Revision and Some Upgrading of Course AT 301 "Arctic infrastructures in a changing climate"

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1. Introduction

The author of the present report is co-responsible for course AT 301 "Arctic infrastructures in a changing climate" taught at The University Centre in Svalbard (UNIS), Longyearbyen. The learning outcomes of the course cover broad engineering areas. For instance, an expected learning outcome is that upon completing the course, the students will be able to understand weather related geological processes and geotechnical aspects connected to planning, design and protection of infrastructures as buildings, roads, bridges and pipelines in a changing Arctic climate. Students have to follow certain requirements in order to be accepted on the course (enrolment in a relevant master programme; knowledge of mathematics and physics at bachelor level). Nevertheless, the author has thought that one challenge is that not all lectures equally good understood by students. Hence, author identified that **improvement of student understanding** of course material excites him when he is thinking about trying something new in his teaching.

Another challenge, which could partly be the reason of the first one, is that there are limited opportunities for direct contact between students and lecturers. Most of lectures on the course are given by guest lecturers, who stay at UNIS only during the period of their lectures (only for few days). The opportunities for direct contact with the lecturer are limited to the classroom session. At the same time, the taught material is usually new for most of the students. One can see a need in maximizing efficacy of classroom time. Acquaintance with the topic prior to lecture seems to be an appropriate approach to better perception of material in classroom.

A typical example of teaching process can be explained on the base of lectures on avalanche protection. The total duration of lectures is about 12 hours (3 days, 4 hour per day). Normally only few students are familiar with avalanche topic from before. In the author's opinion, students are quite overwhelmed by information on lectures. It happens due to new concepts (structures for avalanche protection) and models (or types of avalanches), which are not taught in other engineering areas, so it takes some time for the students to become familiar with the phenomena composing the topic. The topic for next lectures will be normally totally different, for instance "Pipelines in permafrost".

It was decided to organize SoTL project in two separate parts:

1. Part 1: to implement some technique to **facilitate understanding of material**, and to analyse efficiency of implemented measures (autumn semester 2014).
2. Part 2: to analyse grades, which students got and feedback from students from previous years (2011-2014).

Hence one can judge on the efficiency of both the newly implemented approach (Part 1) and on the quality of the course at all (Part 2, 2011-2014). The result of the analysis on course evaluation (Part 2) can help to decide where to look deeper in the course evaluation in order to improve the next generations of the course.

2. Methods

2.1 Just-in-time reading

Just-in-time teaching (JiTT) method was chosen to be implemented. Notes from *Course in basic skills in pedagogics* and information from (http://jittdl.physics.iupui.edu/jitt/) were used as guidelines. The JiTT method was chosen to overcome identified challenges typical for the course. The goals for introducing JiTT method are the following: (i) to reach maximal utilization of available time in class room, (ii) to structure out-of-class time, and (iii) to involve students in a more active studying process.

In autumn term 2014, 18 students took part in the course AT 301. The course description is presented in Attachment 1. It was decided to base JiTT strategic on home reading and quiz (based on home reading) in classroom. All guest lecturers (seven persons) supported the idea to introduce JiTT in the autumn term. Each guest-lecturer had sent to the course responsible one to three short (up to 10 pages) scientific papers sufficiently covering material which was later on presented in classroom. The implemented routine consisted in following:

1. Quiz nr. 1 was made in the first lecture in order to see which level the students taking the course were at, and also to "trigger" involvement of students in active learning process.
2. Handling out printed versions of articles for home reading to students (few days prior to lecture). Students were told that they had to mark five to seven of the most important statements in the text, e.g.: principles, assumptions, limitations (markers for highlighting were given as well).
3. Quiz, based on home reading, was carried out in the beginning of lecture. The quiz consisted of five to seven questions. No options for answers to choose from were given. It was allowed to use a copy of the article given for home reading. One minute was given to answer on each question. The answers and precise comments were presented by course responsible afterwards. Due to issues with personal character of underscore, students were personally responsible to check the answers. Number of correct answers was reported to course responsible in the end of quiz.
4. Lecture, at high degree based on home reading was given by guest lecturer right after the quiz.

5. Articles, quizzes and answers were available to students on the server. Students were aware that problems based on questions from the quiz can appear on the exam.

By the end of the course students were asked to evaluate home reading with question: “Was it helpful to have home reading and test in order to understand material on coming lecture?”.There were three options for answer:

1. Yes, it was easier to listen lecture given in class on the next day.
2. Yes, it helped, but not much, it was still good idea.
3. No, it didn’t help me to understand material on lecture.

2.2 Analysis of grades and course evaluation in 2011-2013

Exam grades and key questions from the course evaluation were analysed for four terms from 2011 to 2014.

2.2.1 Analysis of grades

An average grade was calculated for each year, in order to perform averaging grades were converted in numbers according to the following order (grade/number):

A – 0.95; B – 0.85; C – 0.75; D – 0.65; E – 0.55; F – 0.45.

2.2.2 Analysis of course evaluation

The answers on following key questions from course evaluation were analysed:

Q1: The lectures were clearly structured?
Q2: How would you rate the quality of the reading list/curriculum?
Q3: The course had good lectures?
Q4: The field work was well organized?
Q5: This course was well organized?

The options to answer Q1, Q3-Q5 were (converted in numbers for analysis): Strongly agree (1); Agree (0.75); Neither agree nor disagree (0.5); Disagree (0.25); Strongly disagree (0).

The options to answer Q2 were (converted in numbers for analysis): Very good (1); Good (0.75); Sufficient (0.5); Poor (0.25); Very poor (0).

One can assume that the material for home reading had impact when students answered Q2 in 2014. This could be partial and indirect evaluation of implemented just-in-time method.

3. Results

3.1 Just-in-time reading

Raw data (number of correct answers) presented in Table 1, unfortunately data for home readings №5-6 was missed. The number of correct answers was in average from 80 to 100%.

Table 1. Results of quizzes.

Student/Total number of questions in quiz	**HR1**	**HR2**	**HR3**	**HR4**	**HR7**
	11	**6**	**5**	**5**	**5**
1	11	6	-	5	5
2	9	6	4	5	5
3	9	6	5	5	5
4	10	6	4	5	5
5	7	6	3	5	5
6	10	6	5	4	5
7	9	6	4	4	4
8	9	6	5	5	5
9	9	6	5	5	5
10	8	5	4	4	5
11	4	5	3	4	3
12	10	6	3	4	5
13	6	6	5	5	5
14	9	6	4	4	5
15	8	5	4	5	4
16	10	6	-	0	5
17	7	5	5	4	4
18	10	6	4	5	5
Average	**8**	**6**	**4**	**4**	**5**

Only five students have sent their evaluation of implemented just-in-time reading method. Three of the three answers were “1. Yes, it was easier to listen a lecture given in class on the next day”, two answers were “2. Yes, it helped, but not much, it was still good idea”. No obvious objections from student to implemented method were revealed during the course, however some students told that they had hardly some spare time during the week days due to studying (including home reading).

3.2 Analysis of grades and course evaluation in 2011-2013

The number of students, average grade, average answers on course evaluation and average for answer on questions Q1-Q5 are presented in Table 2, and on Figure 1. The best course evaluation from students was in 2012, at the same year average grade was the lowest. In 2013, better course evaluation corresponded to the best average grade. In 2014 a bit lower course evaluation corresponded to lower average grade.

The range of fluctuation of the course evaluation and grades is narrow. All results showing that material was presented at good level (evaluation from students), and students got very good average grade (B). Hence for further improvement of the course one should perhaps look into comments which were possible to write in course evaluation.

Table 2. Average grades in 2011-2014

Year	2011	2012	2013	2014
Number of students	9	19	18	18
Average grade	0,82	0,81	0,87	0,80
Q1	0,78	0,83	0,79	0,76
Q2	0,78	0,80	0,79	0,76
Q3	0,81	0,88	0,87	0,88
Q4	0,75	0,96	0,83	0,81
Q5	0,81	0,88	0,87	0,81
Q Average	0,78	0,87	0,83	0,81

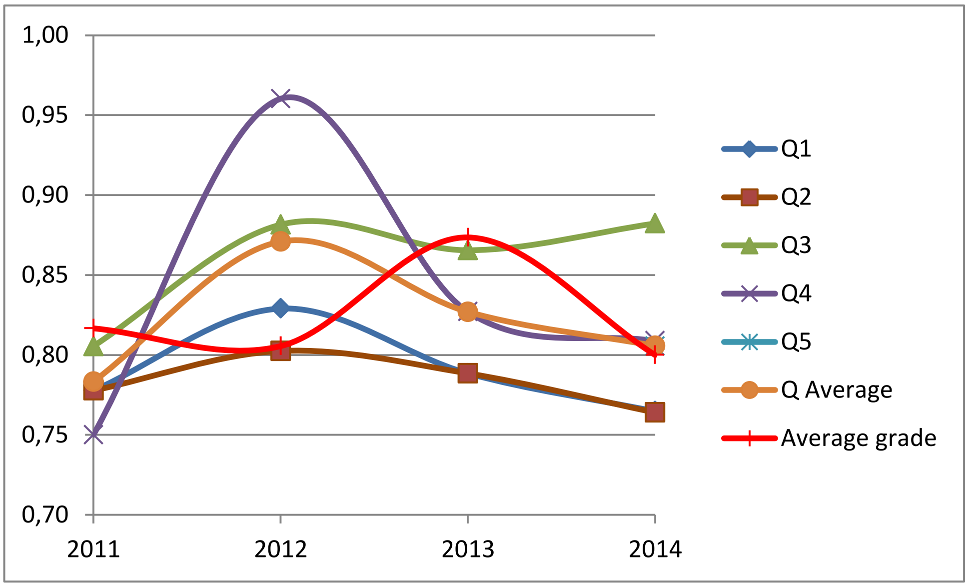

Figure 1. Average grade and feedback from students on course evaluation in 2011-2014

A detailed look into comments from the students in course evaluations gives the following results. After each year (2011-2014), students answered that the best aspect of the course was field work. At the same time, field work was the most common aspect which has to be "improved": students wanted to spend more time in the field and perform more detailed studies. Another aspect for improvement was deeper theoretical studies in lectures. On question regarding weakest points of the course, students again, from year to year answered that they wish to have deeper insight in the problems highlighted on lectures, and stronger binding of lectures and field work. At the same time students reported that they were overloaded sometimes with presentations, and more structured (possibly daily) comments on home assignments should be provided.

4. Conclusion

The implementation of JiTT method showed positive results, however the level of load on students from home work should not increase in the end. This is why the number of home assignments should be lower if one remains home reading in the course. The results from students' feedback show that more detailed, deeper material should be given on the course. It seems to be very important to have better binding of lectures with field work; the latter should be more extensive. Possibly, narrowing and deepening of the course with stronger field part should be considered as direction for further improvement.

Attachment 1 "Course description"

AT-301 – AT 801 Arctic Infrastructures in a Changing Climate (10 ECTS)

Course period: Autumn semester, (August-September), yearly
Language of instruction and examination: English
Credit reduction/overlap: 10 ECTS with AT-801
Grade: Letter grade (A through F)
Examination support material: Bilingual dictionary between English and mother tongue. Non-programmable calculator.
Course materials: Books: Andersland O. B. and B. Ladanyi (2004): "Frozen Ground Engineering". McClung D. and P. Schaerer (2006): "The Avalanche Handbook". Arctic Council report (2005): "Arctic Climate Impact Assessment ACIA", Chapter 16. Jones Ch. L., J. R. Higgins and R. D. Andrew (2000): "Colorado Rockfall Simulation Program, version 4.0". Norwegian Public Road administration: Handbook 174 (1994): "Snow Engineering for Roads".
Course responsible: Jan Otto Larsen; jan.otto.larsen@unis.no
Course costs: None
Course capacity min./max.: 5/20 students (AT-301/801 in total)

Required previous knowledge / course specific requirements:
Enrolment in a relevant master programme. Knowledge of mathematics and physics at bachelor level.

Learning outcomes:
Knowledge; *Upon completing the course, the students will:*
Be able to understand weather related geological processes and geotechnical aspects connected to planning, design and protection of infrastructures as buildings, roads, bridges and pipelines in a changing Arctic climate.
Have knowledge of the impact of climate change on infrastructures in the Arctic, and how to solve this expected issue.
Understand the influence of climate change on natural disasters as snow avalanches and slides in rock and soils.

Have knowledge of design of buildings and roads in snow drift areas.

Skills; *Upon completing the course, the students will be able to:*
Perform evaluation of natural hazards during areal planning and design of infrastructure.
Apply models for simulations of rock falls and avalanches.

General competences; *Upon completing the course, the students will:*
Have insight in and be able to discuss the engineering practice in relation to phenomena of climate change applied to Arctic conditions. Be able to write and present research reports.

Academic content:
Due to the fact that the climate is changing with higher expected temperatures, higher precipitation and probably higher storm activity, infrastructures have to be designed for this new climate scenario. Settlements in the vicinity of steep slopes will be exposed to increasing risk for slope failures, slides in soil and rock, slush and snow avalanches. The course will trough lectures and field trips, focus on recognizing terrain exposed to avalanches and slides, and how to plan the location of infrastructures to avoid natural disasters.

<u>Specific topics:</u>

- Introduction in global warming phenomena
- Design of infrastructures in a changing climate
- General information about avalanches: types, release mechanisms, snow stability evaluation methods, avalanche protection
- Field trip devoted to rock falls and avalanches
- Field trips (Longyearbyen, Pyramiden) devoted to observations of foundation types
- Design of buildings and roads in snow drift areas

Learning activities:
The course extends over 5 weeks including compulsory safety training, and is run in combination with AT-801.

Learning activities consist in lectures, seminars, two field excursions (Longyearbyen, Pyramiden), field work (terrain studies for evaluation of avalanche and rock fall danger).

Through lectures students will be introduced to academic content of the course. Lectures are supplemented with assignments mainly taken from “Frozen Ground Engineering” (2004). Assignments have to be submitted in written form and must be approved in order to take the exam.

During field excursions the students will investigate different foundation presented in Longyearbyen and Pyramiden. The students will work in small groups, to train team work skills. As a result of field excursions each student group must produce a joint report describing observed foundation types and structure failures due to lack of maintenance and due to a warmer climate.

Field work on rock falls and avalanches will take place in proximity of Longyearbyen. As a result of field work, each student group must prepare a joint report on evaluation of zones exposed to rock fall and avalanche hazards.

In addition to contributing to the group reports, all students must write one report on a chosen subject. All results (from field work, field excursions and the personal reports) will be presented and discussed in seminars.

Total lecture and seminar hours: 40 hours.
Field work: 3 days.

Compulsory learning activities:
Seminars, assignments, field work, one written report (on foundation).
All compulsory learning activities must be approved in order to sit the exam.

Assessment:

Method	**Time**	**Percentage of final grade**
Written report on hazard zones in Longyearbyen		10%
Written report on infrastructure types in Longyearbyen and Pyramiden		10%

References

http://jittdl.physics.iupui.edu/jitt/.