5

Redesigning the MSc course Marine Geoscience towards more functioning knowledge

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Introduction

The course Marine Geoscience is an MSc-level course within the disciplines of geography and geology at the Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark. The form of teaching is a combination of lectures, workshops (exercises) and field work. The course is held at the field station *Skalling Laboratoriet* in Ho, NW of Esbjerg. It is an intensive course over eight days, including two days fieldwork with one day offshore Sylt using the German research vessel *Mya* from AWI (Alfred Wegener Institute, Wattenmeerstation Sylt) and one day in the Ho Bugt area. The purpose of the course is to provide knowledge about sea floor processes, marine transport processes in shallow and deep water, marine environments and climate relations, palaeoceanography and practical experience in marine research methods; furthermore, two days offshore fieldwork will give the participants first-hand knowledge of field work in marine geoscience. The intended learning outcomes (ILOs) of the course are that upon completion of the course, students should be able to (see Appendix A):

- identify strategies and methodologies, and to solve scientific problems in the marine geoscience research field;
- possess a general knowledge of marine geosciences, theoretical as well as practical;
- integrate theory, methodology, data and interpretation, and to demonstrate the ability to evaluate new information critically.

The grading is passed/not-passed based on the assessment by an internal examiner of a written report to be handed in after the course. Active participation during the course at *Skallingen* is mandatory for passing the course.

Already in 2010 I had the opportunity, as external postdoc from the research centre MARUM at the University of Bremen, to give an evening guest lecture in the course; and in 2011 I was invited to fill a full course day, giving a self-designed lecture and exercise. At both occasions I stayed several course days in order to see some of the other parts of the course. In general my impression was that 1) more time was allocated to lectures compared to exercises, 2) the lectures contained much information and 3) links between the individual lectures/exercises of the different course days/topics were rarely established. Subsequently, these observations were supported by the student evaluation of the 2011-course (the course was not offered in 2012). Below an excerpt of some of the comments:

> "Too much lecturing, too little hands on exercise fieldwork, too little connection between subjects."
> "Too little practical work in general and the purpose/idea was unclear (8 hours with lectures is too much – practical work is necessary then evening sessions wouldn't be a problem."
> "Way too many lectures."
> "The amount of information is way too much."
> "Instead of giving lectures, let the students prepare short presentations of different relevant topics."
> "It really increases (my) motivation when I have to do something instead of listening all the time."
> "I miss some connection between the different topics of the course, how can each topic relate to each other?"

Currently, the course primarily conveys declarative knowledge from text books and key papers and from the research and experiences of the individual lecturers. This knowledge is mainly based on basic research and less on applied research. Rarely, links to the role of marine geoscience in society is established, e.g. the role of marine geoscience in the management of marine natural resources and the marine ecosystem.

In this paper, the overall aim is to redesign the course to develop a more applied course to obtain more functioning knowledge. More specifically, the objectives are to:

- design additional and/or alternative intended learning outcomes (ILOs), teaching and learning activities (TLAs) and assessment tasks (ATs) for the course;
- balance declarative knowledge and functioning knowledge in the course, including a coupling of the different topics presented during the course and the societal relevance of marine geoscience.
- integrate marine GIS and marine numerical modelling in the course as state-of-the-art marine analysis tools (methodologies).

Theory: central concepts in the redesign of the course

Constructive alignment

Constructive alignment is a design of teaching, learning and assessing. According to Biggs & Tang (2007) it is "constructive" because it is based on the constructivist theory that learners use their own activity to construct their knowledge or other outcome. The intended outcomes specify the activity that students should engage if they are to achieve the intended outcome as well as the content the activity refers to, the teacher's task being to set up a learning environment that encourages the student to perform those learning activities, and then assess the outcomes to see that they match those intended. According to Biggs & Tang (2007) the "alignment" reflects the fact that the learning activity in the intended outcomes, expressed as a verb, needs to be activated in the teaching if the outcome is to be achieved and in the assessment task to verify that the outcome has in fact been achieved. The alignment is achieved by ensuring that the intended verb in the outcome statement (in the intended learning outcome (ILO)) is present in the teaching/learning activity (TLA) and in the assessment task (AT). Hence, constructive alignment itself is achieved once TLAs and ATs are aligned to the ILOs.

Declarative and functioning knowledge

Knowledge, as the object of understanding at whatever level, is separated by Biggs & Tang (2007) into two main kinds: declarative and functioning knowledge, respectively. Declarative knowledge refers to knowing about things. Such content knowledge accrues from research, not from personal experience. It is public knowledge, subject to rules of evidence that make it

verifiable, replicable and logically consistent. It is what is in textbooks and is what teachers "declare" in lectures. Students' understanding of it can be tested by getting them to declare it back, in their own words and using their own examples. Such knowledge is basic to applications and creations, but is separate from them. Functioning knowledge is based on the idea of performances of various kinds underpinned by understanding. This knowledge is within the experience of the learner, who can now put declarative knowledge to work by solving problems. However, functioning knowledge requires a solid foundation of declarative knowledge.

Results: outline of the course redesign

In the following, an outline of the redesign of the MSc course Marine Geoscience.

Course aims

The aims of the course are to:

1. provide students with knowledge about sea floor processes, marine transport processes in shallow and deep water, marine environment and climate relations, palaeoceanography and marine research methods;
2. equip students with essential skills in marine field work;
3. provide students with knowledge about the societal relevance of marine geoscience;
4. familiarize students with marine analysis tools (marine GIS and marine numerical modelling) relevant to their professional career.

Aim 1 is maintained from the current course description (see Appendix). Aim 2 is reformulated from the current course description (see Appendix A) to focus on hands-on experience with marine field work in order for students to actually develop skills. Aim 3 and 4 are new compared to the current course description (see Appendix A).

Intended learning outcomes (ILOs)

On completion of the course, students should be able to:

1. *define*, *describe* and *explain* basic concepts in marine geoscience;

2. *collect*, *compute* and *illustrate* marine geo-data and information;
3. *evaluate* marine geo-data and information critically;
4. *solve* scientific problems in the field of marine geoscience;
5. *reflect* on the integration of marine geoscience in the management of marine areas.

ILO1 has substituted the ILO "possess a general knowledge of marine geosciences, theoretical as well as practical" in the current course description (see Appendix). The main verb of the ILO, i.e. possess, seemed misplaced. Apart from minor reformulations, ILO3 and 4 are practically maintained from the current course description, while ILO2 and ILO5 are new compared to the current course description (see Appendix A). In addition to the ILO "possess a general knowledge of marine geosciences, theoretical as well as practical", the ILOs "identify strategies and methodologies, ... in the marine geoscience research field" and "integrate theory, methodology, data and interpretation" from the current course description (see Appendix A) were also removed.

Teaching and learning activities (TLAs)

TLA1: Afternoon introductory lecture and group exercise (0.5 day):

- Presentation to introduce general concepts and knowledge in marine geoscience, including an introduction to the regional course location and field sites.
- Presentation to introduce the EU Marine Strategy Framework Directive.
- Exercise to identify elements of marine geoscience in the EU Marine Strategy Framework Directive.
- Discussion of the societal relevance of marine geoscience

Major focus: ILOs 1 and 5.

TLA2: Morning lectures and short individual and group exercises (4 days):

- Presentations of concepts and knowledge in different topics of marine geoscience (e.g. as listed in the course aims: sea floor processes, marine transport processes in shallow and deep water, marine environment and climate relations, palaeoceanography and marine research methods).
- Short individual or group exercises to define, describe and explain the presented topical concepts and knowledge. These exercises may be independent from topic to topic (from day to day).

Major focus: ILO 1; minor focus: ILOs 2, 3 and 5

TLA3: Afternoon short-lectures and group exercises (4 days):

- Short introductory presentation to the group exercise on applying the presented topical concepts and knowledge (morning lectures) to a pre-defined case study (e.g. 2-4 different case studies). This case study also forms the basis of the final written report to be handed in after the course.
- Group exercise as just described. In addition to applying the presented topical concepts and knowledge (morning lectures) to a predefined case study, these concepts and knowledge are related to previously presented topical concepts and knowledge in order to establish the topical links. Finally, potential societal relevance and relevance for the EU Marine Strategy Framework Directive is identified. The afternoon groups are pre-defined from course-begin and remain the same during all afternoon group exercises.

Major focus: ILOs 4 and 5; minor focus: ILOs 1, 2 and 3.

TLA4: Field work (2 days):

- Hands-on experience of field work in marine geoscience with one day offshore Sylt using the German research vessel *Mya* from AWI (Alfred Wegener Institute, Wattenmeerstation Sylt) and one day in the Ho Bugt area.
- Collection, illustration and evaluation of geo-data.

Major focus: ILOs 2 and 3.

TLA5: Group work on the written report (0.5 day):

- Group work on the written report to be handed in after the course.
- Group supervision on the written report.

Major focus: ILOs 4 and 5; minor focus: ILOs 1, 2 and 3.

TLA6: Individual work on the written report after the course days on *Skallingen*

- Finalizing the written report to be handed in after the course.

Major focus: ILOs 4 and 5; minor focus: ILOs 1, 2 and 3.

Previously, the lectures and exercises (if any) were planned by each lecturer individually. Hence, there was no overall structure of TLAs.

Assessment tasks (ATs)

AT1: Short individual and group exercises (4 days):

- The daily short individual and group exercises (partly as quiz) in the morning will primarily assess declarative knowledge. This provides the students with an opportunity for continuous self-assessment of their declarative knowledge.

Major focus: ILO 1; minor focus: ILOs 2, 3 and 5

AT2: Group exercises (4 days):

- The daily group exercises in the afternoon will primarily assess functioning knowledge. Likewise, this provides the students with an opportunity for continuous self-assessment of their functioning knowledge.

Major focus: ILOs 4 and 5; minor focus: ILOs 1, 2 and 3.

AT3: Group supervision (0.5 day):

- Group supervision on the written report in order to provide formative assessment.

Major focus: ILOs 1, 4 and 5; minor focus: ILOs 2 and 3.

AT4: Active participation:

- Active participation throughout all TLAs during the course days on *Skallingen*.

Major focus: ILOs 1-5

AT5: Written report:

- Assessment by an internal examiner of the written report.

Major focus: ILOs 1, 4 and 5; minor focus: ILOs 2 and 3.

The grading remains the same as currently, i.e. passed/not-passed based on the assessment by an internal examiner of the written report to be handed in after the course, and with the requirement of active participation during the course at *Skallingen* for passing the course (see Appendix A).

Discussion

Two new ILOs have been introduced in the redesign of the course. The ILO2 (collect, compute and illustrate marine geo-data and information) specifically addresses skills which the student will develop during the course. Through the hands-on field experience the students will develop skills in collecting marine data. Through exercises with marine numerical modelling tools (not specifically outlined in the TLAs) the students will develop skills in computing marine data. Likewise, through exercises with marine GIS tools (also not specifically outlined in the TLAs) the students will develop skills to analyse, visualize and illustrate marine data. These are all skills relevant for their professional career, whether in basic or applied research, consulting or administration. The ILO5 (reflect on the integration of marine geoscience in the management of marine areas) addresses the coupling of marine geoscience (as a natural science) to society and politics, i.e. the societal relevance of marine geoscience, and hence also the applicability of the learning outcomes in the professional career both inside and outside university. In addition, course relevance may motivate students to engage learning. Three ILOs from the current course description have been removed, which was partly due to the choice of verbs and problems of actually understanding the formulation.

The TLAs have been designed to align with the ILOs and in order to balance declarative and functioning knowledge. Earlier, due to the overweight of lectures and the type of exercises, mainly declarative knowledge was attained. With the afternoon exercises on predefined case studies that also form the basis of the written report, a framework is created where the students can apply attained declarative knowledge to solve problems and thereby attaining functioning knowledge.

Leinhardt et al. (1995) make a distinction between “professional” knowledge and “university” knowledge, which is comparable to the separation by (Biggs & Tang 2007) into two main kinds of knowledge: functioning

and declarative. Professional knowledge is functioning, specific and pragmatic, and deals with executing, applying and making priorities; whereas university knowledge is declarative, abstract and conceptual, and deals with labelling, differentiating, elaborating and justifying. In other words, generally university students are trained to label, differentiate, elaborate and justify, when what they need in their professional career is to execute, apply and prioritize. Entwistle & Entwistle (1997) also found that the forms of understanding encouraged by university accreditation and assessment procedures are not those that are professionally relevant. The rhetoric is right, but, in practice, universities tend to focus on declarative knowledge, which students often see as irrelevant and hence worthy of only a surface approach. Hence, establishing a framework which enables a shift towards more functioning knowledge in the course may in addition motivate students to engage learning by a deep approach.

The ATs have also been designed to align with the ILOs and in order to provide self-assessment for the students as well as formative assessment in the initial phase of the report writing.

The grading system was not changed, which is also due to practical limitations. Previously, approximately one third to half of the students were from other universities, mainly Aarhus and the North-German universities in Kiel and Hamburg, and lectures from these universities also contributed to the course. This setup is fruitful and motivating for the teaching, and it is also desirable in order to strengthen the research cooperation between the participating institutions. Due to the geographical distances, however, it is difficult to realise e.g. individual oral examinations where the students present their report followed by an examination. In this regard, video examination may be an option to consider.

The Department of Geosciences and Natural Resource Management is a new department and the result of a merger of the former Department of Geography & Geology and Forest & Landscape, acting as one department from January 2013. Among others, the merger springs from a desire for a stronger combination of basic research and more applied research (). The current course description of the Marine Geoscience course clearly originates in a basic research tradition. With the suggested redesign of the course towards a more applied course, working on predefined case studies and relating marine geoscience to marine management and planning and the EU Marine Strategy framework Directive, the course will also align with one of the primary goals of the new department.

Concluding remarks

A suggestion for a redesign of the MSc course Marine Geoscience is presented. The concept of constructive alignment has been used to formulate intended learning outcomes (ILOs) and to design teaching/learning activities (TLAs) and assessment tasks (ATs). The redesign will enable a coupling of the different topics covered in the course and relate marine geoscience to marine management and planning and the EU Marine Strategy Framework Directive, demonstrating the societal relevance. The suggested TLAs will shift the course towards more functioning knowledge. Also, skills in marine analysis tools relevant for a professional career, whether in basic or applied research, consulting or administration, will be developed. Overall, the redesign will develop the course into a more applied one in line with one of the primary goals of the new department.

A Course description

Marine Geoscience

Udgave:	Forår 2013 NAT
ECTS points:	7,5 ECTS
Punkter:	7,5
Point:	7,5
Blokstruktur:	4. blok
Fagområde:	geog, geol
Institutter:	Institut for Geografi og Geologi
Studieordning:	2012-studieordningen
Uddannelsesdel:	Kandidat niveau
Kontaktpersoner:	Jesper Bartholdy e-mail: jb@geo.ku.dk, tel 35 32 25 04. Verner Brandbyge Ernstsen e-mail: vbe@geo.ku.dk, tel 35 32 25 21
Skema-oplysninger:	Vis skema for kurset Samlet oversigt over tid og sted for alle kurser inden for Lektionsplan for Det Naturvidenskabelige Fakultet Forår 2013 NAT
Undervisnings-periode:	Preliminary dates: 18–25 August 2013
Undervisnings-form:	The form of teaching is a combination of lectures and workshops and field work
Indhold:	The course will be held at the field station Skalling Laboratoriet in Ho, NW of Esbjerg, Denmark. Lectures and workshops will form the basic part of the course. A limited number of a text books can be mailed to the participants prior to the course, and is to be returned at the end. The text book is meant as an introduction to the topic in order to secure a common background for all students. The practical part will be in the form of 2 days fieldwork - 1 day off shore Sylt using the German research vessel "Mya", AWI (Alfred-Wegner-Institute Wattenmeerstation, Sylt) and 1 day in the Ho Bugt area. For more information see the Marine Geoscience flyer at the course hompage.
Kompetence-beskrivelse:	The purpose of this course is to provide knowledge about sea floor processes, marine transport processes in shallow and deep water, marine environment and climate relations, palaeoceanography and practical experience in marine research methods. Furthermore, 2 days offshore fieldwork will give the participants first-hand knowledge of field work in marine geoscience.
Målbeskrivelse:	Upon completion of the course, students should be able to • identify strategies and methodologies, and to solve scientific problems in the marine geoscience research field • possess a general knowledge of marine geosciences, theoretical as well as practical • integrate theory, methodology, data and interpretation, and to demonstrate the ability to evaluate new information critically.
Tilmelding:	Via KUnet mellem den 15. november og 1. december.
Eksamensform:	Written report, internal examiner, grading passed/not-passed. Active participation during the course at Skallingen is mandatory for passing the course. Make-up exam as ordinary examination.
Kursus hjemmeside:	Der henvises til Absalon
Bemærkninger:	There is room for 18 students on the course. 9 places have been pre-reserved for non-Danish and non-KU students. If there are more than 9 KU students applying for the course, places will be prioritized based on the following criteria: 1) Students enrolled in the M.Sc. programme in Geology-Geoscience/Geography-Geoinformatics who have followed the competence course 'Geophysics - Global seismology and potential fields' or 'Coastal, Estuarine and Fluvial Geoscience' 2) Students enrolled in the M.Sc. programme in Geology-Geoscience/Geography-Geoinformatics with a signed Masters' thesis contract. Those applicants with the most passed ECTS points at the time of application will be prioritized highest. 3) Other students enrolled in the M.Sc. programme in Geology-Geoscience/Geography-Geoinformatics Students shall pay for their own travel to and from Skallingen Laboratoriet as well as 700 DKK for food and lodgings.
Pensum:	Please see Absalon The officially approved reading list will be available in Absalon by June 1, 2013.
Undervisnings-sprog:	Engelsk
Sidst redigeret:	14/9-2012

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