UNIVERSITY SNOW SCIENCE COURSES - AN ANALYSIS OF STUDENT LEARNING OUTCOMES

Sarah Valent[1], Nilas Tilo Mikkelsen[1], Jordy Hendrikx[1,2], Holt Hancock[1,3], Christopher D'Amboise[1], Louise Vick[1], Carly Faber[1]

[1] *Department of Geosciences,UiT The Arctic University of Norway, Tromsø, Norway*
[2] *Antarctica New Zealand, Christchurch, New Zealand*
[3] *Norwegian Geotechnical Institute, Oslo, Norway*

ABSTRACT: The Department of Geosciences at UiT The Arctic University of Norway offers two snow and avalanche courses to its students. The bachelor course 'Introduction to Snow and Avalanche Science' (GEO-2015) focuses on teaching the physical characteristics of the seasonal snowpack and learning appropriate techniques for snowpack observation. Its master-level counterpart, the course 'Snow and Avalanche Science and Management' (GEO-3139), concentrates on teaching concepts related to avalanche release and dynamics while providing students experience assessing and applying diverse avalanche risk mitigation strategies. These two courses have been taught for several years, prompting the question; do the student learning outcomes align with the lecturer's intentions for the courses and, more broadly, how the employed learning activities in the courses differ or coincide with activities typically used in recreational or professional avalanche courses outside of the university setting.

Both courses utilize a variety of teaching methods to facilitate the optimal learning environment. This includes both classroom and online lectures in addition to an emphasis on fieldwork. Additionally, guest lectures by experts on different subtopics such as meteorology, organizational mitigation strategies, and governmental administration have been arranged. The aim of this research is to assess student learning outcomes in university-level snow avalanche courses and to identify the learning methods that best resonate with the students to thereby support their learning processes.

The data for this research is obtained through a survey. Students from both courses responded to questions regarding their learning outcomes rated on a Likert scale. Additionally, open-ended questions give insights into more nuanced individual learning goals and motivation.

This study will benefit this year's participants and also future students. The valuable feedback gained from the evaluation will inform suggestions, and further improvements can be stated and implemented. It is a shared mission of the Department of Geosciences at UiT and the students alike to improve snow and avalanche education at the university level. Additionally, the survey results can help to clarify which learning activities university courses can focus on to augment existing non-academic avalanche education curricula more comprehensively.

KEYWORDS: snow & avalanche education, higher education, teaching methods, learning outcome

1. INTRODUCTION

UiT, the northernmost university in Norway, is surrounded by mountains and fjords, and the entire Troms region is appealing for backcountry skiers and other winter recreationalists. Most roads and infrastructure in Northern Norway are also built near mountains and therefore are exposed to natural hazards. Significant natural hazards in this region are snow avalanches, which have caused 58 deaths in Norway in the last 10 years, 28 of them in the Troms region alone (Varsom.no, 2024). The Troms region experiences the highest death rate from avalanches in Norway. Research to understand the underlying mechanics, mitigation strategies and warning systems has high priority at the Department of Geoscience at UiT.

An increase in student numbers in avalanche courses offered by the Department of Geoscience at UiT demonstrates the interest in natural hazards and provides additional motivation for the faculty to improve their courses. A strategic goal of the Department of Geosciences at UiT is to implement a natural hazard study program. A key step in this direction is to assess which teaching methods and learning content are most effective and of interest for students. Feedback from students is therefore highly important. To understand the motivation of the participants in the avalanche courses and to evaluate their learning outcomes and learning experiences, a survey was generated and distributed to the students who participated in bachelor- and master-level snow avalanche courses in spring 2024. This paper describes the results from these surveys, and places them in the context of education and outdoor based learning.

1.1 Learning and teaching theory

"The definition of learning is to gain or acquire knowledge of or skill in (something) by studying, experience, or being taught." (Wu et al., 2022).

Inductive learning begins with case studies, data interpretation or real-life problems as the foundation of instruction, unlike deductive learning, which starts with general principles and applications later. Inductive learning does not promote mindlessly memorizing facts but knowing the why behind the learning material, which is important for students' motivation (Prince and Felder, 2006). The correct motivation drives learners to reach their learning goals more effectively (Filgona et al., 2020). Motivation and success in a course are not significantly linked to whether the course takes place online or offline (Francis et al., 2019). However, the rise of technology has lead to an increase in online classes. Some studies suggest that the inability to ask questions directly in class prevents a complete understanding of the material (Rachmah, 2020). Others do not perceive a clear connection between online classes and ineffectiveness (Pei and Wu, 2019).

Although teaching trends show an increase in lectures with minimal guidance, controlled studies show that direct and strong guidance is more advantageous. Emphasis on practical application is viewed positively, but it should not replace studying methods and processes (Kirschner et al., 2006). This leads to experiential learning, the process where concepts are taken and modified by experiences because ideas are not fixed but formable due to circumstances (Kolb, 1984). In outdoor education experiential learning can be more impactful for students, as they are close to actions and events. There should be a strong emphasis in experiential and situational learning in avalanche courses in Norway as defined by the Norwegian Mountain Forum (NF). The majority of avalanche courses for recreationalists are spent outdoors with theoretical elements taught in appropriate situations (Dassler et al., 2024). An inspection of the avalanche course description offered by the NF points out that the main learning objective of their alpine courses are the understanding of the terrain and the safe trespassing in it. Their focus group are recreationalists who travel privately in the mountains (Norsk Fjellsportforum, 2018). However, the aim of the Department of Geoscience at UiT is to educate students who should go on to be practitioners and decisionmakers at a professional career level. This requires a mixture of experiential and theoretical learning, which the UiT avalanche courses offer.

1.2 Courses at UiT

For several years the Department of Geosciences at UiT has offered a bachelor and a master course in snow and avalanche science.

The bachelor level course (GEO-2015: Introduction to snow and avalanche science) is set up as an entry level course into snow and avalanche science. Snow observations, snow tests, identifying avalanche terrain and the principles of avalanche forecasting are the focus points of GEO-2015. The basic understanding and handling of safety and science equipment is paired with safe and efficient travel through the terrain. The students learn through online and in-person lectures and can develop their interest with extended research through a literature report. A multi-day field trip with focus on basic snow stratigraphy descriptions, temperature and moisture measurements, and snow pit tests is carried out to support practical experiences as well. At the end of the intensive field course, students have a solid grasp of both the science and practice of collecting data in the field.

The master level course, GEO-3139: snow and avalanche science and management, dedicates itself to the physical processes, management and mitigation of avalanches. The in-person and online lectures are supported by guest lectures from different fields. The meteorology leading to snow precipitation was taught by an expert from the Norwegian Meteorological Institute (MET). The Norwegian Water Resources and Energy Directorate (NVE) supported the students in understanding the proceedings of evacuation and first responses in an extreme avalanche event. The students worked in groups to draft a hazard report of a designated area near Tromsø. This report included a hazard map where the students were required to implement the safety classification (S1, S2, S3) for natural hazards, which they learned from the Norwegian Geotechnical Institute (NGI), and to verify their decisions with model simulations and an in-person visit to the observation area.

The courses are designed with significant overlap to ensure they complement and enhance each other. The premise of the courses is that deductive learning sessions in the classroom should be supported by inductive learning experiences in the field and as homework (literature report and hazard map).

A study by Dassler (2024) concluded that a year-long avalanche course (NF course Level 1 and 2) did not promote long lasting deep learning but helps students to understand snow factors. The authors concluded that a lack of practice outside the course may have hindered the long-term understanding of the gained knowledge. Furthermore, they decided that a season-long course did not provide enough high-quality dislocatory learning moments, to nurture transformative change in the behavior of the participants. GEO-2015 and GEO-3139 try to address this issue by giving the students a chance to understand and practice each component of avalanche science on their own, typically in small groups. For example: Level 1 and 2 NF avalanche courses show the participants what a hazard map is and how to use it, while the UiT students must develop their own map and therefore study the different sublayers of avalanche hazard in more detail, which promotes higher quality experiential learning.

The classroom setting promotes the building of companionship, and working together in small groups helps to create a relaxed and trustworthy atmosphere to discuss issues and problems with the material. A lengthy snow analysis discussion was avoided by some participants in the study group of Dassler (2024). Considering the human factor in risk assessment and the negative effects of large group decisions (Ebert and Morreau, 2022), the UiT method is more advantageous and grounded in teaching and learning theory. The difference between NF Level 1 and 2 courses to the UiT courses is evident. The former concentrates on safety and route finding for recreationalists that move in the terrain in their free time, the latter trains students to understand the fundamentals of snow and avalanche science as an object of research.

The goal of this study is not to test the longevity of the learned material from the courses GEO-2015 and GEO-3139, but rather if and what learning outcome(s) the students experienced. Additionally, it seeks to evaluate whether the primary takeaways align with the instructor's intentions to give an introductory approach to the research topic or if the students only take the course to enhance their understanding of snow for their private passion, which would also be conveyed in recreational avalanche courses. Considering the variety of teaching methods, the question arises as to which one was most preferred. This method likely promoted the most 'aha'-moments, indicating high-quality key learning experiences.

2. METHOD

Data was collected in this study using an online survey (Nettskjema) that the participants of the GEO-2015 and GEO-3139 spring 2024 courses were asked to answer after the end of the semester. The questionnaire collected demographic data about the students such as their age, gender, what course they attended and prior experience of avalanche courses, both academic and commercial.

The questionnaire had three major focus points: teaching methods, general learning outcome, past and future interest and knowledge in snow and avalanche education. The questions were reformulated from previous ethics board approved surveys (modified form Greene et al. (2022), Hendrikx et al. (2022), Johnson and Hendrikx (2021)). The survey used in this study received it's own approval from Sikt (Reference number: 416094).

The questions were formulated as single choice questions based on a seven-point Likert scale. The participants were asked to rate their prior and present knowledge in the following six categories: snowpack stability and analysis, avalanche warning systems, avalanche mitigations, avalanche rescue, avalanche terrain and weather analysis, avalanche regulations and laws (in Norway). Furthermore, they were asked about three important take-aways, their motivation for the course and what they would immediately improve, using open-ended questions. Data is presented as word clouds, charts, and as textual descriptions. Word clouds emphasize words or topics that are more prevalent in a dataset. The more often a word appears in the dataset, the larger or bolder the word appears in the word cloud. www.wordclouds.com was used to generate word clouds in this study.

3. RESULTS

3.1 Participants

Of 20 GEO-2015 students, six answered the survey, while five of seven GEO-3139 students responded. This corresponds to 30% and 71% response rates, respectively, and an overall response rate of 41%, which is considered acceptable for an online survey (Wu et al., 2022). Six of the respondents identify as female and five as male. The average age is 26 years. All the participants take part in one or more of the following outdoor activities: downhill skiing, backcountry skiing, snowshoe hiking, cross country skiing, ice climbing, or "other". On average, they have been participating in these outdoor sports for 16 years. There were students present with more than 30 years experience and also beginners with only one or two years of winter outdoor exposure. Six students have attended an introductory commercial avalanche course, but none have done a previous university avalanche course apart from GEO-2015 or GEO-3139. Eight students declared that they want to do another avalanche university course, and two students want to pursue a career in snow science. Most students are affiliated with the Department of Geosciences through pursuing a degree in geology.

Students who have previously completed a commercial avalanche course noted that the primary differences between the introductory commercial course and the university courses are the emphasis on the practical use of safety equipment and the human factor in the commercial course, compared to the focus on background knowledge in the university courses. They pointed out that the longer duration (entire semester) of the university courses provided a better learning environment and created the opportunity for deeper knowledge.

3.2 Course motivation

The main motivations for students to take the courses were reported as a love for the outdoors and to gain more knowledge for their adventures in the backcountry. Many noted that their initial interest began from a desire to deepen their understanding of avalanche processes to be safer while skiing. However, many students mentioned their ambition to use the gained skillset for their future career. Since many avalanche-related processes are similar to other natural hazards, they also aimed to broaden their academic horizons. Figure 1 shows what students emphasized as their own motivation to take an avalanche course.

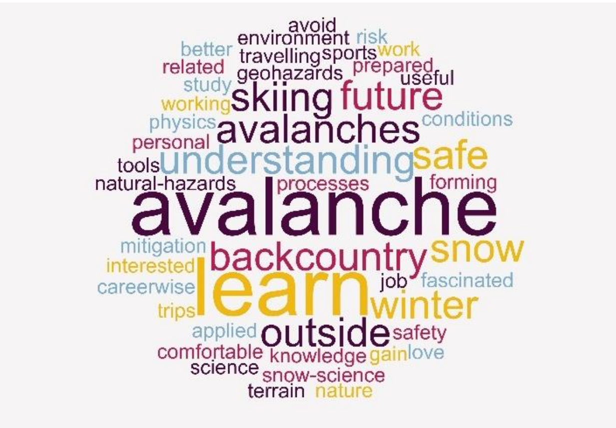

Figure 1: Students own motivation for their chosen course.

3.3 Preferred teaching methods

10 of 11 students strongly agreed with the statement 'I liked the field trips.' (see Figure 2 and Figure 4). Students even pointed field trips out as their additional teaching method when asked if they could think of any additional helpful teaching method other than online, offline, guest lectures and groupwork. All students agreed on the advantage of in-person lectures for their learning outcomes (see Figure 3 and Figure 5). On the other hand, the opinions on the benefits of online classes showed the greatest diversity. Three participants strongly disagreed with liking online classes, while two strongly agreed with this teaching method (see Figure 2 and Figure 4). The remaining participants' opinions were distributed across the spectrum. However, four participants of the GEO-2015 group agreed that online lectures helped their learning outcome, while one participant was less convinced of their value (see Figure 5).

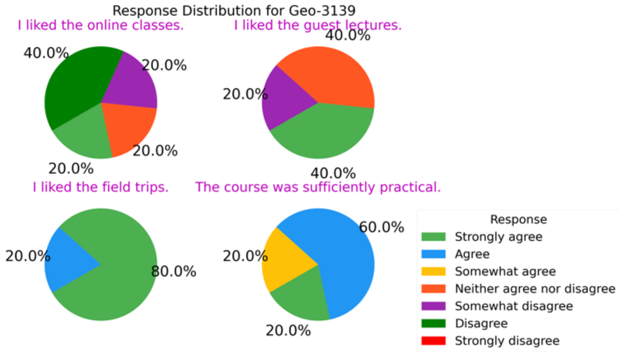

Figure 2: Response distribution for the course GEO-3139

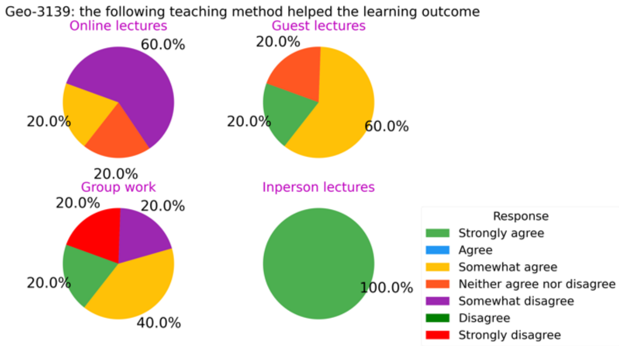

Figure 3: Distribution of student responses to various teaching methods in relation to learning outcomes for GEO-3139.

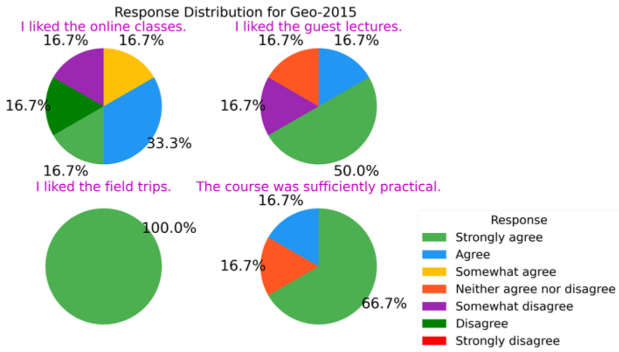

Figure 4: Response distribution for the course GEO-2015

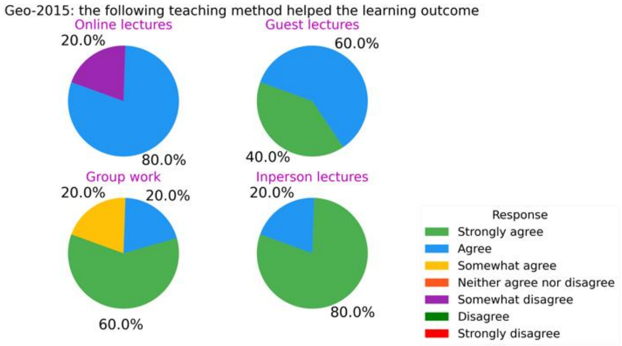

Figure 5: Distribution of student responses to various teaching methods in relation to learning outcomes for GEO-2015.

In contrast, the GEO-3139 students had more varied opinions, but none outright rejected or embraced the idea that online lectures had a meaningful impact (see Figure 3). The same pattern could be observed regarding guest lectures. Opinions varied widely, from strongly positive to slightly negative when students were asked if they liked the guest lectures. However, when questioned about the impact of their learning outcome, all students responded positively or neutrally. Comparing the two courses shows that GEO-2015 students only chose positively, while the GEO-3139 course was more neutral to slightly positive. It must be noted that the guest lectures in GEO-2015 were during the field week and not in the classroom. Group work and literature review had similar responses from students. GEO-3139 students had strongly divided opinions on whether group work promoted better learning results, whereas the GEO-2015 students generally agreed on its benefits. The same pattern applied to literature review as a teaching method.

3.4 Learning outcomes

Figure 6 depicts the six different categories (snowpack stability and analysis; avalanche warning systems; avalanche mitigation; avalanche rescue with beacon, shovel, probe exercises; avalanche terrain and weather analysis; avalanche regulations and laws) the students could choose as topics they were "most interested" in. The results are divided by course to visualize the different focus points the students want from the different courses.

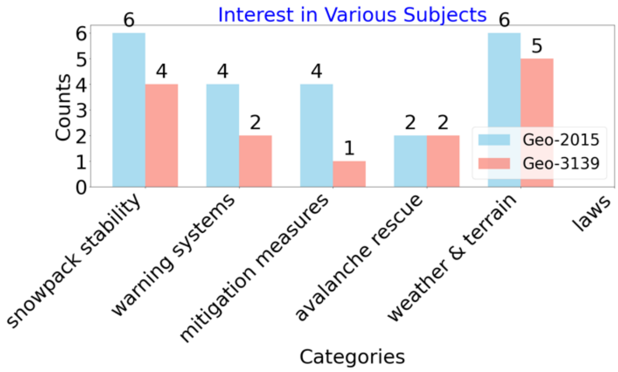

Figure 6: "Most interested" topics divided by courses.

All students voted for avalanche terrain and weather analysis as their most interesting topics, followed by snowpack stability and analysis with 10 of 11 counts. Nobody considered avalanche regulations and laws to be their most interesting topic. Only one participant in the GEO-3139 course choose mitigation measures, while four GEO-2015 students considered avalanche mitigation as interesting.

The students were asked to evaluate their knowledge and skills in the above mentioned six categories prior to and after the course. Four of six respondents from GEO-2015 disagreed with having any prior knowledge in snowpack stability and analysis but three of five participants (one participant did not do the after-evaluation) chose "agree" to have gained sufficient knowledge after the course (see Figure 7).

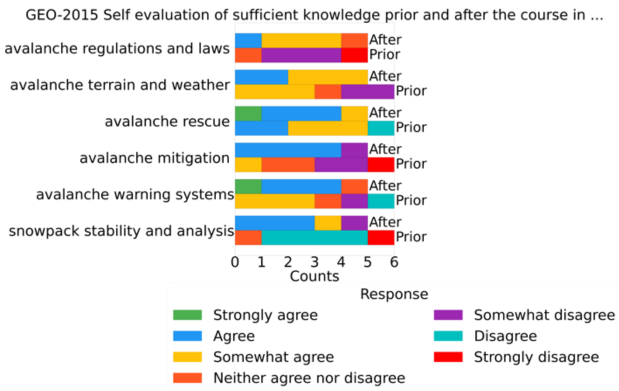

Figure 7: Prior and after course evaluation from the GEO-2015 students.

The GEO-3139 students had more prior understanding of snowpack stability but even they could all improve (see Figure 8).

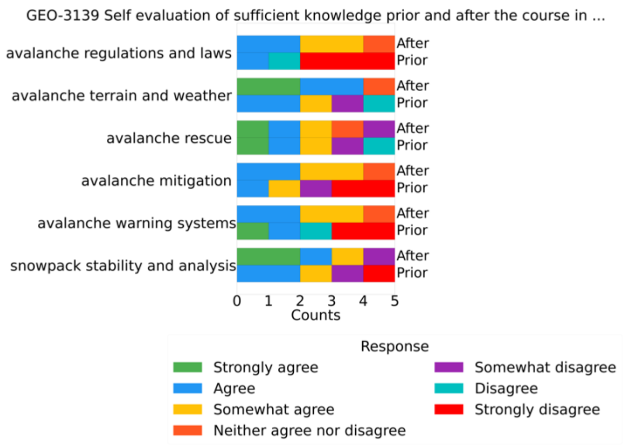

Figure 8: Prior and after course evaluation of GEO-3139 students.

Although, the students did not consider laws and regulations in Norway as their most interesting subject, they had the steepest learning curve and only one participant stated to have a good knowledge a priori (see Figure 8). However, after the course all students chose positively or neutral for their own evaluation. The subject avalanche rescue had the most varied responses in both the after and prior evaluation. But the GEO-2015 course seemed to be better in teaching avalanche rescue, as more bachelor students evaluated to have a better after-knowledge. In contrast, the after-course evaluation showed an increase in self-evaluated understanding in avalanche mitigation and warning systems for both courses.

As an open-ended question, students were asked to list three important things that they had learned from their respective course. The answers range from good teamwork to technical topics like snow metamorphism. Figure 9 presents the answers in a word cloud to summarize what was emphasized most for students from both courses.

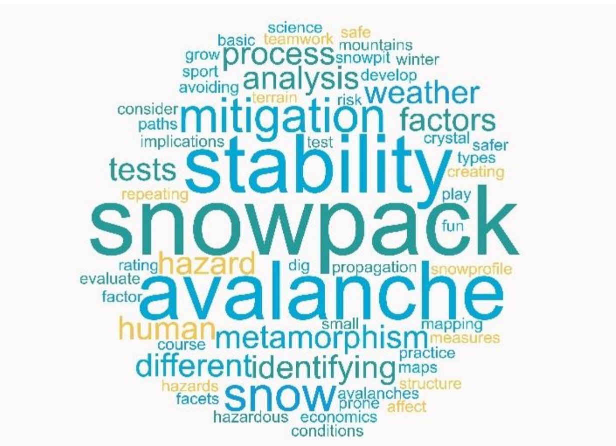

Figure 9: Word cloud summarizing what students from both courses responded to the question; "What are three important things that you learned from this course?"

4. DISCUSSION

4.1 *Course motivation*

A passion for winter outdoor activities motivated most students to participate in the courses. At first, this would be an indicator that they would have prefered the more practical organised commercial avalanche course. But many students pointed out their desire to learn 'the physics behind' the avalanches. This notion aligns with the instructors intentions to develop courses focusing on snow and avalanche science and current research. This also shows that students are intrinsically motivated, which is positive as intrinsically motivated students learn more and retain that knowledge for longer (e.g., Larson and Rusk, 2011).

4.2 *Teaching methods*

Field trips were not only emphasized multiple times as a supportive asset for the students, suggestions were even made to include more small snowpack studies througout the semester. The repetition would create more opportunities to create high quality learning opportunities and suggests the students are interested in case-based learning (e.g. (Holley, 2017). Neverthless, students emphasize that the field trips must be supported by in-person lectures. These viewpoints indicate that students prefer a combination of lectures and field work or case-based learning, and suggest that lectures still hold a valuable place in higher education (e.g., French and Kennedy, 2016). Multiple independent requests were issued from respondents that in-person lectures should be implemented more frequently throughout the semester than they currently are. UiT as a location is therefore very attractive due to its close proximity to possible field and research areas.

The question whether to cut online lectures in their entirety is not easily decided as both teachers usually cannot be in Tromsø for the majority of the courses. On the one hand, the students did not particularly like the online classes, but they still had a positive impact on their learning outcome, which agrees with current research showing that online learning is at least as effective as in-person learning (e.g., Castro and Tumibay, 2021)). However, the effectiveness of online learning is dependent on how well-designed online teaching is, and therefore use of technology should be well-designed and effectively implemented.

As pointed out, the opinions between the GEO-2015 and the GEO-3139 students were divided concerning group work, literature review and guest lectures. These results must be seen in context with the structure of the two courses. GEO-2015 had fewer guest lecturers and guest sessions mostly added only additional material to the course. GEO-3139 included multiple guest lectures with overlapping topics. Many students noted their dislike regarding the overlap in the course and the guest lectures as some theories were repeated. One solution would be to have fewer guest lectures but to let them teach an entire chapter (e.g. meteorological factors). Group work is another controversial method for the students. For both courses, students had to work in small groups in the field. The final project of GEO-3139, which constituted 75 % of the grade, was also group work. Different opinions are therefore unsurprising as they relate to different grades and groups. The final exam for GEO-2015 was split between a written report from the field work and a literature review or reasearch note on a topic chosen by the students, which were both counted 50% towards the final grade. Although, the literature review was part of the grading system, it did not diversify the opinions on its impact in the understanding of the material. That outcome could correlate with the fact that the research topic for the literature review was freely choosen by the participants and that no group work was involved. A more structured and directed exercise may have yielded a different outcome.

4.3 Learning outcomes

Although laws and regulations were the least liked topics in the courses, overall students reported significant learning in these topics. The GEO-3139 students, in particular, had mostly no prior understanding of these topics, but reported that they improved tremendously. This could relate to the fact that GEO-3139 was more focused on the local and national management of avalanche terrain and its mitigation measurements than GEO-2015.

It is unsurprising that GEO-2015 reported a better learning outcome in avalanche rescue as the course spent more time practicing this, with an outdoor practice scenario, compared to the GEO-3139.

Snowpack stability and weather-terrain analysis were the most interesting subjects for the students in both courses. It became evident that the students started from very different backgrounds in these two subjects but both courses taught it at an appropriate level so that all students reported they acquired a basic understanding.

4.4 Suggestions for an effective university avalanche course

The open-ended feedback from students greatly helps us make suggestions for improving the courses. From our study we can make suggestions for other institutions that offer avalanche and snow science courses. We observe that snow and avalanche education works best with a hands-on approach. This was indicated by the frequent requests for in-person lectures and field trips from students, supporting experiential learning. Also, the guest lectures and online lectures generally had a positive impact on reported learning outcomes, but student satisfaction with these teaching methods was mixed.

Feedback from the students showed us how students would like the courses and lectures to be organized, as well as which aspects they would like emphasized; e.g., additional time to be spent on the practical aspects of the course already from an early point, as was tried in this year's version of GEO-2015. One student commented: "What would make my learning experience for the course better is to have more practical exercises early on. The day we had in the parking lot was very useful, so more of these practical workshops already from the start and maybe also get to try some of the snow stability tests close to campus one afternoon."

Students also provided some critical feedback that focused on the structure of course material or how the teaching methods were conducted with guest lectures and online teaching. A suggestion would thereby be to arrange in-person guest lectures that teach an entire segment of the course and give the students online classes with the basics beforehand. This could challenge the students to deal with the material on their own terms and then have an expert to ask questions face to face. This, combined with personal literature reviews as homework, could not only motivate the students, it would also align with the intentions of the lectures. The students could dive deeper into the material faster and more explicit snow research could be taught, which is clearly a desire from the students as the study showed.

This concept will work for both courses equally; however, another result of the survey was that many students missed components in their courses the other course would have offered. Therefore, it is necessary to better align the two courses, with the bachelor course placing greater emphasis on the practical aspects of snow science, and the master course focusing more on management and physics. A better aligned bachelor and master course gives benefits both for the students and the Department of Geosciences in attracting new students that could look for a place that offers courses in this area as a whole.

5. CONCLUSION

The study points out multiple aspects regarding the UiT avalanche courses. The most apparent one is that students have a great desire to not only learn the basic understanding and use of equipment or how to read a hazard map, but they want to gain a deeper understanding of snow avalanche science. This indicates a necessity for continued snow avalanche education at both bachelor and master level at the Department of Geosciences at UiT and emphasizes how the current courses can be improved.

This study also clearly shows that snow and avalanche education is a hands-on science, highlighted by students choosing against online lectures and for in person lectures, as well as requests for more focus on the practical aspect of the education. While guest lectures and online lectures generally had a positive impact on reported learning outcomes, student satisfaction with these teaching methods were mixed.

An improved avalanche and snow science education gives the student the chance to enhance their knowledge even further from commercial avalanche courses and helps them to not only be safe in the terrain and handle the safety equipment, but to satisfy their desire to learn the science of snow and avalanches, which fits directly with the greatest goal for the Department of Geosciences at UiT: to share their love and fascination for the earth sciences.

6. ACKNOWLEDGEMENTS

We thank the students of GEO-2015 and GEO-3139 for their participation in this study. This work was supported by a seed grant from the iEarth Centre for Excellence in Education. This work was carried out in a collaborative effort between students, teachers, and researchers.

7. REFERENCES

Castro, M. D. B. and Tumibay, G. M.: A literature review: efficacy of online learning courses for higher education institution using meta-analysis, Educ. Inf. Technol., 26, 1367–1385, https://doi.org/10.1007/s10639-019-10027-z, 2021.

Dassler, T., Fjellaksel, R., and Pfuhl, G.: Key learning moments as predictors for understanding snowpack dynamics during a season-long avalanche course?, https://doi.org/10.5194/egusphere-2024-1533, 5 June 2024.

Ebert, P. and Morreau, M.: Safety in numbers: how social choice theory can inform avalanche risk management, J. Adventure Educ. Outdoor Learn., 23, 340–356, https://doi.org/10.1080/14729679.2021.2012216, 2022.

Filgona, J., Sakiyo, J., Gwany, D. M., and Okoronka, A. U.: Motivation in Learning, Asian J. Educ. Soc. Stud., 16–37, https://doi.org/10.9734/ajess/2020/v10i430273, 2020.

Francis, M. K., Wormington, S. V., and Hulleman, C.: The Costs of Online Learning: Examining Differences in Motivation and Academic Outcomes in Online and Face-to-Face Community College Developmental Mathematics Courses, Front. Psychol., 10, https://doi.org/10.3389/fpsyg.2019.02054, 2019.

French, S. and Kennedy, G.: Reassessing the value of university lectures, Teach. High. Educ., 22, 1–16, https://doi.org/10.1080/13562517.2016.1273213, 2016.

Greene, K., Hendrikx, J., and Johnson, J.: The Impact of Avalanche Education on Risk Perception, Confidence, and Decision-Making among Backcountry Skiers, Leis. Sci., 0, 1–21, https://doi.org/10.1080/01490400.2022.2062075, 2022.

Hendrikx, J., Johnson, J., and Mannberg, A.: Tracking decision-making of backcountry users using GPS tracks and participant surveys, Appl. Geogr., 144, 102729, https://doi.org/10.1016/j.apgeog.2022.102729, 2022.

Holley, E. A.: Engaging Engineering Students in Geoscience Through Case Studies and Active Learning, J. Geosci. Educ., 65, 240, 2017.

Johnson, J. and Hendrikx, J.: Using Citizen Science to Document Terrain Use and Decision-Making of Backcountry Users, 2021.

Kirschner, P. A., Sweller, J., and Clark, R. E.: Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching, Educ. Psychol., 41, 75–86, https://doi.org/10.1207/s15326985ep4102_1, 2006.

Kolb, D.: Experiential Learning: Experience As The Source Of Learning And Development, 1984.

Larson, R. and Rusk, N.: Intrinsic Motivation and Positive Development, Adv. Child Dev. Behav., 41, 89–130, https://doi.org/10.1016/B978-0-12-386492-5.00005-1, 2011.

Norsk Fjellsportforum: Kursmaler | Norsk Fjellsportforum, 2018.

Pei, L. and Wu, H.: Does online learning work better than offline learning in undergraduate medical education? A systematic review and meta-analysis, Med. Educ. Online, 24, https://doi.org/10.1080/10872981.2019.1666538, 2019.

Prince, M. and Felder, R.: Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases, J. Eng. Educ., 95, https://doi.org/10.1002/j.2168-9830.2006.tb00884.x, 2006.

Rachmah, N.: Effectiveness of Online vs Offline classes for EFL Classroom : a study case in a higher education., 3, 19–26, https://doi.org/10.20527/jetall.v3i1.7703, 2020.

Wu, M.-J., Zhao, K., and Fils-Aime, F.: Response rates of online surveys in published research: A meta-analysis, Comput. Hum. Behav. Rep., 7, 100206, https://doi.org/10.1016/j.chbr.2022.100206, 2022