. If a student is able to successfully negotiate her sense of belonging in the institution, she is more likely to persist in the programme. This study thus places belonging and culture in the foreground but recognises that identity is an important part of both these terms, as outlined above.

The study is conducted at the Department of Geosciences, University of Oslo in Norway. Here we are interested in exploring the students’ experiences and negotiations in relation to the activities the students meet in the first year, as posed in the following research questions:

RQ1: How do first year geoscience students interpret the disciplinary culture they encounter through different faculty-student interactions?

RQ2: How do first year geoscience students negotiate what they experience in these interactions in relation to their belonging to the study programme?

## *Situating the study*

The University of Oslo is a research-intensive university with 28,000 students and 6000 employees (Ottersen & Bjørneboe, 2016). The Department of Geosciences is one of the eight departments at the Faculty of science with approximately 135 students and 202 employees, thereof approximately 40 tenured faculty members with teaching responsibilities (Department of Geosciences, 2016).

## *Fieldwork in the first year*

The first week of introduction to the university includes half a day in the field in the local area of the Oslo fjord. This field trip introduces the local geology and aims at creating further interest in the subject. One member of faculty and a group of PhD students teach and make links to their ongoing research. A social element is arranged after the fieldwork, providing the students’ opportunity to engage informally with the members of faculty. Immediately after the introduction week, the students travel to the alpine area of Finse in central Norway. The days in the field are planned as hikes in the area, where the teachers introduce rock types and features of the glacial landscape along the way. The students collect data in the field to construct a geological map featuring rock types and direction of ice movement during the last glaciation, with the support of the teachers in the evenings. The final field experience in the first semester is a one-day bus excursion in the wider Oslo area. In the spring semester, the students return to the field after the winter for 3 one-day trips in the Oslo fjord area. The focus is placed on practicing the field techniques introduced during the academic year, particularly observing and documenting through

sketches and field notes, and adding to the understanding of the complex geological history of the Oslo fjord.

*The interview exercise*

A few weeks into the first semester, the students are presented with the task of interviewing a member of faculty (see Table 1). The students are divided into groups and are instructed to contact a researcher and make an appointment; they request one scientific paper, the CV, and a list of publications from the researcher. As preparation for the interview, the students read the scientific paper. In the interview, the students’ task is to gain insights about the scope and nature of the interviewee’s research. The students are

**Table 1.** Interview exercise guidelines for geoscience students in table format.

Interview exercise guidelines	
Aim of the exercise	<ol style="list-style-type: none"> <li>1) To introduce you to academic research in geoscience in general and here at University of Oslo in particular.</li> <li>2) Presenting results to a group of recipients.</li> <li>3) Do teamwork. You will be placed in a group, which is responsible for interviewing a scientific employee at the Department of Geosciences.</li> </ol>
Interview	<ol style="list-style-type: none"> <li>1) Select a researcher to interview. All staff at the department can be found on the institute’s website (<a href="http://www.geo.uio.no">www.geo.uio.no</a>) under “Persons”. In the menu, select “scientific staff”. Here you can identify different researchers and their research interests. Everyone on this list is by definition a researcher even though the title is not “researcher”. A PhD student is someone doing a doctoral degree. A post doc is a researcher who has just finished the doctorate. Associate professor/professor have approx. 45% research time in their position. Each person has their own website where you can find e.g., what courses they teach and what they have published.</li> <li>2) Contact the researcher by email or visit the researcher, introduce the group and inquire about an interview. The researcher may say no. If so, find someone else. Ask the researcher to send you a scientific article that exemplifies his/her work and request a copy of the CV and a list of publications. Decide date and time for the interview.</li> <li>3) Read the article that has been sent to you. You may not understand much, but try to figure out what questions the researcher tries to answer in the article, why this question is interesting, and what methods the researcher uses. Try to find out if the article has been cited (referenced) by other researchers (e.g., use Google Scholar and search for the title of the article). Examine the researchers CV and publications. What does a research career look like? Has the researcher worked abroad or in the private sector?</li> <li>4) Plan the interview with your group. Discuss the plan, prepare questions, think about how to ask the questions and record the answers.</li> <li>5) During the interview:               <ol style="list-style-type: none"> <li>i) Be sure that you understand the scope and nature of the research topic of the researcher.</li> <li>ii) Discuss the article you have read. What was the research question in the article? How does an idea become a research project and finally an article?</li> <li>iii) Find out why the researcher ended up doing what he/she does? What is the connection between their education and other interests (e.g., mountain climbing, diving or knitting)?</li> <li>iv) Where does the research fit in the geoscientific research at the department?</li> <li>v) Find out if he/she have any tips for new students!</li> </ol> </li> </ol>
Presentation	<p>Each group will give a short presentation (about 5 minutes). Here you must (at least) include the following:</p> <ol style="list-style-type: none"> <li>i) Present the interviewed researcher. Do not forget to take a picture during the interview!</li> <li>ii) Present his/her research with examples from the article you read or what you found out.</li> <li>iii) How does the researcher’s research relate to his/her education and interests and the geosciences as a whole?</li> <li>iv) What did you think was particularly interesting/surprising/inspiring/strange?</li> </ol> <p>Each group member is responsible for the entire presentation. Each group member must be present during the presentation. All members must be prepared to present all parts of the presentation.</p>
Pass/Fail	<p>This assignment is obligatory. We emphasize effort. Or to put it another way: you will not fail due to lack of presentation skills, but you will fail if the presentation shows a lack of effort!</p>
Student evaluation	<p>Each group is asked to do a short evaluation of the exercise and summarize what worked and what did not work during the group work. If something did not work, why do you think that was ?</p>

instructed to ask how the researcher came up with the idea for the paper, how it is related to the research field and how it was developed into a publication. Secondly, the students are asked to explore how the researcher's career has evolved. For the final part of the exercise, the students give a short presentation of the researcher and their research to the class. The interview exercise is both part of the students' introduction to research and part of the teaching activities in the introductory Earth System Science course.

## Methodology

The first author, a trained geologist and educational researcher, collected the empirical material through ethnographic fieldwork with observations conducted at selected times during the students first year. The time spent as an observer aimed at understanding what it is like to be a new student and documenting the lived experiences at the university (cf. Feig, 2010; Streule & Craig, 2016). Observations of the fieldwork were conducted in accordance with short-term ethnographic techniques (Pink & Morgan, 2013) and extensive fieldnotes were produced (Emerson et al., 2011; Walford, 2009). The observations of the field activities focused on the students' possibilities for participating, the interactions between students and teachers, the outline of the teaching and the use of exercises or data collection in the field.

A brief overview of the empirical material and a timeline is provided in [Table 2](#).

Empirical material specifically related to the interview exercise includes observations of all the students' oral presentations and interviews with seven individual students. The individual interviews were audio-recorded and transcribed. The aim of the interviews was to provide in-depth knowledge about the students reasoning about research in geoscience and how they saw themselves belonging in the programme. The interview guide was designed to be open, with a few guiding questions. The interview also functioned as a validation and expansion of the observational findings as it was structured to facilitate general discussions about the students' experiences in the programme (Creswell & Miller, 2000).

The students were informed that they would be anonymous in the study, that personal information would not be shared and would not influence their grades or course assessment. Conducting observations and interviews have an impact on the participants because the research method is interactive (Angrosino, 2005). Hence, the interview may have had an effect on the students' attitudes and learning processes, as it promoted reflections around studying and belonging in the programme. The students met the educational researcher several times across the year of observations; some approached the researcher with curious questions about the study or asked for help in the field. We see no direct indications in the empirical material that student responses and reflections are influenced by participation in the study. However, as the educational researcher and the students did spend a considerable amount of time together it is likely that the interactions did influence the students' experiences in their first year to some degree.

## Analysis strategy

A thematic analysis was conducted to identify patterns across the observational and interview data (Braun & Clarke, 2006). The analysis focused on the different types of

**Table 2.** Overview of ethnographic fieldwork in the students first year.

Time	Data	Description
First week of the autumn semester: Week 33	Observations	The first week of introduction to the university. The students are met by administrative and academic staff, and by older students in a mentoring/social role. The introduction includes social and academic activities structured by the department aimed at giving the students information about the study programme and a social network. The first week includes a half-day in the field in the local area.
Week 34	Intense observations	Three-day introduction to fieldwork in the Alpine area of Finse, Norway. The field teaching combines introduction to geological processes and materials encountered in the field with data collection by the students. In the evenings, the students organize their data and the teachers explain selected scientific concepts. The students construct a simple geological map with their data. Back at the university, the students produce a field report.
Week 35	Observations	Two-day learning environment seminar off campus with an overnight stay, arranged each year for the new students at the department. The students work with the psychosocial learning environment and organise informal social activities.
Week 35	Questionnaire	The students answer a short questionnaire about research in geoscience and becoming geoscientists. Most of the questions are open-ended.
Week 36	Observations of first introduction lecture	Teaching in the autumn semester begins. The students attend a course in Earth System Science along with courses in mathematics and programming.
Week 36	Intense observations	The students are introduced to the interview exercise (Table 1). The students have two weeks to complete the task.
Week 38	Intense observations	Oral presentations in groups. The students present the research they interviewed and what they learned from the interview. The observations focus on how the students present the researcher, what words they use to describe the research and what the students formulate that they have learned from the researcher.
Week 39	Questionnaire	The students answer a short questionnaire about research in geoscience and becoming geoscientists. Many questions are repeated from the survey in week 35. An evaluation of the interview exercise is added to the survey.
Week 42	Intense observations	One-day bus excursion in the wider Oslo area. The scientific content is closely linked to the course content on glacial morphology.
Week 44, 48, 49 and week 5 in the spring semester	Qualitative interview with individual students. Six students in the autumn and one student in the spring semester.	Selected students are invited to participate in an interview. Seven students agree to participate. The interviews take place at the Department of Geosciences and at the Science Library on campus. The interviews last about one hour and include questions on interest, choosing geoscience, first experiences of the programme, ideas about research in geoscience and becoming a geoscientist.
Week 18 and 19	Intense observations	Three one-day field trips in the Oslo area. Focus on practicing field techniques and introducing the local and regional geology.



faculty–student interactions in the first year and found the interview exercise and the fieldwork at Finse to be particularly important for the students’ negotiations of belonging. As seen in Table 3, the faculty–student interactions are more varied and intensive during the fieldwork at Finse than the other field encounters. In particular, the number of teachers is higher and the type of exercises are different, encouraging more, and more varied interactions between faculty and students.

The second step in the analysis generated three themes: 1) how the students perceive the academic culture in the department, 2) their negotiations of belonging in the programme and 3) the possibilities the students see for themselves in the future.

In the analysis, theme one includes the students’ understanding of the practices of geoscience, which refers to enactment, e.g., using knowledge, investigation of phenomena and the dominant methods in geoscience. The aim is to analyse how the students interpret the geoscience practices, and how they translate this into interpretations of the culture (Gerholm, 1990; Polanyi, 1966). For themes two and three belonging is used as an analytical framework to understand the students’ negotiations of how they fit in (Baumeister & Leary, 1995) and interpretations of their possible future selves in the geosciences (H. Markus & Nurius, 1986).

In the analysis, we provide examples of how each theme contributes to our understanding of how the students interpret the scientific culture and negotiate their belonging. We contextualise this by discussing specific departmental practices and elements of how the programme is structured that influences the student negotiations.

## Students’ belonging in geoscience

Throughout their studies, students will negotiate their belonging in the programme and try to align their interests and aspirations with the culture they meet (Holmegaard et al., 2014; Ulriksen et al., 2017). In the analysis, we unfold how geoscience students in a particular programme use the faculty–student interactions in their ongoing negotiations of belonging in the department culture (theme 1), the geoscience discipline and the field (theme 2) and in relation to their possible futures (theme 3).

### *Belonging in the department culture*

The first weeks of introduction to the geoscience programme are spent on social (learning names, study environment seminar), academic (scientific presentations, fieldwork) and practical activities (tuition fee, library, the programme and rules). Aligned with the research of retention and first-year experiences (Kift et al., 2010; Yorke & Longden, 2008) the goals are to make the students feel at home in the department and get the best possible start. Teaching in the field and the interview exercise are natural extensions of this effort. Both activities provide space for students to interact with faculty in a combination of formal and informal settings.

I have friends that attend university and they experience a poor social environment. They have not had any friends but our tutors in geoscience have been good, and because we had the field trip and Sundvolden [learning environment seminar] then it is impossible not to make friends . . . we go on field trips and become a group of people where everybody talks to each other. (Student\_4 interview)

**Table 3.** Field activities in the first year and analysis of faculty and student roles.

Time	Field activity	Faculty role	Student role
First week of the autumn semester: Week 33	Half-day in the local area of the Oslo fjord. A social element is arranged after the teaching by older students in a tutor role.	One member of faculty (geologist) and 5 PhD students introduce the local geology and show students specific traits of the geology, e.g., fossils and dikes. The PhD students explain their research.	Students listen and ask questions. Explores some features such as sedimentary structures and chilled margins in groups. In the informal setting students talk to older students and faculty.
Week 34	Three days in the field. The group stays at the university's local field station at Finse, Norway.	Five members of faculty teach; two geographers, two geologists and one teaching assistant. The four teachers take turns in teaching as the group of students are guided across the terrain. The teachers make small presentations at selected locations and guide the students' independent exploration and data collection.	Students listen to introductions and collect data in small groups in the field. In the evening, the students work with their data and can ask questions. During the stay the students have opportunities to interact informally with the faculty.
Week 42	One-day bus excursion in the Oslo area.	One member of faculty teaches, a geographer. The teacher introduces the different locations and explains how they are connected.	Students listen and take notes.
Week 18 and 19 in the spring semester	Three one-day excursions in the Oslo fjord area.	Three members of faculty teach: one geologist and two teaching assistants. The teacher introduces the area and tasks. Teaching assistants guide the students in solving tasks.	The students listen to the introduction and work in groups to solve the different tasks.

Students' relations to tutors and participating in the field activities provide opportunities for creating a sense of belonging to the department and the interview exercise creates a space for the students to observe the culture in the department. The analysis of the individual interviews and surveys show that the students encounter a culture among the researchers where being highly invested in the geosciences is ubiquitous.

Interviewer: Have you changed the way you think about what it entails to be a researcher in geoscience?

Student\_3: Yes, there was something new, that I actually did not know, so it was nice to do the interview.

Interviewer: Do you think about something in particular?

Student\_3: Perhaps, that they use so much of their free time, and such, like, it is work, but they include much of their free time (...) what was common for all the researchers were that they loved their work. (Student\_3 interview)

During the oral presentations, the different student groups also report an advice given by practically every researcher interviewed: "find your main interest and let that guide you". In fact, the notion of "interest" is an integrated part of the task in the interview exercise. The assignment explicitly states that the students should ask the researcher about the connections between their education and other interests (e.g., mountain climbing, diving or knitting; Table 1). The implicit message to the students is that there is a strong link between a geoscientist's interests and personal life, on the one hand, and a career in geoscience on the other. Based on this, the students then infer that in order to belong and to become a successful geoscientist they too must be equally invested in the geosciences. This can create a quite narrow definition of how to belong in the department, suggesting to the students that their interests, personal life and aspirations must be interwoven with their studies. Statements in the survey also give some indication of this:

I have learned that it is important to be interested in what you research.

I just learned that as long as I find something that interests me, it is not as much a job as it is a lifestyle.

I have realized that I need to be very interested if I should use a lot of time on research. (Student survey)

The students' interpretations show how a particular type of student is acknowledged and reinforced in the culture. This is important in relation to belonging and retention because it shows how one particular way of being a student is legitimised, which can be difficult for some students fit in to (Hurtado & Carter, 1997; Ostrove & Long, 2007). In the empirical material, we see signs of students reflecting on how they belong or not:

I think I fit well into it [doing research in geoscience]. Think it is very exciting.

I think I don't quite fit into geoscience. (Student survey)

Here, we do not know what exactly brought on these reflections, though it is clear that these first-year students contemplate on what they meet in the programme and evaluate what it means for them and their possibilities of belonging.

An important part of belonging is the perception that others care (Baumeister & Leary, 1995) and for new students at university, the personal interaction with faculty can be central. In the staff-student interview exercise, the students report meeting a passionate researcher that took the time to engage with them and cared that they thrive in the programme.

It is so nice to walk in the hallway now [after the interview exercise]; you recognize a few more people and greet them. There is kind of a cosy and good atmosphere. (...) if there is something you are interested in then it feels easy to contact them [the researchers] and ask.  
(Student\_2 interview)

Observations of the oral presentations confirm that the students feel seen and appreciated by the faculty in this faculty–student interaction. One of the interviewed students further explains that another group of students contacted a different researcher to get help on an assignment later in the semester: “they kind of did the interview again”. In a discussion of the staff–student interview exercise, Brew (2006) argues that there are no evidence of continued contact between faculty and students after the interview. However, this example suggests that the barrier to interact with faculty has been lowered and that some students have come to perceive faculty at the department as a resource available to them in other situations during their studies.

The students also report on a supportive social environment among the students, which is both linked to the group work in the interview exercise and the field experiences. These activities thus support the social network building among the students.

### *Belonging in the geoscience discipline*

The analysis of the survey shows that most students enter the programme with an interest in the ‘big questions’, e.g., climate, evolution of Earth, sustainability and the importance of geoscientific knowledge in our society. One student explains in the individual interview that it can be a challenge to understand how content knowledge in the different courses is connected and provides answers to the big questions. Here the student explains how the interview exercise contextualises the content knowledge.

Interviewer: What do you think was interesting about the interview?

Student\_1: About the scientific content, the way the researcher worked, and the content of the paper when he explained it. It was very interesting but also a bit difficult to relate to.

Interviewer: So it was more the process in research, than the paper?

Student\_1: And why it is interesting. Like the sandstone, it is not that interesting in itself but finding out how it is related to a mountain chain that was extremely exciting.  
(Student\_1 interview)

In this case, the researcher makes the link between the specific content (the sandstone) and the “big questions” (evolution of a mountain chain). Hence, the interview allows the

researcher to make the links between the (opaque) results reported in the scientific paper, the research process, and the “big questions” explicit, enabling the students to relate and connect content knowledge to their personal reasons for studying geosciences.

Several students notice that the geoscientists usually base their research on data they collect themselves; this is commented on in the oral presentations and in the survey. This strong empiric element surprises some students as it does not match their idea about natural science as more theory driven. During their own fieldwork, the students experience how their data, as they are transferred to the map, provide new knowledge about the Finse area. This exemplifies for the students how geoscientists construct knowledge from empirical data. The interview exercise provides insights into some of the associated steps of research, such as processing the data, analysing and publishing the results. The fieldwork and the interview exercise thus supports each other in shaping the students' ideas about working in geoscience.

Interviewer: What was it like to read the paper?

Student\_2: It was difficult, very hard; we used a lot of time just to get through the title. But after we got through the first page, we just read through it and perhaps we understood some of the context, but it was afterwards when we talked to the researcher that we learned something and understood what it actually was about. (Student\_2 interview)

When the students try to read the paper, they access the explicit and official part of the discipline, whereas the discussion with the researcher offers access to the ideas behind and insights into the research practices within the discipline. One of the students describes the impact of the interview of the researcher on ideas about the discipline and the geoscientist:

Student\_3: It was interesting because ‘a researcher’ it is a quite distant word, for me, at least. Before we did it [the interview] researchers do this and this (waves hands) but now I know what different researchers do. Some were geologists and some were glaciologists. (...) Before, when I thought about a researcher, before I met these ones, I thought about someone in the laboratory testing things, but perhaps that is more like a chemist. So getting an idea about how they are in geoscience, to learn how they work, that was interesting. (Student\_3 interview)

The analysis shows that interactions with faculty both in the field and in the interview exercise leave this student with a much more nuanced idea of research processes and disciplinary differences within geoscience.

Taking a longitudinal view on faculty–student interactions allows us to see that students (re-)combine and negotiate their experiences of the interactions continuously. This is also the case for the following student who connects her experiences in the field and the interview exercise to explain why she finds research exciting:

Interviewer: Do you remember anything from the other [student] presentations?

Student\_2: I remember the one about landslides in China, I think it was very exciting because you can't go there easily and I think it was cool to learn about because there are a lot of things that are unresolved, even though we have spent so much time figuring things out. I think it's cool that there are some things that are unclear and you have no

idea what happened. You get some aha-experiences, like what we learned at Finse: that we are not quite sure when the mountains were formed, it's like, ha! I thought it was something everyone knew, I told it to my whole family and they also thought it was awesome, such little things, you get a little fascinated by things you don't know yet. (Student\_2 interview)

In the following analysis, we expand on how different faculty-student activities intersect and what it means for the first-year students.

### *Belonging in the field*

Fieldwork is considered a key element in teaching students the nature of geoscience and in the process of becoming a geoscientist (Raab & Frodeman, 2002). The main reason for including fieldwork very early in the programme is the known affective and social benefits (Boyle et al., 2007). Initiating the students into fieldwork also means that the students have a physical reference and experience to draw on later in the programme.

The most intense field encounters the students have taken place in the alpine area of Finse over 3 days (see Tables 2 and 3). On arrival, the students immediately set out on a four-hour hike from the train station, followed by 2 days of eight-hour hikes. Half a day is spent hiking on a glacier in roped parties. Based on the individual interviews and observations in the field we found that for some students, the fieldwork experience is anticipated and exciting. For other students, this fieldwork is their first time in the mountains and they have prepared by buying new clothes and hiking boots, as advised by the teachers. In both groups of students, their negotiations of belonging in the field intersect with their interpretation of belonging in geoscience. One of the students describes it as a positive relation:

I see myself as a researcher because I think it would suit me well to work in the field.  
(Student survey)

Whereas others have an experience of a negative relation:

In this moment I do not feel secure in the field but perhaps the potential could become greater in time.

I am a bit insecure. I do not see myself being out in the field all day and I have a feeling that research takes time. (Student survey)

Based on the observations in the field, some students struggle with the physical challenge and thus have limited time to observe, make drawings and collect data during the allocated time in the field. One student describes how it became difficult to construct a final map due to too few observations recorded in the field. The student associate being able to perform in the field with being able to perform in relation to learning the content. Hence, the experiences in the field intersect with the students' negotiations of belonging in the geoscience. In a study of disabled students, Stokes et al. (2019) show how the physical element of fieldwork can make disabled students reconsider a future in geoscience. However, this can also apply to non-disabled students if the physical challenges influence the learning experience, as the findings above indicate.

The observations conducted at the department and in the field throughout the first year confirm what is well known among the faculty, some students struggle with the fieldwork, and will leave the programme because of it.

In the field, students can learn to “see” as a geologist (Turner, 2000), and spending time with faculty-students gain access to practices through which they can interpret what it means to be a geoscience person (Dressen-Hammouda, 2008). One student describes how she is now enacting a sense of belonging in the field:

When Dad and I were in the mountains recently, we saw something nice and had to stop the car and had to look up and see what it was. I took many pictures (...) in the past I might have just said: “okay, yes, it is mountains”. Now I am a more interested (...) I knew nothing about the place, but now I can try to understand a bit more. (Student\_2 interview)

The student connects her interest in geoscience with this new way of “seeing” and reading nature. It shows how the experiences in the field are negotiated, enacted and finally reflected upon in the interview. From this, we see how faculty–student interactions in the field can influence students understanding of themselves and their position in geoscience.

### *Belonging and future selves*

The geoscience students use the experiences in the field and the interview exercise to gain insights about future employment possibilities and use this information in negotiations about future selves. Future selves or possible selves are defined as conceptions of the self in the future and are derived from representations of the past (Markus & Nurius, 1986). They are also important in the students' negotiations of belonging (Holmegaard et al., 2014). Future selves are regarded as the cognitive manifestations of enduring aspirations, and influence the student's motivation by providing a clear goal to strive for (or something to avoid) and energises the individual to pursue the actions necessary for attaining a possible self (Markus & Ruvolo, 1989). One student actively makes use of the interview exercise with the researcher to explore her possible self in the future. The student chooses a researcher within a specific field who also has experience from industry. The student tries to imagine what her future self would look like in this line of work in industry and she re-negotiates this based on the interview exercise. The student recounts how the researcher explains why she quit the industry job and returned to the university; the job included many tasks besides working with geoscience, such as project management and keeping track of the economy in the project.

This was very important because I think, as a new graduate, working as a [specific title] seems so tempting. It is like very high class, so cool (smiles), but I think it can be very tough too. I think it is important to know what you are getting into. So perhaps it was not really my thing anyway, but ... yes, she shared both the good and the bad, which was great. (Student\_4 interview)

This student gains access to details in the researcher's career path and this influences how she negotiates her own aspirations. Other students negotiate their belonging in research:

I like geoscience research and want to explore something in depths sometime in the future. I am on the contrary not sure if it is something I want to do for a long time. To publish papers could be quite boring.

It seems very exciting but I am not sure if I want to invest so much time/years in academia. After my education I would like to work with something more practical. (Student survey)

We see how the students through the faculty–student interactions get insights into future possibilities, although somewhat limited as the setup is within the university and how they negotiate these possibilities with their sense of belonging. Research shows that outlining different career paths and talk about overcoming challenges in science can provide students, especially girls, with the knowledge that helps them persist in science (Hazari et al., 2010). Along with seeing a future self, this can be important for retention and motivation in the programme.

### **Main findings: student belonging in geoscience**

This study highlights several benefits of faculty–student interactions for students in the first year at university. We see that talking to a researcher about their research provides students with access to explicit and tacit knowledge about doing geoscience research and the culture in the department. The field activities play an important role in showing the students the nature of geoscience and allowing them to elaborate their ideas about the discipline. The interactions also have a social dimension and help the students see themselves as valued members of the geoscience community at the department, and build social networks among themselves. These benefits are in line with the existing literature and are without a doubt contributing to the emphasis the department places on these activities. However, the analysis also reveals a set of unintended consequences that can exclude some students from engaging in geoscience.

The students encounter a disciplinary culture in the department with a strong emphasis on being personally invested in the geosciences as the pathway to become a successful geoscientist. Many students seem to interpret this strong culture among faculty as a requirement for them to be equally interested or even devoted to geoscience to belong in the study programme.

The students also meet a culture with a strong emphasis on being able to perform in the field. This is visible in the students' negotiations of belonging in the first year and we see signs that being able to perform in the field is a predictor for student retention in the programme. The strong position of fieldwork in the culture, and fieldwork practices performed in rough terrain and requiring a relatively high level of physical fitness, raises questions about diversity, inclusion and equity.

Both findings illustrate how ideas and practices that are typically regarded as positive (exposing students early on to research, being interested in one's field of study, and fieldwork) can conspire to constrain the students' possibilities of creating belonging in geoscience.

For the researched institution, the findings can lead to a discussion of the position of “dedication” and “performance in the field” in the culture that is presented to the new students. Is it a true reflection of modern geoscience that students must have a coinciding personal and professional interest, and must be able to physically perform in the field to thrive in the study programme or work as geoscientists in the future?



The findings also lead us to recommend that higher education geoscience institutions have an in-depth look at what avenues they offer for students to negotiate their belonging, by posing the following questions:

- Are we aware of how the students make sense of our discipline and the department based on the combined activities and interactions we present them with?
- How do we secure that students are presented with multiple authentic avenues for belonging in geoscience?

The study shows that the concepts of belonging and culture allow for a deeper understanding of how the activities in the first year legitimise particular ways of becoming a geoscientist. Further, it outlines how the encounter with the departmental culture plays a strong role for the students' ability to see themselves in the study programme and the field of geoscience in the future. We conclude the paper by arguing that in the future we need to offer first-year students' possibilities for creating a sense of belonging that are varied, authentic and inclusive.

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No potential conflict of interest was reported by the authors.

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